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ACRONYMS

NON-SCIENCE STUFF

There'll also be an index of terms, I think, but it's not written yet.

FLOSS free/libre open source software

GPL GNU General Public License

GNU GNUs Not Unix

PLOS Public Library of Science

OS open science

FLOSS free/libre open source software

GPL GNU General Public License, the founding document of the Free Software Movement

PLOS Public Library of Science, a leader in open access publishing

OS open science

TREND Teaching and Research in (Neuro)science for Development in Africa

OKF Open Knowledge Foundation

GMH growing misconduct hypothesis (per Fanelli 2013[28])

SSH 'stronger system' hypothesis (per Fanelli 2013[28])

PPV positive predictive value (per Ioannidis 2005[46])

IF Journal Impact Factor

CNS JOURNALS *Cell*, *Nature*, and *Science*

MIT the Massachusetts Instituite of Technology

NIH National Institute of Health

OEAC Other Euro-American Countries, including Australia, NZ, and Canada

ROW "Rest of World", for what that's worth

OECD Organisation for Economic Co-operation and Development

BRICS Brazil, Russia, India, China, considered the rising economic and scientific powerhouse countries

SCIENCE

GPCRS G-protein coupled receptors

G-PROTEIN guanine nucleotide-binding proteins

RA retinoic acid

5-HT 5-hydroxytryptamine

CNS central nervous system

CNS central nervous system

GDP guanosine diphosphate

GTP guanosine triphosphate

LSD lysergic acid diethylamide, colloquially acid

MESCALINE 3,4,5-trimethoxyphenethylamine

OCD obsessive-compulsive disorder

DMT *N*,*N*-Dimethyltryptamine

DOM 2,5-Dimethoxy-4-methylamphetamine

DOI 2,5-Dimethoxy-4-iodoamphetamine

STP Serenity, Tranquility, Peace

1

"SCIENCE STUDIES, FEMINIST THEORY, CULTURAL STUDIES"

Science is an empowering technology. It satisfies some deep drive to understand and explain the world around us. "Science" is part of a long heritage of bold exploration, innovation, and human ingenuity.

define science here. Generally, great power -> great responsibility

1.0.1 *"I am become death": Biopolitics and scientific responsibility*

Science is both handmaid to progress and the worst ever.

"Science" – "modern" science – evolved in an era of Western expansionism and wholehearted imperialism.The Scientific and Industrial Revolutions enabled and fed on the expansion of European powers into new territory. Discovery of the 'cure' for malaria (by indigenous tribes in the Amazon, transferred to the Jesuit, and eventually the expanding European empires) allowed European nations to make inroads into tropical areas, as their soldiers were no longer dying at the prodigious rates.[44]

find ref: scientific imperialism

western expansionism has not stopped, merely transmuted.

Scientific ethics and responsibility is often looked at only within the frame of experimental design and execution. This is, indisputably, desperately important. The Tuskegee Syphilis Experiments represent a clear failure on the part of the scientists involved, their funding body, and whatever oversight the university claimed to consider basic human rights ; undoubtedly, the study leaders were deeply and irrevocably shaped by the anti-black racism in the post- Civil War. The following experiments on prisoners in the U.S. and around the world remains in the same vein

re bioprospecting and new forms of scientific/medical colonialism

more on Tuskegee

Obviously, in the U.S. racial frame black bodies are unhuman, and the experimenters were more or less within their rights, so...

fix me

More insidious and more difficult to make sweeping moral judgements on is the way science has not just been done "poorly", but used to justify and *create* new systems of exclusion, as well as enabling [[war!]], all while staying within the ethical bounds of the time. Racism – the peculiar brand of American racism, derived from slave-owners desperate to justify their brutality of human bondage – was created through the collusion of science and society, specifically a science that carefully cataloged and characterized the way Africans and African-Americans differed, and were therefore lesser, than White slaveholders. Lest we dismiss scientific racism as a legacy of the United States past, the eugenics ("well-born", in Greek) movement came to us from Charles' Darwin, via Francis Galton. Eugenics, of course, gained notoriety in Nazi Germany, but its legacy in the United States is deeply rooted.

That was the 40's and 50's – today, we have genetic surveillance.[72].

rewrite: Add detail, re 1000 genomes project and current abuse?

We have the science of homosexuality – every time we discover a new gay, someone uses that 'fact' to cure queers.

Trans bodies have entered the neuroscientific sphere – brain images used to confirm that the brains of transmen are more like cis men than they are cis women.

The scientific heritage, the accumulated knowledge upon which we build our futures, is not exempt from criticism more commonly leveled at explicitly political institutions. At the same time, the undeniable power of science and technology to do "good" – hormones for trans people, Internet communities for otherwise isolated activists, the reclamation of environmental sciences by Native communities, technologies that re-enable disabled bodies, pharmaceuticals that prolong lifespans

and raise quality of life, technologies that allow people to take control of their bodie's reproduction in every dimension* – means we need it. Not to mention the insatiable curiousty to understand and the delightful appeal of "basic" research, of discovering something new, that drives much of research.

Science is not going away, and nor should it; but to ignore our scientific inheritance, the complicity between science and power, and the role of individual scientists in perpetuating and creating power dynamics is to be neutral in the face of injustice.

1.1 SCIENCE STUDIES

find ref: on science studies: – Donna Haraway, Sandra Harding, Uma Narayan, Deboleena Roy, Banu Subramaniam, everybody from Alcoff and Potter *Feminist Epistemologies*. Also, probably both Fortun and Bernstein [33], Raskin and Bernstein [68]

Both my historical time line and ideological foundation for science studies starts with Ludwik Fleck's *Genesis and Development of a Scientific Fact*, originally published in 1935 pre-WWII Germany.[32]} A practicing syphilis researcher and pathologist, Fleck proposes that scientists are the creators of facts, rather than mere passive observers. He proffers an explanation that certain *styles* of thinking permeate and circumscribe scientific collectives and the people within them. Scientific knowledge is only accepted as true once the evidence been thoroughly vetted, trimmed, mediated, and judged acceptable by experts in the field. "Facts" are then not so much realities of the world but interpretations of it, made by collaboration between individual, collective, and evidence; they only take shape in a matrix of other beliefs and discoveries about the world.

Expand historical section of science studies to generate a foundation for current critiques. Probably means a more explicit Fleck summary w/-page numbers, quotes

His ideas re-appear in one of the most well-known historians or sociologists of science, Thomas Kuhn, famed writer of *Structures of Scientific Revolution*.[51] The publication of Kuhn's *Structure* in 1962 is considered a landmark event in philosophy and history of science.He coined the usage of "paradigm" in the incredibly-common, borderline meaningless sense it's used today.† A previous Div III expressed my feelings, with regards to at least *Structures:*

Debating Kuhn's usefulness

> "Thomas Kuhn's work occupies an awkward and somewhat inexplicable position in the contemporary intellectual environment. Kuhn's thinking, and here I refer specifically and exclusively to the thoughts put forth in The Structure of Scientific Revolutions (SSR), while conceptually worthwhile, erodes quickly under scrutiny. "
>
> -Campbell, *Essays on Biological Epistemology*, Div III in 2007

Fleck and Kuhn and many of their concurrent and subsequent philosophers, historians, and sociologists of science offer compelling arguments that science is, yes, evolution, but not evolution *towards* anything. Science is just another way to try to make sense of the world,.

Don't actually know enough about science studies to make these kinds of judgement, probably, but it's my general impression

[[Linking paragraph about how dissatisfying it is to deconstruct science without talking about the *implications* of a value-laden science]]

1.2 FEMINIST THEORY

"...Questioning representation with a vengeance."

*Given access and governments that don't insist on fucking bullshit lookin' @ you, everybody.

†Masterman (reference not currently included) cites 21 diff uses of paradigm

Find feminist science studies chronology; and also maybe ways it is or is not western?

feminist science studies more specifically tied to 1970s women's & environmental social movements: also in a specifically Western/US context

At some point in the past 30-40 years (mid-1980s?), feminist science happened; not, of course, always under one name or one set of goals. New ways of knowing overlaps with technology and science studies overlaps with philosophy of science overlaps with a plethora of other modes of analysis. What I now call feminist science studies emerges out of activists against white supremacy, patriarchy, heteronormativity, and ecological destruction working on ways to critique science as a social institution, and find new ways of answering scientific questions.

What I call feminist science studies is then at confluence of many ideas, summed up in Donna Haraway's 1994 *Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies.*[42]. Per Haraway, feminist science studies is at some meeting point of:

> **"Cultural studies** ... Not culture only as symbols and meanings, not comparative culture studies, but culture as an account of the agencies, hegemonies, counter-hegemonies, and unexpected possibilities of bodily construction... Relentless attention to the ties of power and embodiment... location and knowledge. Unconvinced by claims about insuperable natural divides between high and low culture, science and everything else, words and things, theory and practice.
>
> **Feminist, Multicultural, and Antiracist Theory/Projects** ... situated knowledges, where the description of the situation is never self-evident, never simply "concrete," always critical; the kind of standpoint with stakes in showing how "gender," "race," or any structured inequality in each interlocking specific instance gets built into the world–i.e., not "gender" or "race" as attributes or as properties, but "racialized gender" as a practice that builds worlds and objects in some ways rather than others, that gets built into objects and practices and exists in no other way... gender and race are built into practice, which is the social, and have no other reality, no origin, no status as properties ... questioning representation with a vengeance."
>
> **Science Studies** ... reflexivity, constructionism... science in the making (not science made), actors and networks... science as practice and culture... the culture of no culture, the nature of no nature... All the disciplines of science studies: history, philosophy, sociology, semiology, and anthropology; but also the formation of science studies out of the histories of radical science movements, community organizing, and policy-directed work. These histories are regularly erased in the hegemonic accounts of disciplinary and interdisciplinary development in the academy and the professions."
>
> -Donna Haraway, *Cat's Cradle*, p. 66-68

So now that we know what we're dealing with (sort of, although it's a slippery web of concepts), that brings us to: so what? Sociological and historical questions are all very good, but what of the modern day?

1.3 WHAT DOES THIS DO IN A PRACTICAL SENSE?

1.3.1 *"Asking Different Questions"*

Feminist science studies allows, and demands, a number of things of practicing scientists. It lets us ask questions of representation in our labs, our most important journals, and our students: "Where are the women? *Who* is practicing science, and who is deciding what science is important?" This extends to questioning not just gender, but about the representation of race, physical ability, nationalities, and other sociological classifications.

Or should *extend...*

Feminist science studies also lets – and again, demands – that we ask questions on a deeper level, about the nature of the knowledge produced. This includes (among many other things),

weak representationally. Mostly women (9/11), but only 3 of the 9 are women of color (African-American, Asian-American, and Indian).

- an examination the scientific *construction* of race and gender perpetuated by the perceived objectivity of the sciences,[34,31,25]
- the deep paradoxes involved in the ab/use of women's bodies in pursuit of reproductive technologies,[71,8]
- the shaping of science by gendered and racialized metaphors and languages,[49,60] and the historical complicity between scientific exploration and colonialism, misogyny, and racism[43,68,74]
- challenging the artificial boundaries between "basic research" and nature/culture to explain a rapidly-growing scientific-industrial complex, and then linking basic research to community activism for women's rights and environmental movements.[78]

It asks us to look at science as a practice inseparable from culture, and what that might mean for knowledge and for scientists as the future producers of that knowledge.

1.4 INDIGENOUS KNOWLEDGES AND LOCAL BIOLOGIES

edit/smooth out these paragraphsWe often conflate oppressions. Sexism was created by second wave feminists to draw a parallel to the preexisting racism. This is, at its best, a solidarity tool – using our intimate understandings of our oppressions to help form coalitions with others against the interlocking systems of imperialist white supremacist capitalist patriarchy.

"...because I wanted to have some language that would actually remind us continually of the interlocking systems of domination that define our reality" -bell hooks

At worst, this conflation and confusion leads to movements that claim "gay is the new black", dismissing one oppression in lieu of another. So although they pair nicely, indigenous sciences are not the same as local biologies.

To try and parse out an indigenous science is to frame it against a Eurocentric background, placing it in square opposition. This is the only framework within which I am capable of understanding an indigenous science or a local biology.

1.4.1 *Local biologies*

Establish that talking about gendered health issues is not a specialized "women's issue" but is something for the medical community as a whole. But then what about gynecologists and medical commu-

Local biologies are implied by feminist science theory, and indeed general science studies. That biological realities differ between geographical

and cultural locations should not, realistically, surprise anybody who's made the commitment to trek through this div.

Local biologies were initiated by Margaret Lock, in comparing the uniquely North American symptoms of "menopause", a recognized disorder often treated with pharmaceutical interventions, to the experience of Japanese women after cessation of menstruation.‡

> Rather, local biologies refers to the way in which the embodied experience of physical sensations, including those of well-being, health, illness, and so on, is in part informed by the material body, itself contingent on evolutionary, environmental, and individual variables."
>
> Lock and Kaufert [59]

Moreover, while local is often geographical, location is only one of many axes. "Local" biologies more accurately speaks to our specific socioeconomic, racialized, gendered, sexual, *and* geographic identities and locations.

In practice, that means young boys in the United States who act out are diagnosed with autism, while young girls are ignored. Dialysis patients in Egypt might refuse a kidney donation from their Egyptian relatives, recognizing that the unique stresses placed on Egyptian bodies might require two functioning kidneys, differing from the global biomedical truth that one kidney is sufficient.[41]

find ref:

More examples/elaboration here

1.4.2 *Indigenous knowledges and sciences*

Indigenous sciences are hard to define without explicit reference to our dominating framework of Eurocentric experiment-based knowledge production, which holds objectivity as king. Maintaining a myth of Indigenous inferiority in scientific development allows European-based systems to devalue and demean indigenous knowledge, erasing and destroying locally created systems of knowledge. The long history of "reschooling" of Aboriginal children in all areas colonized by European expansionism (notably Canada and the U.S., as well as Australia). The systematic cutting down of non-European knowledges has tentacles in all eras:

1. the blind reliance on and citation of Greco- Roman references despite the fact that the Greek alphabet is largely of Syrian/Lebanese origin

2. the manipulation of dates and demotion in importance of non-European knowledge such as Mayan, Hindu, and Arabic numerals, the concept of zero and algebraic notations, the use of decimals, and the solution of complex equations

3. the Europeanization of the names of outstanding scientists and their devices, scientific documents, and processes to undermine equal and fair assessment of the global history of knowledges (for instance, a comet identified by the Chinese as early as 2,500 years ago is attributed to Haley)

‡There's a whole book dedicated to explaining this, I'll see what I can do in a paragraph.

4. and the classification and trivialization of non-European science and technological innovations and invention as "art"

Battiste[7]

Define specific cultural/inherited knowledges, intentionally threatened/attacked by colonialism, knowledges

rewrite: Indigenous Knowlededgs. The Section.

1.5 WHY SHOULD SCIENTISTS CARE?

find a frame to efficiently explain why this matters for a given audience.

Because feminist science asks questions that are fundamentally geared towards addressing socialized inequalities in science, it can help scientists take those inequalities into account. Scientists (in theory) care about helping people, and choose science because it seems like the best way to do so. It can't help people if it's racist, misogynistic, and not considerate of how work will be ab/used downstream.

do they?

1.5.1 *The point of the thesis*

Scientists should care about where their work is coming from and where it's going, and we *need* good – read: concerned and activist – people everywhere if we want social progress. This div is (hopefully) a road map and detailed exploration into doing (good) value-laden science. Figure out *how* to apply all of that stuff to everything else I care about: namely, open science, open neuroscience, molecular neuroscience and then write about what did and did not work.

1.6 WHAT YOU HAVE TO LOOK FORWARD TO!

Sketch of regular book introductions with what chapter is going to be about and why. Not always updated.

Chapter 1 (aka what you just read) describes (in brief) the theoretical logic behind my Div III, explaining why I believe that science is just as much a cultural construct as any other knowledge project, and as a result, why scientists have a serious responsibility to consider their work in the greater context of social issues.

Troubling Scientific Systems

Chapter 2 starts where most criticisms of science stem from: the scientific ecosystem, and the ways in which the current system of reward, funding, and prestige distorts the pursuit of truth and knowledge in science.

Chapter 3 continues on a similar theme considering the question of representation within the global scientific community.

Chapter 4 explores the growing and heterogeneous community of open science (OS) advocates, who propose to make science more inclusive, collaborative, and useful, largely via the power of the Internet for sharing. OS is an alluring idea, especially backed with the rhetorical power of "open"; but "open" is not by itself a panacea for the hegemony of scientific establishments.

In Chapter 5, we explore the possible implications of "fixing" science through greater sharing and disseminatin of information. This hegemony is not merely theoretical. The proposed 'solutions' to the scientific systems's failures have serious implications, from a science studies and a feminist point of view, on the production and kind of knowledge production. It examines the open science movement with

a mind to discover and analyze the values underlying those efforts. Ultimately, I'd propose how a movement hoping to democratize and equalize science desperately needs to consider and account for their values from a (feminist) different standpoint.

Chapter 6 is things I *like,* that I want to emulate, and projects that have attempted to wrestle with all or some of my issues and succeeded in some measure.

Doing Science Like a Scientist

Chapter 7 is the background to my work – a "purely" scientific description. It describes why I think serotonin systems are important to model and explore, why I care about them, and my attempts to create a way to explore hallucinogenic pharmacology by manipulation of a stem cell line.

Chapter 8 is the follow up to this – it's a description of my attempts to implement open science proposals into a biological project, and the myriad complications and barriers I've surmounted – or not – in doing so. It offers a description of what I think the open science movement is missing on a practical implementation level.

Reconstructive Neuroscience

Chapter 9 is the capstone chapter of sorts. It is critical questions about the links between my own areas of interest – molecular signaling and psychotropic drugs – and gender, environmental concerns, indigenous rights and colonialism, and race relations. While I don't have answers to any of those questions, asking those questions has (already) helped find d a myriad of ways in which social factors are fundamental parts of my scientific process and questions.Then there will be a conclusion when I finish my div!

2

PUBLISHING FAILURES IN SCIENTIFIC STRUCTURES

rewrite: Transition

The broad initiatives huddling under the OS umbrella begin from the point of view in which the scientific ecosystem – that network of funding and publishing that undergirds the production of knowledge – is suffering from serious problems in access, reproducibility, and efficiency. They propose transparency, greater access, and technological innovation can 'fix' or alleviate those flaws, as well as increase the speed and quality of scientific discovery.

The "fundamental goals" of open science include:

1. Transparency in experimental methodology, observation, and collection of data.
2. Public availability and re-usability of scientific data.
3. Public accessibility and transparency of scientific communication.
4. Using web-based tools to facilitate scientific collaboration.

Different groups see and emphasize different problems, proposing specific solutions accordingly. Generally, those solutions center around digitizing and opening the scientific ecosystem in ~three areas, implementing structures that allow for and incentivize:

1. open access publishing - namely, cost- and licensing-free to full-text published papers and research results
2. open data - publishing raw data pre- or concurrently with paper publication
3. open research - everything else, including, but not limited to:
    a) code distribution - code for analyses, model generation, etc. should be hosted somewhere accessible
    b) lab notebooks - tracing the entire research process with all dead ends and kinks included in an accessible (read: digital) form

There's also a hundred other subcategories on the fringes of those overarching categories new systems of distributed, ongoing, or otherwise "open" peer review; community discussion of publications, billed as an "online journal club"; altmetrics to re-allocate scientific credit away from impact factors towards diverse forms of knowledge transmission.

Despite the complexities and contradictions of any movement, OS included, here are sufficient commonalities in both intent and execution to examine the value systems composing both problem and solution.

2.1 SCIENTIFIC COMMUNICATION WOES

Before we start talking about solutions, it makes sense to identify the problems. To some extent, the OS movement takes these as a given, and move straight to proposing the solution.

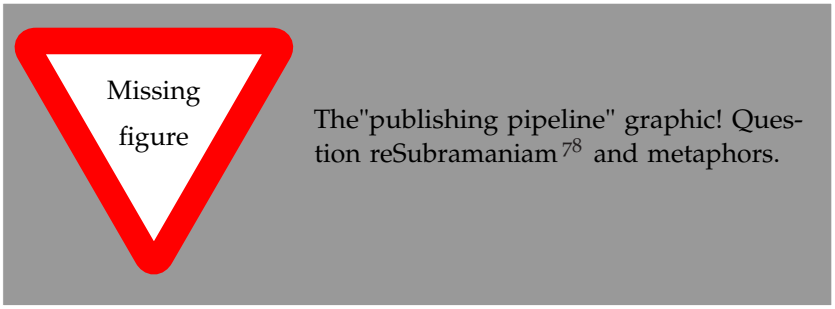


Figure 1: The "classic" current publishing pipeline

2.1.1 *The Publishing Pipeline*

Publishing in a scientific journal, as the main form of scholarly communication for much of modern Western science, is where most attempts to "fix" science start. The pipeline of research to dissemination is not that exciting but important. To be written.

> "Scholarly journals have been at the heart of academic life since the publication of the *Journal des sçavans* and the *Philosophical Transactions of the Royal Society* in the middle of the 17th Century." -Parker 2013 [65]

more on this history

Publishers, unpaid labor, & 'community' service

Publishers act, although the boundaries are shifting in the digital age, as a clearinghouse and managerial stage. They don't *produce* the content, make the figures, or draw the conclusions in scientific papers. Journals provide, to varying degrees: a measure of typesetting and formatting, editorial work, and a distribution system.

Labs submit a manuscript (gratis); publishers coordinate the peer review of said manuscript by shipping it out to 2-3 other academics. Those academics review the paper, give feedback, and send it back – also gratis. This process alone can take 2-3 months, during which time the submitting author can do nothing else with the manuscript. The original writer makes revisions, and, if the paper is accepted, the submitting lab pays a per-figure per-page fee, signs away their copyright, and the journal takes the final work as its own. Then, those submitting and reviewing scientists pay to access the product of their intellectual labors, having given up the legal right to share that knowledge on their own accord.

find ref: these two paragraphs

Pre-Internet, the cost of the journal was tied to the costs of printing and physical distribution. With that barrier out of the way, replaced by digital access, it's hard to see exactly how worthwhile the services of publishers are.

2.1.2 *Access & Pay Walls*

> Under the prevailing subscription-based system, commercial publishers own a monopoly over the distribution of scientific research. They charge authors for the publication of their works, then charge the readers subscription, advertising,

> and online access fees; in addition they retain the copyright of the articles they publish.
>
> Shelton [75]

"Primary literature" is the holy grail of contemporary knowledge. 6 pages of double-column size 10 text in *Nature*, *Science*, or *Cell* represent the cutting edge of scientific research; the foundation for future work, and the hallmark of a great researcher.

I've been working from primary scientific literature since my first semester at Hampshire, but it was only a few minutes after my first Google Scholar searches that I immediately slammed up against pay walls to the papers I wanted. So did everyone else I knew. I've spent the past four years of my education begging for paper access from friends at UMass, in pharma, and at MIT.

Nature *is paywalled back to* 1867.

Let's be clear: If I did not have a very good friend at the Massachusetts Instiitute of Technology (MIT), the extreme breadth of sources at the bottom of this paper would be reduced by at least half. * Even at MIT, there's numerous journals out of reach.

Data about access & paywalls here.

There's a justifiable sense of outrage at these monetary barriers to research that is (a) publically funded and (b) all of the writing/production is done by uncompensated scientists.

Publicly Funded Research

> Consequently, though the vast majority of the scientific research is publicly financed by taxpayers' dollars, access to research is not freely and publicly available: it is restricted to customers who can afford to pay for subscriptions.
>
> Shelton [75]

Most studies in the U.S. and U.K (the strongholds of scientific research generally) are publically funded research, in part or in whole. "Taxpayer dollars" fund, via the NIH, much of the high-profile, high-impact research that subsequently appears in journals. Taxpayers – your average layperson, or average scientists – then have to pay *again* for access to th eproduced knowledge, when they paid to fund it.

The National Institute of Health (NIH) requires funded researchers to deposit after a period of time.

2.1.3 *Reproducibility and Retraction: Crisis!*

The principle of the elusive scientific method is replication and reproducibility. Researchers document their methods and results to such an extent that any other researcher is able to reproduce their data independently, or, more often, build more experiments atop their conclusions.

Unfortunately, that optimistic theory of reproducibility is in question. The so-called reproducibility crisis had many harbingers, but the flashiest remains a 2005 article titled *Why Most Published Research Findings Are False*.[46] John P. A. Ioannidis' calculations led him to estimate that more than 50% of published biomedical research findings with a p value of < 0.05" are likely to be false positives.[1]

aka research deemed 'significant' aka the research that's get published

*Data forthcoming.

While the *extremely* inflammatory title ruffled the feathers of statistications round the world, leading to a fierce statistical "battle of the titans", Ioannidis' statement echoed into hallowed scientific halls and won't go away.[38,47] *Brief* sketch of proof and discussion

Evidence for the practical ramifications of replicability (or lack thereof) comes on a larger scale from pharmaceutical and biotech companies translating academic preclinical research into clinical drug trials. Amgen had an 11% success rate with respect to 50 very high-profile cancer studies[9]; generally, drug targets identified by academics rarely pan out in the clinic.[5,67]

This gets back to local biologies.

There's "explanations" for that – principically, that biological research is at such a level of complexity that even minor changes from lab to lab in the microenvironment can "break" an experiment.

RETRACTION We can explain away the lack or replication with varying degrees of success. Where the literature really gets into trouble is retraction – that is, journals and authors withdrawing published articles, those already having undergone peer review.This represents an enormous cost to both journal and author; retraction often leads to firing (or mandatory stepping down) of the editor, and more insidiously, a distinct downward trend in the citation rate of the author's former papers. Retraction is *serious* business for everyone involved, which makes the relatively increasing incidence all the more concerning.

rephrase

In 2008, Cokol, Ozbay, and Rodriguez-Esteban concluded that[†]

> "...even limiting our analysis to the period between 1990 and 2006, we found a significant increase (r = 0.55, p = 0.02) [in retractions]...From these observations, we conclude that retraction rates are still on the rise.
>
> Cokol et al. [19]

This, of course, begs the question: why? Some propose the pressure to publish, increasingly important to funding and hiring decisions, hits researchers in a vulnerable spots. To some extent this is borne out, as "... papers were more likely to support a tested hypothesis if their corresponding authors were working in states that, according to NSF data, produced more academic papers per capita... competitive academic environments increase not only scientists' productivity but also their bias."[27]

> "[Two viable interpretations] The first interpretation implies that increasing competition in science and the pressure to publish is pushing scientists to produce flawed manuscripts at a higher rate, which means that scientific integrity is indeed in decline. The second interpretation is more positive: it suggests that flawed manuscripts are identified more successfully, which means that the self-correction of science is improving."
>
> 19

Intriguingly, and tellingly, not only are the rate of retractions increasing, but they're increasing in the journals we respect the most. In a 2011

[†]Publishing in *EMBO*, a European journal, plausibly explaining why U.S. metric fiends hadn't caught on to it.

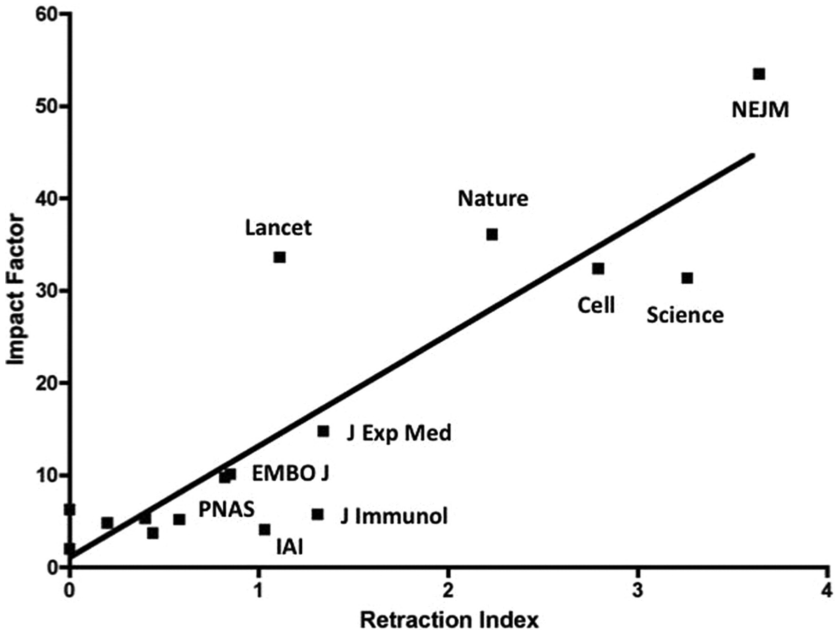


Figure 2: "Correlation between impact factor and retraction index. The 2010 journal impact factor...is plotted against the retraction index as a measure of the frequency of retracted articles from 2001 to 2010."[29]

PloS publication, Fang and Casadevall found a "strikingly robust" correlation between a journal's "retraction index" and its impact factor (Figure 2). [29]

But if we look past the doom and gloom, Daniele Fanelli is here to save us again. Fanelli proposes four lines of evidence to support that the relative increase in retraction rates is due to an increased awareness and responsiveness to misconduct (the 'stronger system' hypothesis (SSH)), rather than increased misconduct itself (the growing misconduct hypothesis (GMH)).[28] In summary:

1. Corrections to scientific papers have been published for much longer than retractions, and show little sign of a recent increase.

2. The number of journals issuing retractions has grown dramatically in recent years, but the number of retractions per retracting journal has not increased.

3. The number of queries and allegations made to the US Office of Research Integrity has grown, but the frequency of its findings of misconduct has not increased.

4. Therefore, the rising number of retractions is most likely to be caused by a growing propensity to retract flawed and fraudulent papers, and there is little evidence of an increase in the prevalence of misconduct.

5. Statistics on retractions and findings of misconduct are best used to make inferences about weaknesses in the system of scientific self-correction.

Data to support the proposals comes from Grieneisen and Zhang, who did not just count numbers of retractions, but examined *why* articles were being retracted. Of the 4,449 retracted articles found in 42 of the largest bibliographic databases from 1928-2011, retractions were due to

47% alleged publishing misconduct‡

20% alleged research misconduct

42% the usage of questionable data or interpretations

% stack to >100% because more than one reason is often cited

Of the alleged research misconduct, fifteen individuals accounted for >50% of the retractions. WhileGrieneisen and Zhang admit the growth in retractions by a factor of 11.36 (excluding repeat offenders, adjusting for literature growth), they assert that neither data nor research misconduct underlie most retractions.[40]

Summary re: conflicting evidence ,but there is *concern*, which is more the point.

*Statistical Failures: Underpowered and Badly Analyzed Data Sets*****

Everybody is bad at statistics.

> *Power failure: why small sample size undermines the reliability of neuroscience* -Button et al.[13]
>
> *Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition* (originally *Voodoo Correlations in Social Neuroscience*)[83]
>
> *Willingness to Share Research Data Is Related to the Strength of the Evidence and the Quality of Reporting of Statistical Result*s
>
> 88

File Drawer Problems, Negative Results, Publication bias

> Publication bias occurs when results of published studies are systematically different from results of unpublished studies.
>
> Empirical research consistently suggests that published work is more likely to be positive or statistically significant (P,0.05) than unpublished research [3].
>
> 23

An experiment that is *not* working that *should* work (with regards to the current literature) lays its blame on reagants, on the technical skill of those involved, on the time of year§, as seen in – everywhere but the "science".

the thing where we can really only see difference *so if we can't literally notice a difference it's not meaningful*

rewrite: positive publications bias

It's hard for scientists to say "*this* is the reason we're *not* succeeding" because there's always more variables.In the literature, this problem shows in the positive publications bias. This appeared first in *The Lancet* in 1991, when Easterbrook, Gopalan, Berlin, and Matthews reviewed a set of clinical research trials, concluding:

> "Studies with statistically significant results were more likely to be published than those finding no difference between the study groups... Studies with significant results were also more likely to lead to a greater number of publications and presentations and to be published in journals

‡Peer review and citation RINGS. People making up email addresses. What a fuckin' world.

§Of course, the time of year *is* a meaningful factor, as seen in the experiments by Otto Loewi that established chemical neurotransmission in frog hearts

> with a high citation impact factor. An increased likelihood of publication was also associated with a high rating by the investigator of the importance of the study results, and with increasing sample size."

This is not limited to clinical trials: ecology and other "harder" fields show a similar bias.

find ref: on biology, ecology, and physics. And math, if it exists

One effect of this is the file drawer effect (per Robert Rosenthal): many studies in a given research area may be conducted but never reported, leading to a set of journal articles wholly unrepresentative of the actual research state of affairs. The abandoned data stays in a theoretical file drawer, useless to everyone but the carpenter ants.

> The file drawer effect, or file drawer problem, is that many studies in a given area of research may be conducted but never reported, and those that are not reported may on average report different results from those that are reported. An extreme scenario is that a given null hypothesis of interest is in fact true, i.e. the association being studied does not exist, but the 5% of studies that by chance show a statistically significant result are published, while the remaining 95% where the null hypothesis was not rejected languish in researchers' file drawers. Even a small number of studies lost "in the file drawer" can result in a significant bias.
>
> Wikipedia page on publication bias, re: file drawer effect

Why there is a preponderance of significant results is unclear, but it's likely due a combination of effects. Scientists, first and foremost, are extremely loath to submit a paper with negative results. Journal editors, especially those in high-impact journals, are less likely to accept themandfFunding bodies aren't interested in therapies that *don't* workresearch findings may often be simply accurate measures of the prevailing bias".[46] Negative papers are most likely to be suppressed when:

find ref: for this section

- studies conducted in a field are smaller
- effect sizes are smaller
- there is a greater number and lesser preselection of tested relationships
- there is greater flexibility in designs, definitions, outcomes, and analytical modes
- there is greater financial and other interest and prejudice
- more teams are involved in a scientific field in chase of statistical significance"

perIoannidis[46]

> "In the basic biological sciences, statistical considerations are secondary or nonexistent, results entirely unpredicted by hypotheses are celebrated, and there are few formal rules for reproducibility...

> A signalling benefit from the market—good scientists being identified by their positive results—may be more powerful in the basic biological sciences than in clinical research, where the consequences of incorrect assessment of positive results are more dire. As with clinical research, prominent claims sometimes disappear over time. If a posteriori considerations are met sceptically in clinical research, in basic biology they dominate.
>
> ... Negative data are not necessarily different than positive results as related to considerations of experimental design, execution, or importance. Much data are never formally refuted in print, but most promising preclinical work eventually fails to translate to clinical benefit [22]. Worse, in the course of ongoing experimentation, apparently negative studies are abandoned prematurely as wasteful."
>
> [89]

> Studies with positive results are more likely to be published than studies with negative results (publication bias). One reason this occurs is that authors are less likely to submit manuscripts reporting negative results to journals. There is no evidence that publication bias occurs once manuscripts have been submitted to a medical journal.
>
> Olson et al. [64]

Whatever the reason, the current journal system, the de facto dissemination system for scholarly production, is leaving out an enormous amount of information. Researchers may spend years trying to duplicate results, since the papers of failures to replicate weren't published. Meta-analyses, papers that use the entirety of collected data in a field to compare results, report positive results that are flawed to an extraordiary degree because of lack of access to the entirety of conducted research.

2.1.4 *Impact Factors: Gatekeeping Dissemination*

> "Does the pressure to publish in prestigious, high-ranking journals contribute to the unreliability of science?"
> -Brembs, Button, and Munafò

find ref:

Citation is the metaphorical currency of science because it leads to real currency!

Nominally, choosing papers to read and base future work off of is based on relevance and applicability, but a serious factor in where scientists invest their researching and publishing time and energy is which journals are the highest ranked.

> Most researchers acknowledge an intrinsic hierarchy in the scholarly journals ("journal rank") that they submit their work to, adjusting not only their submission but their reading strategies accordingly. [11]
>
> The citation game has created distinct hierarchical relationships among journals in different fields. [89]

Presumably physics and plants as well, but it seems like nature mostly does bio? I have literally no idea

Qualitatively, the top of the biology journal hierarchy is the *Cell*, *Nature*, and *Science* (CNS journals) triumvirate; journals that are instantaneously recognizable and eminently reputable. To get a "*Cell* paper" is to be immediately given respect in the scientific world.[¶]

Quantitatively, the journal hierarchy is represented by the Journal Impact Factor (IF), assigned to journals by publishing hous? Thomson-Reuters,. The IF was originally proposed as one metric of many to track scientific productivity: a simple mathematical formula reflecting the number of citations of a journal's material divided by the number of citable materials published by that same journal.[||] [52]

$$\text{Impact Factor} = \frac{\text{number of citations}}{\text{total number published in journal}} \tag{2.1}$$

> "The original intention for the use of the impact factor was to allow comparison between the citation rates of journals... This has proven invaluable for researchers and librarians in the selection and management of journals."[52]

reformat equation

That's all well and good, but like with many metrics, it's been applied with a widening and indiscriminatory brush. IFs have evolved from metric for journal quality overall, on the premise that a higher citation rate indicates higher journal quality.[52]From there, IFs also serve as a marker of quality on individual papers and researchers. Undeniably, this is an abuse of a simple equation, but just as undeniably, it has serious consequences for the scientific ecosystem of research, hiring, grantsmanship, and publishing.

Metrics immediately lead to gaming the system.

2.1.5 *How Journals choose their acceptances*

> ... Editors make estimates of likely citations for submitted articles to gauge their interest in publication.[89]
>
> See Lawrence for experiential account of how editors modulate for interest

Journal editors and publishing administrators shape what we see and pay attention to; peer reviewers have to maintain impartiality when reviewing the make-or-break publication of their competitors.

who thought this would go well?

- has implications for "paradigm shifts"
- duplicate results can't be published even if they're temporally simultaneous/very slightly behind the other

Choosing the right journal

> Impact factors are widely adopted as criteria for "success", despite whatever qualms have been expressed. [quotes mine] Young, Ioannidis, and Al-Ubaydli

Scientists choose, extremely carefully, which journals they'll submit to. It's a game of saying is this research trendy *and* of high enough quality *and* an original idea *enough* to make it in this high-impact journal or

[¶]Sources are: my life, everybody's life, a lot of blog posts, general atmosphere.
[||] insert time (2 years) and other data

another? A manuscript submission takes months, especially high-profile journals, and in the intervening time, the manuscript can't be sent out anywhere else. This means choosing a too high impact journal is a loss of months of publication time; but publishing in a less-cited journal can have serious consequences on tenure decisions, grant applications, and other administrative gambols.**

Choosing the "best" journal wastes time and leads to not picking the best journal for functional *dissemination*

> They powerfully discriminate against submission to most journals, restricting acceptable outlets for publication.

Moreover, impact factor trumps audience: while a field-specific journal might make your research more visible to people who could use it, it won't have the same on-paper look as a CNS journals publication.

effects on the kind of research that gets done and acceptde

Gaming the System?: Fraud in High Impact journals

> "What is obvious from this equation is that the impact factor depends crucially on which article types Thomson Scientific deems as "citable"—the fewer, the better (i.e., the lower the denominator, the higher the impact factor)." -††
>
> . . . Because a journal's impact factor is derived from citations to all articles in a journal, this number cannot tell us anything about the quality of any specific research article unin that journal, nor of the quality of the work of any specific author. These points become particularly evident by understanding that a journal's impact factor can be substantially affected by the publication of review articles (which usually acquire more citations than research articles) or the publication of just a few very highly cited research papers.
>
> The PLoS Medicine Editors 2006[80]

Fixin' Data to Meet Cell *Standards*

High-impact journals tend to have higher retraction rates. Why, and how?

> On the other hand, much has been written about the negative effects of institutionalizing journal rank as an impact measure. So far, contributions to the debate concerning the limitations of journal rank as a scientific impact assessment tool have either lacked data, or relied on only a few studies. The most recent and pertinent data on the consequences of our current scholarly communication system with respect to various measures of scientific quality (such as utility/citations, methodological soundness, expert ratings or retractions) corroborate previous hypotheses: using journal rank as an assessment tool is bad scientific practice. [11]
>
> So what can we do to return to how things once were? The rewards of science rise out of publications, but simply publishing does not guarantee success. We are increasingly

from Lisberger 2013*: I realize it would be a big change of culture, but data fraud would be reduced - and the quality of the entire scientific literature improved - if we established requirements for publishing not just your paper, but also your data.*

**There's a number of sources denying that IFs are specifically counted in any of these. But they're certainly powerful tokens in the scientific imaginary, from which reviewers of any kind are hardly exempt. Except maybe in our school, where there's only one scientist.

††And because they only take shit in english.

judged according to where we publish rather than what we publish. Remarkably, we are ranked in proportion to the number of citations garnered by the other papers in the journals that contain our papers (the impact factor). **Some organizations decide promotions and grant applications on the basis of the impact factors of the journals that publish a scientist's papers.** So, **rewards come from being published in the journals with the highest impact factors.** As a result, the perception of the need for this kind of reward runs strong and deep.[58]

2.1.6 *Knowledge Gaps: Developed/ing Worlds*

The science base in the developing world cannot be strengthened without access to the global library of research information. Currently, this is nearly impossible due to the high costs of journal subscriptions, with the result that even the most prestigious institutes in poorer countries cannot afford to buy the journals they need. Many initiatives have been started to resolve the access problem, but progress has been slow and, since they are generally dependent on grants or subsidies, are unlikely to be long-term solutions. With the advent of the Open Access (OA) initiative, the outlook for building science capacity in developing countries has improved significantly. In particular, the establishment of interoperable open access archives that is now underway by a rapidly growing number of institutes opens opportunities for true global knowledge exchange.

Chan et al.[16], 2005

3

REPRESENTATION & SCIENCE

From a "purely" numbers standpoint, scientific production is unequally distributed around the world and on a variety of axes. This is the basic question of representation: where are the women? Where are the colonized countries? Where are the black and brown researchers, and where are the queer and trans researchers?

The place it's easiest to see this, at least in science, is looking back at our publishing pipeline and noting the abysmal numbers of women and minorities participating in the production and editorial system. This is not a point blank question or indictment of "Is *Nature* sexist?" Lack of representation does not *necessarily* place blame on paper and grant reviewers, editors, faculty members, or other individuals, although undoubtedly this plays a part. The prominence of white men from Europe and North America in our literature stems from (as per feminist theory), a structural system that discredits, discourages, and actively shunts women and minority groups away from positions of power.

Who gets to make science, and who gets credit?

SOME NOTES

- "Science" as an analytical category is going be pretty generalized.
  - clinical research is generally more studied and more prioritized in the literature
  - plausibly as a result of a pervading belief in the relative hardness of sciences.
- Also, there *is* some representation in clinical research{ It seems plausible that the "harder" fields simply don't have the capacity to create and be a part of data production at the LHC. *
- Ii you don't have internet access, you can't even do bioinformatics. Entire scientific fields are built purely on the internet.

3.1 DEVELOPING COUNTRIES:

3.1.1 *Who gets counted?: global citation indices*

In *Unseen Science: Scholarly Publication in the BRICs but not in the Web of Science*, Wagner examined representation in citation indices and found only 4% of developing countries journals were counted. Luckily, this isn't country-specific – only 4% of journals in *any* country are indexed. Which is not so much an indictment of what countries get indexed, but of impact factors in general.

More starkly – the disproportionate – truly disproportionate data in Figure 3

> "Of the material in SCIE, more than 50 percent of journals are attributed to just three countries: the United States

*Although this *might* not be the case. Research hasn't shown.

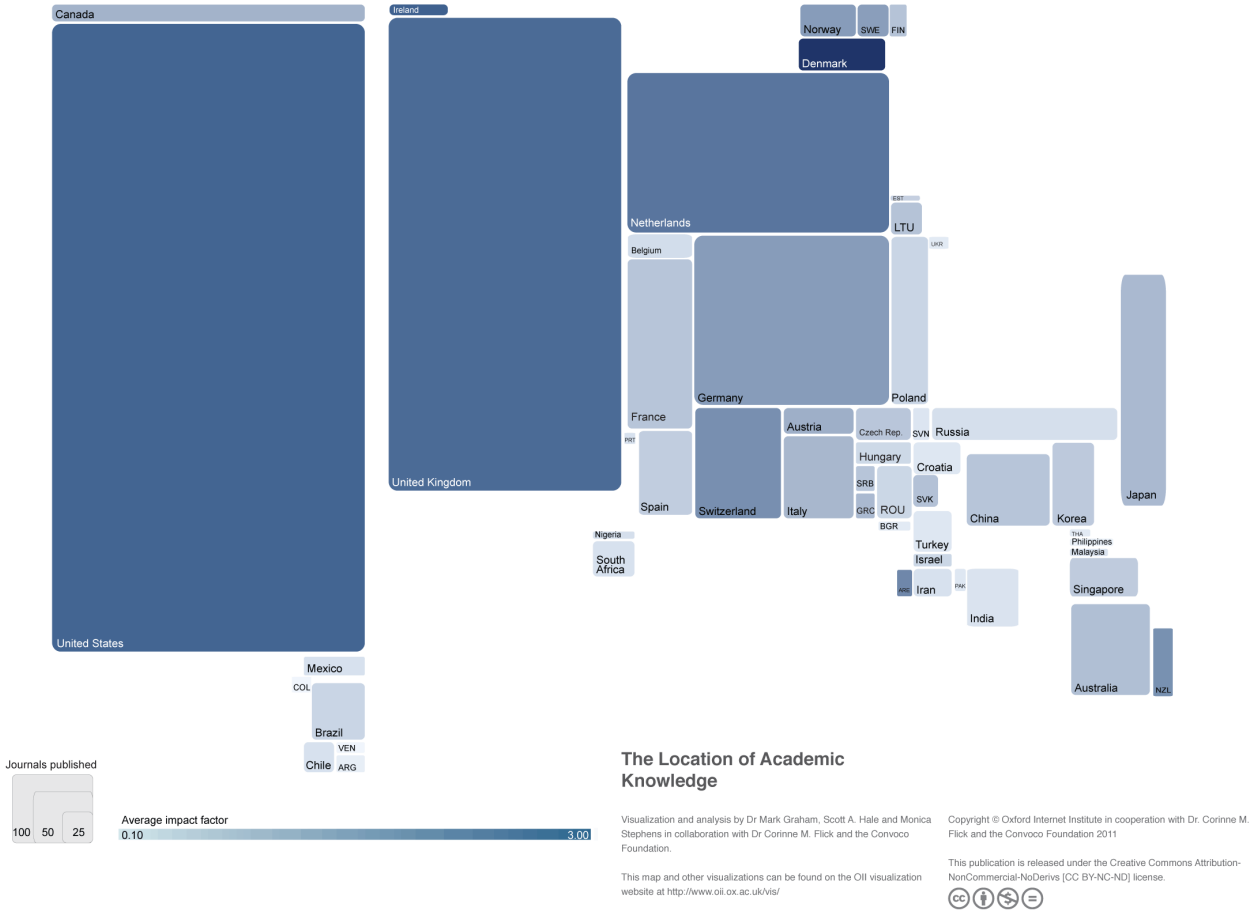


Figure 3: The location of academic knowledge
"This map reveals a staggering amount of inequality in the geography of the production of academic knowledge. The United States and the United Kingdom publish more indexed journals than the rest of the world combined. Western Europe, in particular Germany and the Netherlands, also scores relatively well. . . One of the starkest contrasts is that Switzerland is represented at more than three times the size of the entire continent of Africa."

> (34 percent); England (19 percent) and the Netherlands (8 percent) reflecting an English-language bias that has been documented"[84]

Numbers are boring, but wow, are they depressing.

In a retrospective of 5 major medical journals, Sumathipala, Siribaddana, and Patel examined contributions by 4 geographic areas: the UK, USA, Other Euro-American Countries (OEAC), and "Rest of World" (RoW). RoW, on average, contributed 6.5% of the research literature. The highest seen was in the Lancet (12%), and of the 151 RoW articles involved, 68.9% involved authorship from a developed county in Europe or North America. 15 original papers in the journals had data from RoW w/ no RoW coauthors.

rewrite: This whole section

This study selected the highest impact general purpose medical journals, of all issues in one calendar year (either 2000 or 1999), and examined authorship (by institutional affiliation) and the methods, to ascertain the geographic origin of data. Some notable variations in the regional data: 2 countries (Japan and Israel) contribute a 5th of the RoW-published literature, while China and India combined (the two most populous countries in the world) contribute a total of 13%. Only 31% of the total articles were entirely independent RoW.

Interesting to remember that Japan was the aggressor in WWII; Japanese nationalism. Israel is...well, Israel and Palestine. Their research is not an *accident*.

3.1.2 *notes on production from the Scholarly Communications in Africa report*

UB FOH University of Botswana, Faculties of Humanities

UOM FOS University of Mauritius, Faculties of Science

UCT COMM University of Cape Town, Commerce

UNAM FHSS University of Namibia, Humanities and Social Sciences

rewrite: SCAP report: instead of covering ALL of the non-Western world, do case studies

from the last summary chapter of Henry and Catherine, who performed a case study of scholarly communication from four research universities in southern Africa.

FINDING 1 Southern African research is comparatively marginal and invisible in the global context of academic research production.

> This general condition of marginality and invisibility is due to both external and internal factors. Externally, the wealth and productivity of Northern institutions (and increasingly other Southern ones in China) simply dwarf the research potential of the smaller Southern African countries, a fact that will not change soon. However, it is also influenced by internal factors which, if altered, could increase its reach, prestige and relevance.

FINDING 2. Southern African scholars are motivated to produce and disseminate research for both intrinsic and extrinsic reasons, including: the institutional mandate (University of Botswana, Faculties of Humanities (UB FoH)), peer expectation (University of Cape Town, Commerce (UCT Comm)), personal desire (University of Mauritius, Faculties of Science (UoM FoS)) and to generate new knowledge and enhance teaching (University of Namibia, Humanities and Social Sciences (UNAM FHSS))

FINDING 3 Not all Southern African scholars want their research to be visible.

- anxieties about quality, peer judgment and community exposure (especially if they doubt the value of their research contributions)
- a culturally informed sense of modesty (where it is considered improper to engage in self-promotion, such as calling attention to one's own work)
- a minimalist communications strategy (where dissemination is achieved through reading a paper at a conference, or perhaps allowing a journal to publish it, but nothing further)
- fear that others may steal their ideas/data (especially if still in gestational form)
- a teaching- rather than research-oriented approach to scholarship (which speaks to one's sense of academic identity, as a teacher rather than a researcher)

FINDING 4 Heavy teaching and administrative loads hinder research production in Southern African universities.

FINDING 5 The majority of Southern African research projects are either unfunded or funded by their universities.

> Considering that the four universities that we profiled were some of the more prolific in the region (each was the top producing university in their respective countries) and belonged to countries that had moderate financial resources (especially as compared to their neighbours), the challenges of research funding are likely much greater across the rest of Southern Africa.

FINDING 6. Many Southern African research projects are small, local projects, confined to an immediate geographical area.

3.1.3 *Which Bodies Are In Research?: The 10/90 problem*

The 10/90 problem is simple: only 10% of the world's resources are used for 90% of health problems. Only 6% of psychiatric jurnals arose from regions accounting for >90% of the population.[79]

In Rochon et al., *Relation between randomized controlled trials published in leading general medical journals and the global burden of disease*

> **Background** More than two-thirds of the world's population live in low-income countries, where health priorities are different from those of people living in more affluent parts of the world. We evaluated the relation between the global burden of dis- ease and conditions or diseases studied in randomized controlled trials (RCTs).
>
> **Results:** Among the 286 RCTs in our sample, 124 (43.4%) addressed 1 of the 35 leading causes of the global burden of disease... Almost half of the 40 leading causes of the global burden of disease were not studied by any trial.

> **Interpretation:** Many conditions or diseases common internationally are underrepresented in RCTs published in leading general medical journals. Trials published in these journals that studied one of these high-priority conditions were generally rated as being of little relevance to international health.
>
> 73

3.2 GENDER DISPARITIES

> "Although there are more female than male undergraduate [especially in "softer" scientific fields" and graduate students in many countries, there are relatively few female full professors, and gender inequalities in hiring, earning, funding, satisfaction and patenting persist."

Quantitition of gender disparities in measures of scholarly output and has been few and far between – "highly localized, mono-disciplinary, and dated"; they take little account of the rise in collaborative research and a changing scholarly landscape. Larivière et al.[54] analyzed the relationship between gender and research output (authorship), collaboration extent (co-authorships) and scientific impact of publications (citation count, according to the Web of Science); The authors analyzed >5 million research papers and reviews with more than 27 million involved authors, assigning gender using data from the Social Security database.

Web of science, of course, is an extremely flawed way to do this because it barely includes anything that isn't the US or UK. See the sections on citation factors and global publishing

1. in the most productive entries, all articles with women in dominant author positions receive fewer citations than those with men in the same position
    a) accentuated by domesticity: women benefit less from the extra citations accrued by international collaborations
2. globally, women account for <30% of fractionalized authorship, men are >70%
    a) 1:1.93 women:men in first authorship positions
3. South America & Eastern Europe had best gender parity –
    a) female authorship generally more prevalent in countries and/or states with lower output
4. **impact:** when a woman is in prominent position (sole authorship, first-author, last-author), the paper attracts fewer citations; holds for national and international collaborations

West et al.[86] published an extremely similar paper in PLoS one the same year, without the global analysis component but with even more papers as part of the analysis. Their source was the JSTOR corpus, "a body of academic papers...spanning five centuries". They look at similar variables – authorship order and overall percentages.

There are, of course, major limitations to this kind of bibliometric study. For one thing, age has an enormous role to play – older investigators will be more reputed, but are also more likely to be men because of sexism in the past.

with the mention that publication counts obviously are relevant in tenure *discussions, e.g. hiring e.g. perpetuating cycle*

Many trends are likely not actually markers of overt discrimination against women in *publishing*, but rather that women aren't making it to the top ranks of science and thus are not in a position to be publishing or collaborating on the most important papers.

3.3 DIGITAL DIVIDES

Lots of new scientific endeavors focus on the internet as an equalizing tool, but realistically, the digital divide is very very clear and doesn't seem to be going away anytime soon.

4 SOLUTIONS: CRACK IT OPEN?

> "Open means **anyone** can **freely access, use, modify, and share** [content] for **any purpose**."

When applied to the different "problem" areas of 2, open results in a number of related goals, ideally put into practice together.

4.1 OPEN ACCESS

Open access is an exclusively digital invention. Paying publishers for access used to mean you(r library) received a hard copy, delivered to the doorstep. One assumed subscription costs were largely a function of the work involved in collation and the physical manufacture and distribution costs; publishers also dealt with corralling peer reviewers

However.

Any reputable journal (and many non!)is now expected to provide digital access to their publication, rendering the paper version far behind.

4.2 OPEN CODE

5 WHAT HAPPENS WHEN WE "FIX" PUBLISHING?

5.1 FIXING SCIENCE

Open science proposes a "fix" of sorts, a return to a scientific world marked by honesty and loyalty.

> I think that fraud has increased since I came into scientific research 40 years ago, as the challenges of running a successful research laboratory, obtaining funding, and publishing papers likewise have increased. In the not-so-recent past, we did not have cutthroat competition to publish in the most prestigious journals as we do today, and grant funding flowed freely. There was enough reward to go around. The life of a scientist was relatively simple, so there were fewer incentives to cheat.
>
> "So what can we do to return to how things once were?"[58]

Lineages of open (science)

> "The most common narrative about open science tells us that, once upon a time, science was an ethical enterprise: sharing, equality, disinterest and the common good drove the everyday work of scientists. Then evil corporations entered science and changed the rules of the game, patenting life, enclosing the commons, and eventually destroying the willingness to share data, information, and knowledge. But today, so the story goes, we have new tools that together with the old open science spirit an be used to rebel against evil, defeat it and allow scientific knowledge to flow freely again. These tools are open source and open access science, and they can be used to tear down the barriers to the access of scientific knowledge." (Delfanti, p. 5)

Open science rhetoric draws on a mystical past where information flowed free ("In the 17th century, journal publication *was* open science!"), and in so doing, constructs a seamless narrative where open science is part of every major discovery since Newton. Or whoever, pick your scientist. The construction of an illustrious history lends legitimacy to the moral appeal of the movement.

5.1.1 *Open, not free*

The open science movement is closely affiliated with the free/libre open source software (FLOSS) movement, and so it's taken as almost a default that the "free" is free as in freedom, not as in beer. For clarification:

> "The terminology of and factions within this movement are complex, but, in short, "free software" tends to be associated with the ideology of freedom, "open source" with the openness of the development process, and "libre" with

> those concerned about confusion from the previous two. FLOSS are used as monikers to refer to all of these meanings." (Reagle[70])

Part of what draws many to OS are its ties to the free and open source software movement, specifically in the realm of community-driven creation. The similarities are many and significant; since the OS movement grows out FLOSS community, it makes sense to start there.

For the FLOSS movement, there's a sharp ideological divide between the free/libre and the open licenses. Advocates of the libre licensing model use many rhetorical tools, but their focus is on libre software as social imperative. User freedom, as laid out in the founding document of the Free Software movement (the GNU General Public License (GPL)) is paramount. "Open source", as a term and associated licensing models, comes from an explicit attempt to side-step the social values and ideological connotations of the term "free software". It instead has a narrow focus on access and production of source code - i.e. the 'practical' benefits of distributed production.

Bearing that distinction in mind, as trivial as it may seem, I think the usage of *open* in OS is a valuable point of entry into the ambivalent moral aspects of open science. Lots of proponents of OS either come from and/or explicitly draw from the F/LOSS movement, but the chosen movement nomenclature is "open". The same disavowal (or maybe just lack of acknowledgment) of social values seen in open source is apparent in a lot of the open science movement. It's not about science helping (or empowering) people, it's about doing "better" science – more reproducible, more reliable, more powerful (disruptive, even!). Open science is defined almost entirely by the *mechanisms*, in the same way open source is *just* focused on production. Even projects that pitch themselves as a place for citizen scientists can be construed as just a way to shift labor from cheap graduate students to even cheaper laypeople.

A lot of the following ideas draw heavily on analyses of the FLOSS movement, because that's where work has been done to some extent. "Open science" isn't nearly as widely talked about or analyzed.

5.2 CORPORATE USES OF OPEN SCIENCE

Open science, by intent, can be used by anybody for anything. That also means corporate entities can take advantage of the methods, tools, and data released into the public sphere.

In the free software world, corporate uses aren't bad – and here, as well, I don't think they're necessarily *bad*. But they do undercut the "open is good" in the sense that corporations are notorious for only considering the bottom line. That means any usage of open resources is for the bottom line, and not necessarily for whatever heroic potential purpose open data/science advocates had in mind.

Interestingly, there's been attempts to implement a copyright license similar to the GPL, but with a clause of "only ethical consideration"

5.3 CREATION AND REPRESENTATION

5.3.1 *Who gets to create?*

Generally, white men. In free software communities, men outnumber women to a much greater degree than in more traditional development structures[63]; presumably, racial and ethnic minorities fare even more poorly, although there's even less data to support that.

find data on representation

The dismal representation in FLOSS derives in part from a flawed perception that social stratifications and classifications "don't matter" on the internet. Code is race- and gender-agnostic (except that, for somewhat obvious reasons, it's *not*). Thus, collaborative, decentralized community structures like those in FLOSS usually fail to include any direct safeguards or rules about what kinds of behavior are acceptable. As a result, misogyny and racism run rampant and unchecked.

Whether representation is *worse* in open science than science at large is something I don't know yet, but it's probably fair to say that open science carries professional risks, and women and minorities in the sciences tend to disproportionately suffer for taking risks.

5.3.2 *Who is it designed for?*

- People with internet access
- technogical knowledge
- hardware access, time to build and fiddle with things

5.4 GLOBAL DEFINITIONS OF "OPEN" AND "FREE"

Free software and open science are built on European/U.S. legal, moral, and social codes. Probably and definitely an issue, especially when "open science" is supposed to level the playing field but other communities, sciences, etc. aren't actually consulted in how they would like that leveling to be done in the legal sense.

Refs*Christian* [18], *Dahdouh-Guebas et al.* [20], *Gorelick* [39], *Jolliffe* [48]

5.5 INDIGENOUS SCIENCES AND LOCAL BIOLOGIES

Local environments: weather systems

if indigenous sciences are local sciences, specific to the time and place and users involved, then they may not be generalizable to a mythic global community of "scientists".* And *if* we create a system where one of those many sciences is designated as the right one to be spreading, and making access to it the ultimate and only bridge to success, local knowledges are crowded out and erased. Indigenous sciences lose by virtue of what they are – non globalized, local knowledges, with no (monetary, legal) excuse to *not* use globalized standardized bits of (scientific) knowledge.

5.6 EFFECT OF OPEN ACCESS PUBLISHING *on* ACCESS

Limited data implies that that OA makes the greatest impact in increasing access and scientific participation globally, and specifically in the "developing" world.

> Across sub-fields, the impact of commercial online availability was positive, statistically significant, and on average 40% larger than the OA effect, suggesting that most researchers rely on institutional subscriptions.

*Again, *if* science is local, there is no homogeneous global community of science/tists. There isn't one anyway tho.

> The influence of OA was more than twice as strong in the developing world but was less apparent in the very poorest countries where electronic access is limited
>
> Evans and Reimer [26], Open Access and Global Participation in Science

> What is the influence of publishing OA on relative research impact? It's at least equal – impact factors and citation count remain the same.
>
> Björk and Solomon [10], Open access versus subscription journals: a comparison of scientific impact

5.6.1 *Digital Divides and Open Access*

> "Does open access actually increase access?"
>
> [77] Do developing countries profit from free books? Discovery and online usage in developed and developing countries compared

If OA is internet enabled (largely it is!), then...broadband matters, and broadband is not equally distributed (as per Digital Divides, 3.3 on page 26)

5.7 XENOPHOBIA & INCENTIVES

Much of the open science initiatives are focused on incentivizing science as a field for young researchers. This belies, however, *which* young researchers count. The motivations to "improve" science come from a perception that all of the good American students are being pushed out, and foreigners are taking all of the current post-doc positions.

find ref: for quotations about all the bad foreign postdocs

5.8 ISSUES I'M RUNNING UP AGAINST

I can't actually do an anthology of open science in the developing world. I can't catalog all of the grassroots citizen science projects. I can only speak about my concerns and highlight specific projects that are doing well or poorly (by my standards). It is not, by ANY means, definitive or even whole.

6 SHIT I LIKE

Acronyms

6.1 TREND IN AFRICA: 3D PRINTED LABS, NAIROBI, KENYA

The Teaching and Research in (Neuro)science for Development in Africa (TReND) organization "run[s] a wide range of educational activities, and support the establishment of top-level scientific facilities at several countries across the continent by leveraging large scale, low cost approaches to innovation and research. For this, [they] make use of latest technologies and developments, ranging from open source software and hardware approaches such as 3D printing, online teaching tools, and the use of the cost-effective yet powerful model organism, the fruit fly Drosophila."

They believe "scientific education is pivotal to the ability of societies to innovate, move forward and integrate within the global society. To date, most developing nations need to import their solutions, innovations and patents from abroad, while losing their most capable minds to Western universities. Therefore we believe that providing top-level education to local elites in their home country is key to enabling developing societies to take their futures into their own hands."

> "On December 8th of 2014, two of TReND's founders ran a two day "workshop module as part of the currently ongoing IBRO school on Behavioural Neuroscience run at icipe, Nairobi (organised by N Patel and R Brown). For the first time we are proud to report that the entire module was successfully run using exclusively free and open source materials – from 3D printed pipettesand behavioural assays using simple off-the-shelf tools to custom built behavioural arenas based on Raspberry Pis and simple electronic control circuits that allow targeted activation of light- and temperature-sensitive proteins expressed in different lines of transgenic fruit flies. Even our microscope ("RPiscope") was home-built. "

find out re: availability of 3d printers; also accuracy, and tips?

6.2 COMMUNITIES USING OPEN ACCESS

The Public Lab project builds and publicizes cheap, easy tools to test environmental pollutants. The goals is to encourage and enable people to take control of their environment away from corporations and governments, and to provide data to oversight committees that yes, there *is* an issues.

6.3 GREEN NEUROSCIENCE LAB, SAN DIEGO

The Green Neuroscience lab really deserves its own section. It's a lab studying various aspects of neuroscience; it refuses military funding and is a zero emissions lab. They believe in neurodiversity and making

neuroscience that empowers. They work with community members and they take their research with a grain of salt.

7

"every biological organism is inherently individual"

7.1 PSYCHOTROPICS & PHARMACOLOGY: BIG INTRODUCTORY OVERVIEW!

Culturally significant and an identity at my (soon to be) alma mater, hallucinogens – psychedelic hallucinogens, drugs that induce a profound qualitave perceptual change – are small molecules. They entered the modern scientific frame with with Albert Hoffman's 1938 synthesis of lysergic acid diethylamide, colloquially acid (LSD) from ergotamine, a isolated compound from the rye fungus ergot. In the intervening years, the broad class of drugs exemplified by LSD have been, variously: implicated in CIA coverups and brainwashing; a foundational symbol of counter-culture movements; effective treatment for alcoholism and obsessive-compulsive disorder (OCD), the inspiration for a number of scientific breakthroughs; as a field of battle for the rights of indigenous rights .

I hate *myself*

The plants and complexes they come from – ayahuasca in the the past and present Amazon river basin, ergot-containing drinks for ancient Greek philosophers. etc.

these drugs have been around a hella long time, and it's only just now that Western science/culture is beginning to treat them as a potentially meaningful therapeutic substance.

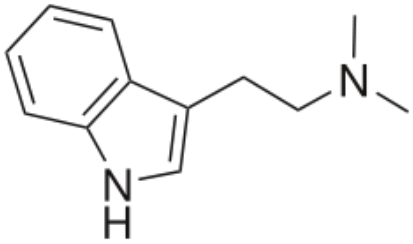
In my own experience and those around, they're either positively life-changing; or not. Some functionally similar signaling mechanism interacts with environment and person to crate this completely unique experience. Part of what's incredible about really any drug experiences is the alterning of how you think – it's a paradigm shift in the most literal sense of the word

7.1.1 *A brief history of psychedelic research*

Discovered in Switzerland, underwent furious experimentation until they became a Schedule I drug (i.e. no medical usage and dangerous), and have recently started to re-emerge in the scientific literature at specific labs.

7.1.2 *Consciousness-raising molecules?*

One small piece of the psychedelic puzzle is understanding what happens on a molecular level to induce both short and long term perceptual changes. While the molecular and single-cell level changes are only one level of the alteration in experiences, and only make meaning in the context of networks of neurons, brain regions, the body, and the environment, and are hardly *the* defining feature they're on,they're still fucking interesting.



(a) *N*, *N*-dimethyltryptamine

Figure 4: figure with structures here yay

7.2 THE CLASSICAL PSYCHEDELICS

at this point in time, ofc

Psychedelic hallucinogents are classed according to their chemical structure, receptor binding affinity, psychedelic effects, addictive potential, lethality (or lack thereof) and the ineffable desire of humans to classify fucking everything. The classical psychedelics, the best known of which is synthetic LSD, has natural analogues in psilocybin, produced by a genus of mushrooms; mescaline, produced in several species of

New World?

New-World cacti; and *N*,*N*-Dimethyltryptamine (DMT), widespread throughout the plant kingdom, as well as plethora of other plants. Synthetically, the analogues are numerous and endlessly permeable – 2,5-Dimethoxy-4-iodoamphetamine (DOI) is a common molecule in laboratory studies, while 2,5-Dimethoxy-4-methylamphetamine (DOM), street name Serenity, Tranquility, Peace (STP), has enjoyed usage in both recreational and academic settings.

Psychological Effects

- woooo pretty colors and stuff!
- non lethal, non addictive
- a qualititively different experience than day-to-day life; a "noetic" perception that the user knows isn't real to the external world, but accepted as 'real' to their internal life

Receptors

ignores transport of the drug to the brain, ingested, diluted and digested

Biology's point of entry into molecule-body interactions starts with receptors. Cell-surface receptors either bind the molecule and transmit a signal, or act as a channel to allow direct access to the intracellular milieu. Measures of receptor-molecule interaction then lie at the heart of pharmacology.

Well. Cap'n Obvious.

All of the classical psychedelics share a binding affinity for the 5-HT_{2a} receptor, normally targeted by 5-hydroxytryptamine (5-HT). LSD and ergoline analogues also bind to some dopamine receptor subtypes and

we assume...

5-HT_1 receptors, while DOI binds, evidently exclusively, to the 5-HT_{2a} and 5-HT_{2c} receptor subtypes. This shared affinity for a single receptor is seen as the essential component of psychedelic signaling.

Again, obvious.

5-HT also has an affinity for the 5-HT_{2a}, but 5-HT hardly results in an alteration of the conscious state. Woo drugs have different effects than the ones they mimic yah! The user-reported differences between drug trips can then be at least with a model that relies on 5-HT_{2a}

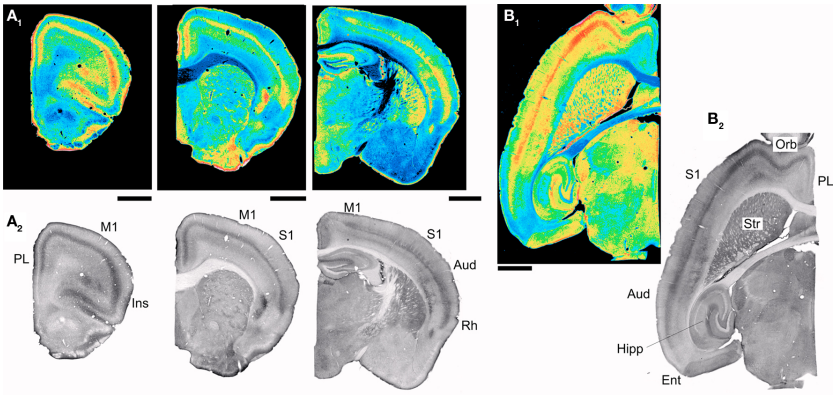


Figure 5: distribution of 5-HT$_{2a}$ neurons in the prefrontal cortex, from Andrade and Weber

activation, tempered by modulatory effects of dopamine and 5-HT$_{2c}$ receptor activation.

Differential drug effects can also be attributed to intracellular signaling. According to classical concepts of pharmacology, different ligands should only modulate the *quantity* of a signal, but not the *quality*.[81] This seems improbable in the face of evidence for ligand-specific intracellular effects on second messengers, transcription factor activation, receptor sensitization and/or internalization, and other effects on the internal life of the cell. In the case of psychedelics, there are distinct *hallucinogenic* downstream effects in the form of transcriptomic "fingerprints"[36], and specific and preferential activation of second messengers[37,53]; these differ between non- and psychotropic 5-HT$_{2a}$ ligands.

consequence of this theory –> idea of a therapeutic "magic bullet"

IDK about this

Because biology focuses on the receptor-ligand interactions as the site of action, and downstream effects as the consequence, this is where we pick up. Our area of interest becomes very narrow: the elucidation of the intracellular signaling pathways activated by the stereoelectronic perturbation and conformational movement of specific amino acid residues at the shared binding site of psychedelic hallucinogens, ideally while maintaining the most *in vivo*-like intracellular environment possible. The grand goal remaining, of course, is to explain how a small molecule can qualitatively and irrevocably shake loose for examination our deep-seated notions of who we are.

7.3 THE 5-HT$_{2A}$ RECEPTOR

7.3.1 *Distribution*

- Text about distribution in the PFC and GABAergic neurons and layer V pyramidal neurons and interneurons
- Brain anatomy: 5
- more info

rewrite: 5-ht2a distribution

7.3.2 *G-protein coupled receptors*

THE 5-HT$_{2A}$ RECEPTOR IS A GPCR GPCRs are a extremely diverse class of heptahelical transmembrane signaling proteins. They comprise approximately 30-40% of current drug targets, which covers some astro-

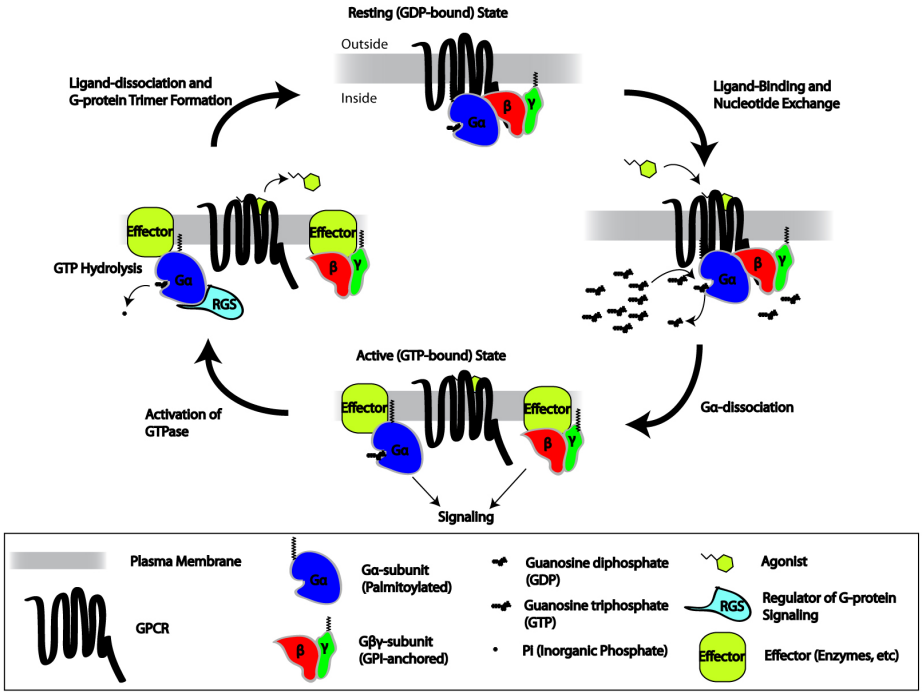


Figure 6: Adapted from Wikipedia, the general active-inactive cycle of GPCRs

source?

nomically small # of potential targets, and are highly conserved across species. Ligand binding to a the extracellular terminal of GPCRs initiates a conformational change in the protein that transmutes through the membrane to interact with a heterotrimeric guanine nucleotide-binding proteins (G-protein) complex on the oher side.

The G-proteins on the intracellular side consist of a modular configuration of an intracellular α-, β-, and γ-subunit.[87] In the inactive receptor, all three subunits associate; the α-subunit maintains a boundguanosine diphosphate (GDP). Ligand binding induces, in the receptor and consequently the bound G-protein complex, a conformational shift. In the classic model of signaling, this leads to the exchange of the α-bound GDP for guanosine triphosphate (GTP), and then to α-subunit and βγ-complex* dissociation from each other, while remaining anchored to the membrane. They are free to diffuse laterally and initiate signaling cascades, until termination of signaling by the innate GTPase activity of the α-subunit. The resulting GDP-bound α-subunit re-associates with a βγ-complex to reform the G-protein complex. (See Fig. 6)

The classical model is complicated by evidence that suggests activation can trigger a conformational change without subunit dissociation; nonetheless,it's complicated and waahh it matters whatever. .

The modular structure of the G-protein complex lends it a complex profile adaptable to many different cells, species, and functions; subunit variations are crucial to tuning, modulating, and transmitting receptor-ligand interactions.

*The γ-subunit is extremely unstable alone, and is thus almost exclusively found in and exerts effects as part of a dimeric βγ-complex; with one exception, the dimer functions as a single entity.

α-SUBUNIT There are sixteen α-subunit genes, and for much of the time spent researching GPCRs, the α-subunits were considered the 'active' protein, and defining feature

> The α-subunits that define the basic properties of a heterotrimeric G protein can be divided into four families, $G_{\alpha s}$, $G_{\alpha i}/G_{\alpha o}$, $G_{\alpha q}/G_{11}$, and $G_{12}/G_{\alpha 13}$.

βγ-COMPLEX The βγ-complex of mammalian G proteins is assembled from a repertoire of 5 G protein β-subunits and 12 γ-subunits.[14]

and yet-undiscovered units

> Gβγ subunits, once thought only to be negative regulators of Gα-dependent signaling have come into their own as mediators of receptor signaling.[22]
>
> The β1- to β4-subunits form a tight complex with γ-subunits which can only be separated under denaturing conditions.[†]
>
> The βγ-complex was initially regarded as a more passive partner of the G protein α-subunit. However, it has become clear that βγ-complexes freed from the G protein α-subunit can regulate various effectors.
>
> In the inactive state, the GDP-bound Gα subunit is associated with the obligate Gβγ dimer, which slows the rate of spontaneous GDP release by Gα acting as a guanine-nucleotide dissociation inhibitor

7.3.3 *The α subunit: $G_{\alpha q/11}$*

The 5-HT$_{2a}$R couples to $G\alpha_{q/11}$ and an unknown βγ-complex, or some configuration thereof.

Canonical Signalling pathway

Other pathways?

7.3.4 *Biased Signalling/Functional selectivity*

While the specifics are unclear, signalling biases play an undoubtedly important role in determining the effects of hallucinogens, with both immediate and longer term effects. González-Maeso et al., at Mt. Sinai, attribute the main action of hallucinogens to the binding event at the 5-HT$_{2a}$R and subsequent differential activation of second-messenger intracellular pathways.

If you accept that cells –> people?

probs review the evidence a lil

Binding at the 5-HT$_{2a}$R does not, inherently, cause hallucinations – otherwise, our normal course of perception would involve a lot more colors and a lot less filtering. They are created through a binding event by some drugs at specific receptors, likely modulated by the *lack* of binding at other receptors that would normally modulate 5-HT$_{2a}$R activation.[‡] Internally to the cell, however, hallucinogens and non-hallucinogens have very different downstream effects, which is given credit as the cause of psychedelic effects.

Nothin' is real and I hate it

[†] the β5-subunit interaction with γ-subunits is comparably weak (347, 543). The β5-subunit is an exception in that it can also be found in a complex with a subgroup of RGS proteins (689).

[‡] ~thoughts~ cellular signaling is only imp. if it's not being modulated by other cells; hallucinogenic action is an emergent property of both activation of *those* receptors and the non activation of *other* receptors. DUMB}

More about this here and specifics (transcription, lcal events, etc)

7.4 MODEL SEROTONIN SYSTEMS

Those signaling pathways have been investigated in a variety of systems. This is by no means a comprehensive overview, but studies on hallucinogens have occurred in a number of different systems.

1. Humans: with psilocybin, LSD, and MDMA
    a) fMRI, EEGs,
    b) interviews of subjective experience
2. Rats: LSD + many other drugs
    a) global RNA extraction to look @ gene transcription
    b) staining to see receptor expression
3. primary neurons? (pretty sure)
4. Oocytes with mGlu & 2a receptors: LSD, lisuride, psilocin
    a) to study signaling & colocalization
5. CHO cells expressing a fluorescent 5-HT2a receptor and variants

find ref: neuroimaging sucks

Obviously, 1 is the most full bodied (pun *totally* intended) "system", but we can't look at short term neuronal changes, and imaging studies have all the flaws of imaging studies.

2 has problems. Largely cost, and scale, and I can't use them at Hampshire, and it's harder to study specific receptors in specific cells on a tiny temporal basis.

3 are expensive and hard to maintain and dumb.

(4) and 5 both suffer from what seems to me fatal flaws – cells express different internal proteins and matrices. Undifferentiated cell lines won't have the same signaling pathways set up to receive signals from a receptor; what's the point in studying signaling pathways, receptor dynamics, or gene transcription in a set of cells that likely is incapable of accurately reproducing the full breadth of signaling pathways

7.4.1 *Frustrations with model systems*

7.5 BACKGROUND

7.5.1 *Project outline*

1. Clone the receptor from rat cDNA into a plasmid that is also expressing a large fluorescent protein (GFP), an antibiotic resistance gene, and promoter region to force expression of the DNA.
2. Transfect HEKs to test expression of the construct, and then into P19 mouse stem cells
3. Induce neuronal-like differentiation into the transfected P19s, and see if the cell is capable of reconstructing a dendrite with localized serotonin receptors

7.5.2 *Why am I doing this @ Hampshire?*

Because I wanted to write a div about more than "just" science, I opted to work at Hampshire. Our money and our model systems are limited; I also won't be getting DEA approval, so I can't work directly with psychedelic drugs.

7.5.3 *Resources*

P19 stem cells, which are known to differentiate into relatively poorly-characterized neuron-like cells when cultured with a micro-molar concentrations of retinoic acid (RA).

The trick for us, however, is not just the production of neuronal cells, but neurons expressing the 5-HT_{2a}receptors, with the machinery of GPCRs fully intact and functional.

as far as cancerous, genetically manipulated, and traumatized rat cells can be "normal"

7.6 P19S

P19s are derived from embryonal teratocarcinoma cells, from behind the testes of XY-karyotype mice. They are immortal and easy to maintain, retaining pluripotency under normal cell culture conditions. Upon RA application and a slight modification of culture conditions, P19s differentiate into central nervous system (CNS) cells, including glia, neurons, and fibroblast-like cells.[6] Studies of this differentiation pathway have elucidated a number of genes important for neural development,[85] and they're an established model system for exploring embryonic differentiation of neuronal cells.[30]

8

OPEN SCIENCE & SEROTONIN: CASE STUDY

Open notebook science has been described as the "epitome of open" and a "revolution" in scientific opportunities.

It's also (I think) the easiest for an undergraduate biologist to implement. I don't publish, yet, so I can't publish any papers open access. I don't generate a lot of data or have data sets, so publishing a data note for others to analyze is out of the question, and of course, since I'm not publishing I can't publish supplemental data.

So, starting from scratch, making all of my lab work openly accessible is the first and easiest way to implement open science. My efforts were inspired and guided by other proponents and practitioners of an Open Notebook methods.

8.1 OPEN NOTEBOOKS IN THE WILD

The first open notebook, and the originator of the term, was Jean Claude-Bradley, a chemist, in a blog post in 2006:

> "... By this [Open Notebook Science] I mean that there is a URL to a laboratory notebook that is freely available and indexed on common search engines. It does not necessarily have to look like a paper notebook but it is essential that all of the information available to the researchers to make their conclusions is equally available to the rest of the world.
>
> -Jean Claude-Bradley

He maintained, and the group has continued the effort, a project exploring synthesis and testing of anti-malarial compounds in the effort to hasten the search for an effective cure. The group has also added a similar project on HIV.

A second and more technically minded scientist is Carl Boettinger, a mathematical ecologist who's maintained an open lab notebook hosted on Github since 2010. His work and has been mentioned at least three times in Nature (once in 2013, twice in 2014).[35,61,82] His technical model for sharing his scientific progress is one that I emulated – the technicalities are detailed elsewhere, but it relies on minimal HTML, CSS, and coding knowledge to produce a reasonably clean and logical website, with lab notebook entries and any other relevant pages.

With that, I've been keeping my online notebook more or less in sync with my physical lab work since the first entry on July 15, 2014. All the entries are time stamped and track revisions, and are written in human-readable HTML Markdown.

Although the current systems may be undergoing some fairly large revisions in the next month

The bulk of this project is currently located at a Github repository (`https://github.com/kathleenleeper/workhorse`) and detailed there.

8.2 TECHNICAL DISCOVERIES

A large part of my goal with documenting my scientific process was to access its feasibility on a large scale, and for those who weren't already

deeply invested in open science. What would be required for open notebooks to become common place? What would happen if they were? What do we lose when we go digital, and what do we gain?

8.2.1 *Frustrations*

1. The pure technical set up takes too much time. To mimic Carl Boettinger's Github-hosted and tracked site, it took a not-insignificant technical investment of time into exploring options and figuring out how to use the tools. There's no good guide to getting your standard wet lab "pure" biologist set up with Jekyll and Github to build a site from scratch like I did.
2. It's clear from my efforts to keep the digital version up with the paper version that any digital notebooks *need* automatic integration; they're otherwise unsustainable and always a little behind the times.
    a) Because paper notes don't translate perfectly to typed text (see 3a), it's frustrating and tiring to have to re-type and revisit a protocol run just earlier, and translate from paper to digital.
    b) Writing up negative results is *annoying* and feels *useless.* Trouble shooting procedures is incredibly tedious; having to write up and explain your attempt and subsequent failure time and again is far from encouraging, and I would venture to say increases the feeling of failure upon revisiting the entry.
3. While there are tablet and smart phone options, a basic laptop is simply not as versatile for note taking as a paper notebook. Computers can't get wet; you can't prop them against a beaker on a crowded lab bench.
    a) This also relates to the sketching and informal drawing that happens in lab notebooks – quick calculations, arrows between protocols, annotations of protocols on the fly as you mis-time, forget, or mix up steps.

Can cite this if people feel strongly

4. Studies have shown time again that physically writing notes helps students retain knowledge better than typing them. Similarly, I do more careful checking of protocols and the steps I have to follow when I'm writing them, rather than just reading and following a protocol from a typed page.
5. Some advocates claim that knowing your work flow could be examined at any time – an ever-present Potential Big Brother
    a) good to consider other people reading it, but i find it doesn't really change my choices in lab work – not my top focus
    b) dissemination is not a high priority

8.2.2 *Celebrations*

There are, of course, many benefits, although I'm not sure I'm taking full advantage of them yet. Some that have already proved immensely useful, and in fact often saved serious time for me.

1. Full text searching of entries, by date, content, and tag. This reduces the time spent flipping back and forth between physical pages, trying to figure out when exactly a sample was taken and the conditions it was processed with (Did you elute that DNA sample in TE, H_20, or elution buffer?)

2. It's very easy to share and talk about my project – because the repository and site are accessible from my smart phone, I can pull out data and explain the state of my lab work almost anywhere, quickly, efficiently, and with a minimum of fuss.*

3. Because I've already documented everything (mostly), I never have to *remember* small details that take up mental space. I'm never at a loss of which bands in a gel correspond to which samples – because I annotate my gels as soon as I get them, so that I can update the protocol with the results immediately.

4. Version control of files. It's easy to ask a computer to compare many different runs of the same protocol and show you differences in the protocols (assuming you've entered all the relevant information), which helps in comparing why an experiment may not have replicated properly.

    a) Version control of *protocols*, where if you modify a protocol, it's easy to add a note saying why. This would be very helpful for a collaborator of mine, who might wonder why a given protocol deviated from the lab standard in seemingly idiosyncratic ways.

5. Metrics on my lab entries. It's very easy to generate maps and time lines of processes; to see how many times and when my work has been done. I can run self-improvement metrics on myself

I'm not saying they're not *idiosyncratic, but at least now there's some accountability for why changes were made and when.*

Or at least prove to my committee how much work I am or am not doing

8.3 SUGGESTIONS FOR SURMOUNTING NOTEBOOK CHALLENGES

These might belong in the earlier section? Or the earlier sections analyzing OS belongs here

Some thoughts: Since being open is *not* the same as being accessible, transparent, or even useful (re: Slee, *Notes against openness*); anything that wants to accomplish those goals needs a lot more thought and planning. I think open notebooks are only a small component of what sharing procedures is; said differently, "notebooks" need redefinining. The open, accessible, etc. notebook online is identical in terms of words, graphics, etc. to my paper notebook – in many instances, it's even better. It is not, however, *complete*. No one would ever look at my paper notebook and be able to coherently trace protocols as they evolved; at least, not without my help. A direct transfer of notebook pages to web pages doesn't help the situation.

I think a more ideal situation is *not* a transfer of paper to electronic.

Rather, multiple layers of publication - namely, including methods. Real protocols, but protocols as you might write them out for someone in your lab running an experiment for you, instead of bite-sized uber-simplified "Procedures were performed as described previously." Following an open lab notebook with nothing else is hard; using it

*This is mostly useful when John is upstairs on the 3rd floor and I forget to bring my notebook up when I ask him questions, but it's also been used when I'm traveling and unexpectedly meet someone who's interested. And then I have something to show *right then*.

as a reference to supplement a larger work sounds like an incredible resource.

9 CRITICAL NEUROSCIENCE

9.1 FEMINIST SEROTONIN STUDIES

9.1.1 *Stem Cells and Gender*

Problems – points of analysis – come in the form of either not enough attention to gender (seatbelts, heart attacks, stem cells) or too much attention to gender.

Stem cells: They have a "sex", in the sense that there is a chromosomal makeup, and it matters. See Ray et al. [69] and Gendered Innovations.P19s are karotypically 'male' – i.e. XY. This has consequences for how they differentiate and how their signaling pathways work downstream of differentiation.

9.1.2 *Serotonin & Gender/Race*

Questioning the use of race as a categorization without defining what is meant *by race, re feminist/womanist analyses of the use of racial categories in medicine*

- serotonin receptors are differentially distributed and have different activation levels in male vs. female rats [56,15,90]
  - specifically the 5-HT2_a receptor
- pharmacogenetics are differential along racial and gender lines [62]
- depression (associated with the 5-HT system, among others) shows different responses along racial and gender lines [12]
- if hallucinogens and signaling differentially affect men/women and different races/ethnicities,[57] then that has to be studied in model systems as to how it might affect plasticity and molecular effects

  > "However, the binding of serotonin-2A receptor measured with [$_3$H]ketanserin was significantly higher in females in all regions of the hippocampus." [90]

  - modulated by testosterone

9.1.3 *Serotonin Model Systems*

If serotonin systems are affected by testosterone (re: Zhang et al. [90]), how would incorporating androgens and estrogens into the cell culture dish affect the effectiveness of P19s as a model system?

9.2 CULTURAL NEUROSCIENCE

9.2.1 *Hallucinogens*

I'm a little conflicted about the relevance of this section, but I also am really *excited about it, and the possibilities for re-envisioning how I could do cultural molecular neuroscience.*

Psychotropic drugs have a rich and important history of spiritual and mental use in nearly every human culture.It seems that any and every culture has sought new insights and views with the help of native pharmacological agents. Although largely reduced now to their chemical structurein the labs funded by the NIH, most of the compounds derive

find ref: hallucinogen history

site of reductionism?

from different cultural traditions. Peyote (active ingredient: mescaline)* has historically been used by the Native American church, a right they successfully fought for in court. Ayahuasca (active ingredient: DMT combined with monooxygenase amine inhibitor) is a traditional South American drug. LSD is derived from ergot, a fungus – it's often thought that outbreaks of "witch craft" in medieval Europe are actually attributable to ergot contaminations.

Source for ergot and historical significance

On a related note – how presumptuous to take drugs from indigenous cultures and push them into the laboratory. Is plasticity and all of the signaling mechanisms relevant if the experience isn't included? Hallucinogens are notoriously sensitive to situation – or rather, individual interpretations of a situation. The quality (and thus long term effects) of a psychotropic experience is created through the *interplay* between environment and individual; like facts, it doesn't wholly reside in either, or even at the mere intersection. Trying to pull that out in a lab environment, is, as Fleck describes, not just a translation of information from one knowledge realm to another, but a full fledged transformation such that the ayahuasca in the lab is only nominally related to ayahuasca in practice.†

9.3 TURTLES ALL THE WAY DOWN: HISTORY'S NEUROSCIENCE

"Neuroscience" as a discipline constructs a history tied to Galen and Aristotle and ancient Sumerian hieroglyphs,[2]. More realistically, "neuroscience" isn't a discipline, but rather a heterogeneous mush of an extremely broad range of nearly unrelated subfields. That said, neuroscience, the field, was deliberately named, funded, and institutionalized to lie at the intersection of complementary disciplines – "interdisciplinary" from the start.[2]

Disciplines aren't real, basically.

9.3.1 *Interdisciplinary studies*

Need to define scientism/find description from Crit Neuro. Also page numbers.

- In *Critical Neuroscience*,Choudhury and Slaby[17] propose "interdisciplinary" as a code word for scientism(which I recall as being a bad thing)
- Situating the brain/cognition within a culture is an expanding trend (which I should be happy about). The large problem is that when "culture" and its importance are talked about in scientific settings, culture is a fixed quantity with Right responses. Hispanic medical patients require an interpreter; cases of Vietnamese epilepsy require a cultural translation between spiritual/traditional Vietnamese and doctors with curative drugs.
- Epigenetics – the metaphorical and physical incorporation of social effects into the genome, is a way of explaining what culture does for human development, creating a narrative of "soma to society". But incorporating social factors as a genomic part of

*A comparison of the plant/spiritual context to the chemical structure should go here to demonstrate how we separate them out. With an analysis of the rights of traditional groups to use those drugs [re: NA church lawsuits], and also the danger of deforestation and environmental destruction to *traditional* methods of harvesting plants – making them only available with clinical approval – and chemical synthesis methods, which probably contribute to pollution and destruction.

†Anne Fausto-Sterling, and many others, talk about knowledge outside the academy – communal, social, and indigenous knowledges.

humans also creates new "at risk" populations, making the epigenetic traces of historical marginalization into fundamental parts of those groups that need fixing.[50,66]

9.3.2 *Molecular and genetic reductionism*

"Reductionism" is a bit of a catch all. To a large extent, the Western scientific traditions is entirely focused on reducing systems to their smallest working unit,, with the intention of finding out one "answer" and threading it into many other answers to form a kind of tapestry of knowledge. The reduction and simplification of systems roughly correlates with the notion of "pure" sciences, pure being perceived as better, "harder", and (incidentally, of course) more masculine. In the biological sciences, and in the neurosciences, reductionism is generally

- generally a trend in the biological sciences – maybe due to perception of increased objectivity/hardness (a la physics and chemistry).
- Somewhat inherent to "neuroscience", since the ultimate goal is to reduce function/cognition to a set of circuits/cells/meaningful small and completely circumscribed/understood units.
- Where does it come from?
  - What goals are there and how does reductionism accomplish them for us? What is good and not good about applications to neuro? Can and should cell studies be used to "answer" or explore questions about cognition? What do we lose when we "solve" disease in vitro? ‡
- Personalized medicine; or personalized neuroscience is still a way of reducing the individual to the cellular and genomic information, without accounting for personhood. "Personalized medicine" is not actually personalized; it's genomic. Relying on genetic information to give meaningful information about health care and responses is hardly specific to an individual's needs and abilities, as we'd like a feminist science t be.

9.4 COLONIALISM AND WESTERN KNOWLEDGE

- psychedelic use in Mexico was pushed out by the Spanish conquerors
- ayahuasca experiences can be bought and sold in South America – which turns out to be okay, from an appropriative standpoint, because those services were always part of the indigenous economy as well

‡"A sensible research strategy (isolationism/reductionism) becomes a metaphysical commitment to a system, where the system is reality." For us, cell lines are indicative of some reality. It's plausible that scientists themselves know their work to be missing enormous sweeps of holistic knowledge, but any written work rarely acknowledges it. Grants and papers imply and argue, point-blank that molecular work is the answer to XYZ – and not just the answer, but the problem to be studied as well.

9.5 INFORMAL AND FORMAL KNOWLEDGES

The re-introduction of psychedelics into the clinic is also paired with a systematic devaluing of recreational users, and a low-key but distinct disdain for traditional usages.

In reality, however, hallucinogens have amazingly well-documented and supportive informal communities. Taking psychotropics is, for many, a spiritual and deeply-prepared for experience. Users are often hyperaware of the chemical effects, interactions with medical conditions or other drugs, how to set scenes, how to guide their mental state in meaningful ways – in short, expert and specific knowledge more typically associated with discerning scientists than hippies in the woods.

But hippies in the woods may know a lot more about how to *use* those drugs than scientists who have never experienced them and treat them solely as tools in a molecular toolkit.

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