

# **Building a culture of open and reproducible science**

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*Culture*: The norms, principles, and practices of an institution

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“Culture is created by the behaviors you tolerate” - Jacob Engel

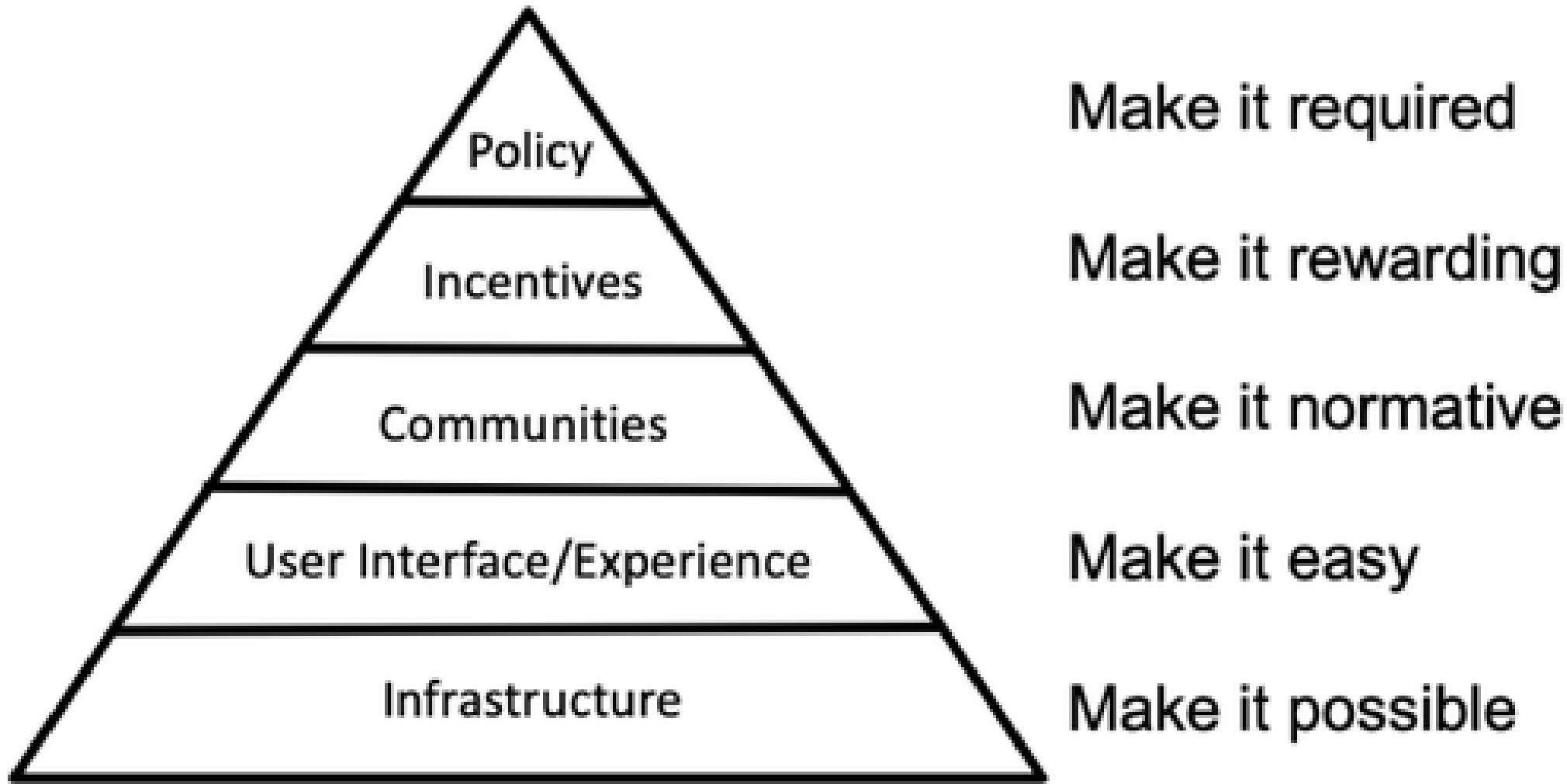
# Closed-science lab culture

- Competitive atmosphere
- High level of secrecy and paranoia
- Pressure to find specific results
- Lack of trust

# Open-science lab culture

- Openness and transparency
- Collaborative atmosphere
- Trust

# How can we move from closed to open science culture?



<https://www.cos.io/blog/strategy-for-culture-change>

# Making open science normative



“Incentives drive behavior, and behavior spawns culture.” - Rob Asghar

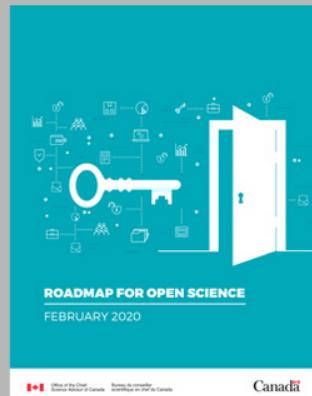
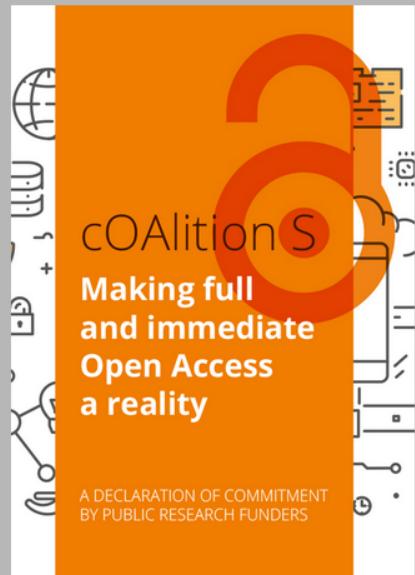
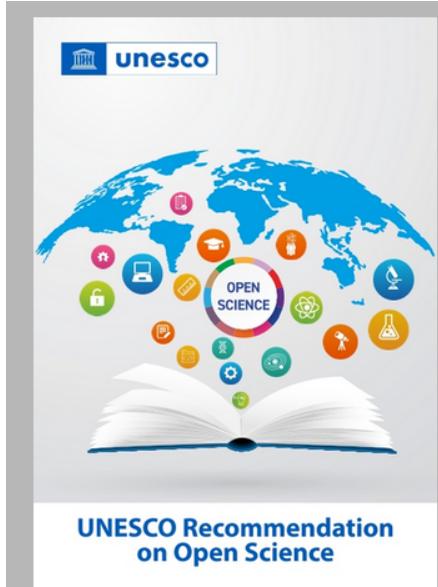
# Aligning the incentives

- Researchers should be rewarded for doing the right thing
- Problem:
  - Who makes the decisions about hiring, tenure, and funding?

# Mutually reinforcing vectors for change



# Increasing high-level support for open science

A screenshot of a White House Briefing Room press release. The title is 'OSTP Issues Guidance to Make Federally Funded Research Freely Available Without Delay'. Below it is the date 'AUGUST 25, 2022 • PRESS RELEASES'. The text discusses the update to U.S. policy guidance to make taxpayer-supported research immediately available to the public at no cost. It mentions a memorandum to federal departments and agencies, Dr. Alondra Nelson, and the goal of making publications and research funded by taxpayers publicly accessible without an embargo or cost by December 31, 2025.

Today, the White House Office of Science and Technology Policy (OSTP) updated U.S. policy guidance to make the results of taxpayer-supported research immediately available to the American public at no cost. In a memorandum [to](#) federal departments and agencies, Dr. Alondra Nelson, the head of OSTP, delivered guidance for agencies to update their public access policies as soon as possible to make publications and research funded by taxpayers publicly accessible, without an embargo or cost. All agencies will fully implement updated policies, including ending the optional 12-month embargo, no later than December 31, 2025.

The logo for the G7 Science Ministers' Communiqué, Frankfurt am Main, 12-14 June 2022. It features a stylized 'G7' logo with the text 'G7 GERMANY 2022' and 'G7 Science Ministers' Communiqué' below it.

A news article from the Open Research Funders Group (ORFG) titled 'Open Research Funders Group Pilots Program to Help Funders Advance Open Policies'. The date is February 28, 2022. The text discusses the success of a pilot program designed to empower funders to advance open access guidance within their organizations. It notes that the project's success suggests a guided cohort approach may accelerate the adoption of open policies.



# Translating open science into institutional policy



- At a high level, engagement from colleges and universities has three core components:
  - Presidential Commitment
  - Campus Engagement
  - Community of Practice

Higher Education Leadership Initiative on  
Open Scholarship

<https://poldrack.github.io/talks-IncentivizingGoodScience/>

# Institutional change will take time

- What can we do on our own in the meantime?
- Two case studies:
  - 1: Changing norms around errors
  - 2: Building infrastructure for collaborative software development

# Case study #1: Changing norms around errors

- No human enterprise is free from errors
  - E.g. professional software developers make 1-50 errors per 1000 lines of code
- Rather than viewing errors as a sign of incompetence, we should view them as teachable moments

# Normalizing the discussion of errors

Wednesday, February 20, 2013

## Anatomy of a coding error

A few days ago, one of the students who I collaborate with found a very serious mistake in some code that I had written. The code (which is [openly available through my github repo](#)) performed a classification analysis using the data from a number of studies from the [openfmri](#) project, and the results are included in a paper that is currently under review. None of us likes to admit mistakes, but [it's clear that they happen often](#), and the only way to learn from them is to talk about them. This is why I strongly encourage my students to tell me about their mistakes and discuss them in our lab meeting. This particular mistake highlights several important points:

1. Sharing code is good, but only if someone else actually looks at it very closely.
2. You can't rely on tools to fail when you make a mistake.
3. Classifiers are very good at finding information, even if it's not the information you had in mind.

<https://russpoldrack.blogspot.com/2013/02/anatomy-of-coding-error.html>

# Normalizing the discussion of errors



EXERCISES FOR LAB GROUPS  
TO PREVENT RESEARCH MISTAKES

Julia F. Strand

Carleton College

<https://psyarxiv.com/rsn5y/>

# Errors as a teachable moment: The Morbidity and Mortality Conference as a model

- Aims to identify the root causes of poor outcomes or near-misses
- Focuses on the system, with no blame or finger-pointing



<https://hawaiiresidency.org/ob-gyn-residency/morbidity-and-mortality-m-m>

# Finding and fixing errors early



New Results



## **Design issues and solutions for stop-signal data from the Adolescent Brain Cognitive Development [ABCD] study**

Patrick G. Bissett, McKenzie P. Hagen, Henry M. Jones, Russell A. Poldrack

**doi:** <https://doi.org/10.1101/2020.05.08.084707>

# Finding and fixing errors early



Cold  
Spring  
Harbor  
Laboratory

New Results



## Design issues and solutions for stop-signal data from the Adolescent Brain Cognitive Development [ABCD] study

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### Coding error postmortem

August 10, 2020

We had posted a preprint describing some issues that we had identified with the stop-signal task in the ABCD Study, along with the code used for all of the analyses. The ABCD stop-signal team performed a detailed review our code and notified us of an error

in the code that resulted in inaccurate estimation of one of the basic behavioral

<https://poldrack.github.io/talks-IncentivizingGoodScience/>

# Finding and fixing errors early



RESEARCH ARTICLE



## Design issues and solutions for stop-signal data from the Adolescent Brain Cognitive Development (ABCD) study

Patrick G Bissett\*, McKenzie P Hagen, Henry M Jones, Russell A Poldrack

### Acknowledgements

We would like to thank Sage Hahn, Hugh Garavan, and their team for identifying an error in a previous version of our manuscript and code that resulted in an inflation in our stop-failure RT estimates.

# Root cause analysis

## 1. Flawed code review process

- The person who initially reviewed the code focused on the analysis code, rather than the preprocessing code where the error occurred

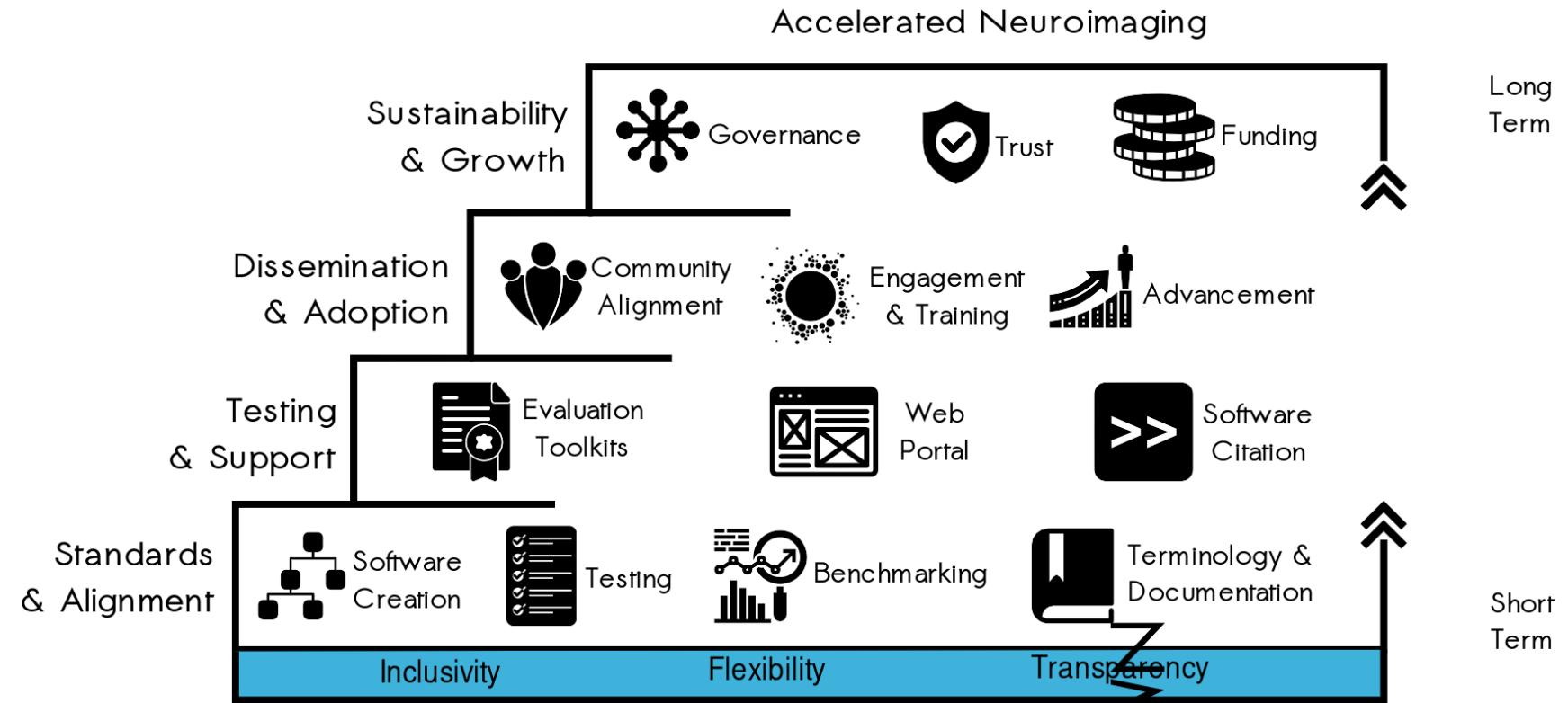
## 2. Time pressure

- We were pushing to complete the work quickly, and our speed-accuracy tradeoff was not as focused on accuracy as it should have been

# Case study #2: Infrastructure for collaboration across labs

- There are many labs developing tools for neuroimaging analysis
  - Most of these groups write code to solve the same problem, duplicating effort
- We could reduce the wasted time and effort by working together

# NMIND: Nevermind, this Method is Not Duplicated



### Efficiency

-  Coordinated development
-  Increased re-use
-  Avoiding duplication
-  Accelerated discovery

### Collaboration

-  Close link to tool users
-  Software training  
Guidance on decision making
-  Parallel development of tools  
and acquisition
-  Improved reproducibility

### Confidence

-  Consistent testing  
Application benchmarking
-  Adoption of vetted pipelines  
Consistent terminology
-  Improved sense of sample  
requirements
-  Simplified meta-analysis

### Recognition

-  Recognizable status badges  
Citable software packages
-  Leadership opportunities  
Endorsement & promotion  
Model for other domains



Tool makers



Data analysts



Data producers



The Field

# Conclusion



- We must all work to change the incentive structures of science
- We can all start now to establish the practices that will give rise to a culture of open and reproducible science





# What are the norms that we want to encourage?

- Intellectual humility
- Community over competition
- Interpersonal respect and trust
- Openness and transparency