How to write a strong (NRSA) grant

A primer with practical, crowdsourced tips

Edited: Dec, 2020, some links may be outdated

Federal Funding opportunities for Graduate Students & Postdocs

NSF

Graduate student

GRFP: supports outstanding graduate students who are pursuing research-based master's or doctoral degrees in STEM — science, technology, engineering and mathematics — or in STEM education. The five-year fellowship provides three years of financial support that can be used at accredited U.S. institutions. This support includes an annual stipend and a cost-of-education allowance covering tuition and fees.

DDRIG: Some of NSF's programs offer grants to doctoral students, allowing them to undertake significant data-gathering projects and conduct field research in settings away from their campus.

NRT: The NSF Research Traineeship Program gives graduate students opportunities to develop the skills and knowledge needed to pursue a range of STEM careers. Graduate students funded by the program receive, at minimum, 12-month-long stipends that support their participation in the program's training activities, which can include courses, workshops and research projects.

Postdoc

Postdoc research fellowships: NSF's Postdoctoral Research Fellowships support independent postdoctoral research, allowing fellows to perform work that will broaden their perspectives, facilitate interdisciplinary interactions, and help establish them in leadership positions. These two- or three-year fellowships provide a stipend and a research and training allowance.

https://new.nsf.gov/funding/graduate-students

Federal Funding opportunities for Graduate Students & Postdocs

NIH

Graduate student

F31: Provides up to 5 years of support toward a research doctoral degree (Ph.D., D.Sc.), annual stipend, funds for tuition/fees, research supplies, equipment, travel and related items. Funding Announcement

F31, diversity: Provides up to 5 years of support to individuals from underrepresented groups (including individuals from racial/ethnic groups, with disabilities or from disadvantaged backgrounds) toward a research doctoral degree or combined professional doctoral/research degree (M.D./Ph.D.). Funding Announcement.

F30: Provides combined medical school and predoctoral Ph.D. support for a maximum of 6 years, annual stipend, funds for tuition/fees, research supplies, equipment, travel and related items. Funding Announcement.

R36: Provides up to 2 years support for drug abuse doctoral dissertation research. Funding Announcement.

F99/K00 DSPAN: The purpose of the NIH Blueprint and BRAIN Initiative Diversity Specialized Predoctoral to Postdoctoral Advancement in Neuroscience (D-SPAN) Award is to support a defined pathway across career stages for outstanding graduate students who are from diverse backgrounds, including those from groups that are underrepresented in neuroscience research. This two-phase award will facilitate completion of the doctoral dissertation and transition of talented graduate students to strong neuroscience research postdoctoral positions, and will provide career development opportunities relevant to their long-term career goal of becoming independent neuroscience researchers. For the F99/K00 award, individuals may receive up to 6 years combined support for both phases, which includes 1-2 years in the F99 fellowship phase and up to 4 years in the K00 career development phase. https://neuroscienceblueprint.nih.gov/training/nih-blueprint-and-brain-initiative-d-span-award-f99k00

https://nida.nih.gov/research/research-training-career-development/training-career-development-fellowships-grants

https://www.niaaa.nih.gov/research-training-and-career-development

Federal Funding opportunities for Graduate Students & Postdocs

NIH

Postdoc

F32: Provides up to 3 years support at postdoctoral level, for expenses for supplies, equipment, travel, tuition and fees. Stipend based on years of relevant postdoctoral experience. Funding Announcement.

K99/R00: Provides up to 5 years of support consisting of two phases: 1-2 years of mentored support for highly promising, postdoctoral research scientists, followed by up to 3 years of independent support contingent on securing an independent research position. K99/R00 applicants must have no more than 4 years of postdoctoral research experience at the time of initial application or resubmission. Funding Announcement.

K99/R00 Brain: BRAIN K99/R00 – Career Transition Award to Promote Diversity

Provides up to 5 years of support consisting of two phases: 1-2 years of mentored support for highly promising, postdoctoral research scientists, followed by up to 3 years of independent support contingent on securing an independent research position. This program is designed to enhance workforce diversity and foster a strong cohort of new, highly skilled and well trained, NIH-supported, independent investigators from diverse backgrounds (including nationally underrepresented groups) working in research areas supported by the BRAIN Initiative. BRAIN Program Funding Announcements.

Mosaic K99/R00: The MOSAIC K99/R00 program is designed to facilitate a timely transition of promising postdoctoral researchers from diverse backgrounds from their mentored, postdoctoral research positions to independent, tenure-track or equivalent faculty positions at research-intensive institutions. Similar to other K99/R00 mechanisms, the MOSAIC K99/R00 award provides support during a postdoctoral and independent phase. MOSAIC K99/R00 scholars will be part of organized scientific cohorts to participate in mentoring, networking, and professional development activities. MOSAIC Program Funding Announcements.

INVEST: The NIDA International Program, INVEST Drug Abuse Research Fellowship, combines postdoctoral research training in the United States with professional development activities and grant-writing guidance to form a unique program for drug abuse scientists. This 12 month fellowship provides opportunities for fellows and their U.S. mentors to be part of a network of international scientists who exchange information and collaborate on drug abuse research nationally, regionally, and globally. Eligibility and how to apply.

K22: Career Transition Award (PAR-24-120) supports postdoctoral researchers as they transition to a tenure-track position. Candidates should apply in the final 1-2 years of their postdoctoral research. *only specific institutes*

https://nida.nih.gov/research/research-training-career-development/training-career-development-fellowships-grants

https://www.niaaa.nih.gov/research-training-and-career-development

Federal Funding opportunities for Graduate Students & Postdocs

NIH

Career development

K01: Mentored Research Scientist Development Award (K01) provides support for an intensive, mentored career development experience in the biomedical, behavioral, or clinical sciences leading to research independence. The K01 is typically a career development award for faculty members, but if you're a postdoc who has already negotiated a faculty position, the K01 might be a good fit for you as well. Provides support for 3 to 5 years of intensive, supervised career development in the biomedical, behavioral, or clinical sciences leading to research independence.

K02: Provides 3 to 5 years of salary support and "protected time" for newly independent scientists who can demonstrate the need for a period of intensive research focus as a means of enhancing their research careers.

K08: Provides 3 to 5 years of supervised specialized study for outstanding clinical research scientists with health professional doctoral degrees, who have the potential to develop into independent investigators and who are committed to a career in laboratory- or field-based research.

K23: Supports 3 to 5 years for the career development of individuals with a clinical doctoral degree who have made a commitment to focus their research endeavors on patient-oriented research.

K24: Provides support to mid-career health-professional doctorates or equivalent who are typically at the Associate Professor level for protected time to devote to patient-oriented research and to act as research mentors primarily for clinical residents, clinical fellows and/or junior clinical faculty.

K25: Provides support and "protected time" for a period of supervised study and research for productive professionals with quantitative (e.g., mathematics, statistics, economics, computer science, imaging science, informatics, physics, chemistry) and engineering backgrounds to integrate their expertise with NIH-relevant research.

People who helped in preparing this:

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- Sci Twitter
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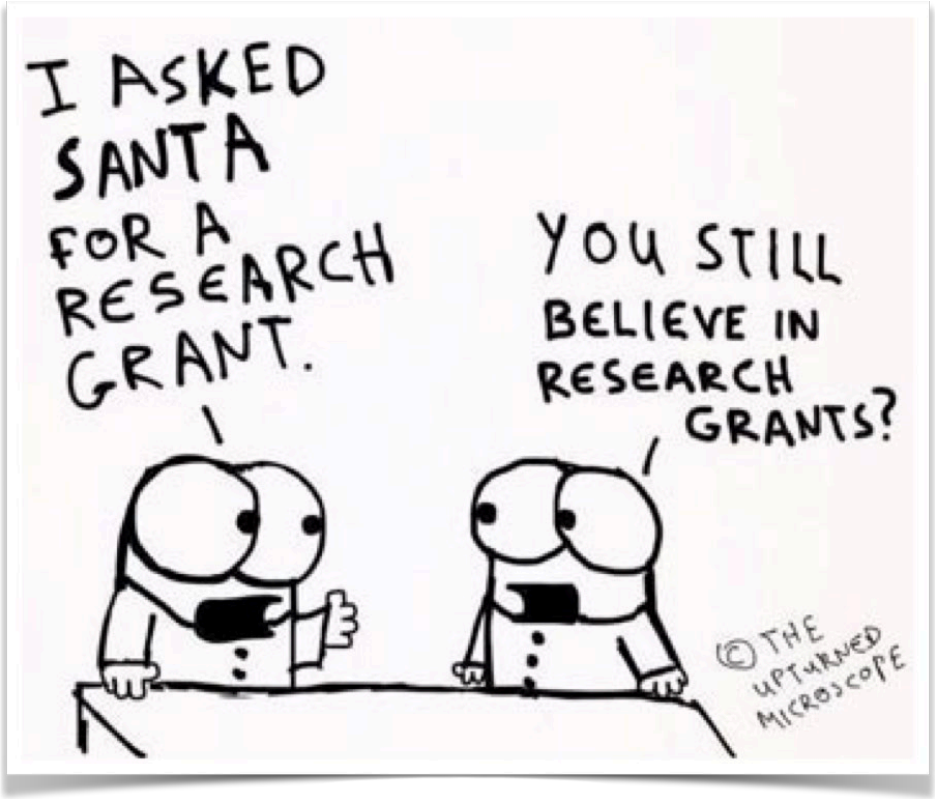
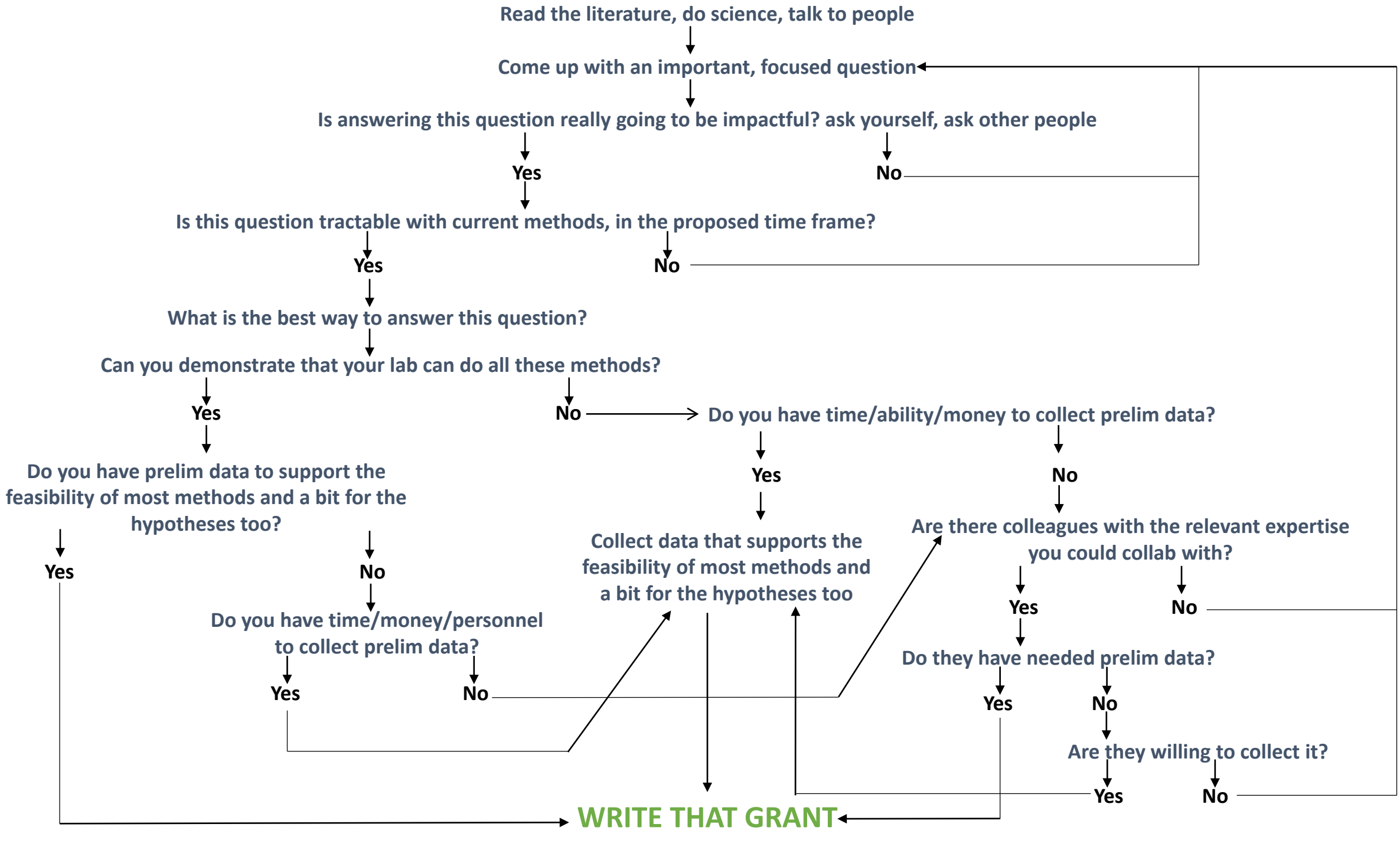
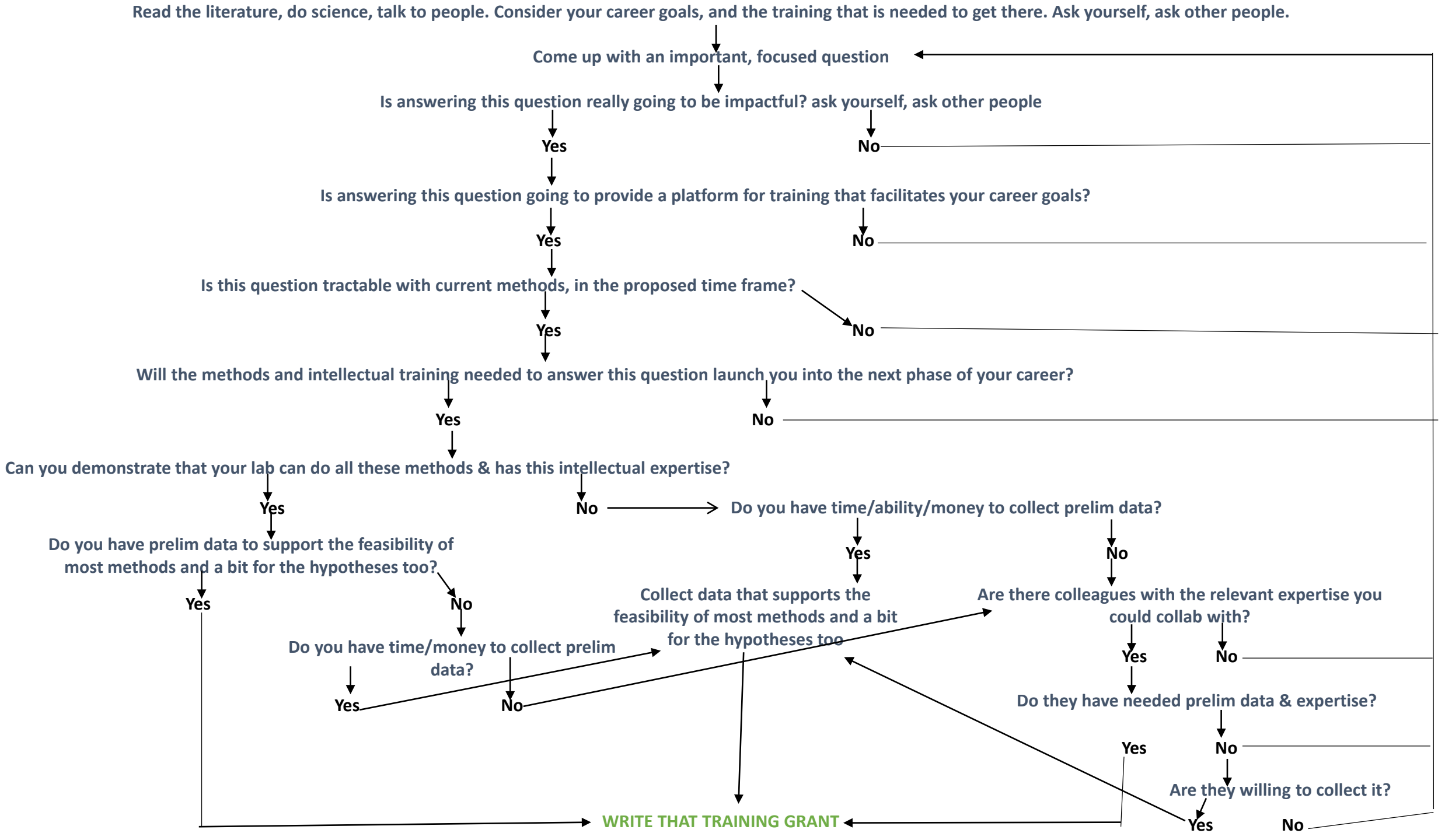
  - Follow @drugmonkeyblog
  - Follow @geneticexpns




Read the literature, do science, talk to people
Come up with an important, focused question
Is answering this question really going to be impactful? ask yourself, ask other people
Yes
No
Is this question tractable with current methods, in the proposed time frame?
Yes
No
What is the best way to answer this question?
Can you demonstrate that your lab can do all these methods?
Yes
No
Do you have prelim data to support the feasibility of most methods and a bit for the hypotheses too?
Yes
No
Do you have time/money/personnel to collect prelim data?
Yes
No
Do you have time/ability/money to collect prelim data?
Yes
No
Collect data that supports the feasibility of most methods and a bit for the hypotheses too
Are there colleagues with the relevant expertise you could collab with?
Yes
No
Do they have needed prelim data?
Yes
No
Are they willing to collect it?
Yes
No
WRITE THAT GRANT


Read the literature, do science, talk to people. Consider your career goals, and the training that is needed to get there. Ask yourself, ask other people.
Come up with an important, focused question
Is answering this question really going to be impactful? ask yourself, ask other people
Yes
No
Is answering this question going to provide a platform for training that facilitates your career goals?
Yes
No
Is this question tractable with current methods, in the proposed time frame?
Yes
No
Will the methods and intellectual training needed to answer this question launch you into the next phase of your career?
Yes
No
Can you demonstrate that your lab can do all these methods & has this intellectual expertise?
Yes
No
Do you have prelim data to support the feasibility of most methods and a bit for the hypotheses too?
Yes
No
Do you have time/money to collect prelim data?
Yes
No
Do you have time/ability/money to collect prelim data?
Yes
No
Collect data that supports the feasibility of most methods and a bit for the hypotheses too
Are there colleagues with the relevant expertise you could collab with?
Yes
No
Do they have needed prelim data & expertise?
Yes
No
Are they willing to collect it?
Yes
No
WRITE THAT TRAINING GRANT

Disclaimers

- This focuses on the NIH NRSA (F30/F31/F32), and more specifically, the specific aims and research strategy component of that grant (though will touch on the other components)
- It comes from the perspective of investigators with experience writing grants on topics related to systems/behavioral neuroscience
- This is a brief primer with tips, and is definitely NOT a comprehensive NRSA instruction guide
- I'm one person. Get advice from lots of people (see resources at the end)
- This document outlines a fairly specific strategy for writing an NRSA (though also provides general advice). There is not "one way" to write a strong NRSA
- Kate wrote this on airplanes in 2019…Steve edited during the COVID lockdown in 2020.

- Not getting an NRSA is not the end of the world. There are other options (R36, K etc) and it won't make or break your career.

Table of contents

The basics of a National Research Service Award (NRSA)

What is an NRSA?

The purpose of the Kirschstein-NRSA F31 program is to enable ***promising*** predoctoral students with *potential to develop into a productive, independent research scientists*, to obtain ***mentored research training*** while conducting *dissertation research*. The F31 is also used to enhance workforce diversity though a separate program.

National Institutes of Health

F30: dual degree MD/PhD
F31: predoc (and diversity)
F32: postdoc
F33: experienced scientists making big shifts
F99/K00: Pre to Post-doctoral transition (some restrictions); D-SPAN
R36: dissertation award
K99/R00: postdoc-independent transition

2020 guidelines:
F31 https://grants.nih.gov/grants/guide/pa-files/PA-20-246.html
F32 https://grants.nih.gov/grants/guide/pa-files/PA-20-242.html

https://researchtraining.nih.gov/programs/fellowships
https://researchtraining.nih.gov/programs/research-education/r36
https://researchtraining.nih.gov/programs/career-development/k99-r00

What are the components of an NRSA?

Section of Application	Page Limits * (if different from FOA, FOA supersedes)
Project Summary/Abstract	30 lines of text
Project Narrative	Three sentences
Introduction to Resubmission or Revision Application (when applicable)	1
Applicant's Background and Goals for Fellowship Training	6
Specific Aims	1
Research Strategy	6
Respective Contributions	1
Selection of Sponsor and Institution	1
Training in the Responsible Conduct of Research	1
Sponsor and Co-Sponsor Statements	6
Letters of Support from Collaborators, Contributors, and Consultants	6
Description of Institutional Environment and Commitment to Training Note: This page limit includes the Additional Educational Information required for F30 and F31 applications.	2
Applications for Concurrent Support (when applicable)	1
Biographical Sketch	5

https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/page-limits.htm#fell

What are the components of an NRSA?

- Project Summary/Abstract (limit 30 lines)
- Project Narrative (limit 2-3 sentences)
- Bibliography (literature cited, no limit)
- Facilities and Other Resources (no limit)
- Equipment (no limit)
- Cover letter (include list of references)
- Letters of Support
- Research Training Plan
- Introduction (resubmissions and revisions only, one-page limit)
- **Specific Aims (limit 1 page)**
- **Research Strategy (limit 6 pages)**
- Vertebrate Animals (must answer all five points)
- Resource Sharing Plan(s)
- Respective Contributions (limit 1 page)
- Selection of Sponsor and Institutions (limit 1 page)
- Responsible Conduct of Research (limit 1 page)
- Current or Prior Kirschstein-NRSA Support (limit 1 page)
- Application for Concurrent Support (limit 1 page)
- Goals for Fellowship Training and Career (limit 1 page)
- Activities planned under this award (limit 1 page)
- Doctoral Dissertation and other Research (limit 2 pages)
- Sponsor information (limit 6 pages)
- Appendix (optional)

This is what we will focus on, but don't take this to mean the other parts aren't important--they are, especially the training plan and sponsor info

When is the NRSA due?

F Series Fellowships (including F31 Diversity – NOT-OD-17-029) *new, renewal, resubmission*	***Individual*** **National Research Service Awards (Standard)** (see NRSA Training Page)	April 8	August 8	December 8

Review and Award Cycles

	Cycle I	Cycle II	Cycle III
Application Due Dates	January 25 - May 7	May 25 - September 7	September 25 - January 7
Scientific Merit Review	June - July	October - November	February - March
Advisory Council Round	August or October *	January	May
Earliest Project Start Date	September or December *	April	July

https://grants.nih.gov/grants/how-to-apply-application-guide/due-dates-and-submission-policies/due-dates.htm

NRSA Review Process
(NIH Center for Scientific Review)

What is the review process?

- Assigned to a Scientific Review Officer (SRO) and Program Officer (PO)
- Assigned to Initial Review Group (IRG), informally called a “study section”
  - ~30 active investigators (PIs, usually NIH-funded) in your *general* area (e.g., behavioral neuroscience)
- Evaluated by 3 reviewers; if in top 50% of scores (or rescued), then will be discussed at in-person (now Virtual/Zoom) study section meeting
- Each discussed grant will only receive ~15-20 min of discussion!!
  - Primary reviewer will introduce your grant: describing all scorable criteria, strengths and weaknesses. Chair directs reviewers to focus on “score-driving factors”.
  - Next second and third reviews chime in (and in some cases, ‘have nothing new to add’)
  - Main reviewers state their final scores (which may shift depending on the discussion)
  - Everyone enters a score in the range of the primary reviewers, unless they say otherwise (i.e., “voting outside the range”).

- Reviews and scores go to program, who then select grants to fund based on the scores and recommendations of the reviewers

Review criteria

Scored Review Criteria

Reviewers will consider each of the review criteria below in the determination of scientific merit, and give a separate score for each. An application does not need to be strong in all categories to be judged likely to have major scientific impact.

Fellowship Applicant

- Are the applicant's academic record and research experience of high quality?
- Does the applicant have the potential to develop into an independent and productive researcher?
- Does the applicant demonstrate commitment to a research career in the future?

Sponsors, Collaborators, and Consultants

- Are the sponsor(s') research qualifications (including recent publications) and track record of mentoring individuals at a similar stage appropriate for the needs of the applicant?
- Is there evidence of a match between the research and clinical interests (if applicable) of the applicant and the sponsor(s)? Do(es) the sponsor(s) demonstrate an understanding of the applicant's training needs as well as the ability and commitment to assist in meeting these needs?
- Is there evidence of adequate research funds to support the applicant's proposed research project and training for the duration of the research component of the fellowship?
- If a team of sponsors is proposed, is the team structure well justified for the mentored training plan, and are the roles of the individual members appropriate and clearly defined?
- Are the qualifications of any collaborator(s) and/or consultant(s), including their complementary expertise and previous experience in fostering the training of fellows, appropriate for the proposed project?
- If the applicant is proposing to gain experience in a clinical trial as part of his or her research training, is there evidence of the appropriate expertise, experience, resources, and ability on the part of the sponsor(s) to guide the applicant during the clinical trial research experience?

Research Training Plan

- Is the proposed research project of high scientific quality, and is it well integrated with the proposed research training plan?
- Based on the sponsor's description of his/her active research program, is the applicant's proposed research project sufficiently distinct from the sponsor's funded research for the applicant's career stage?
- Is the research project consistent with the applicant's stage of research development?
- Is the proposed time frame feasible to accomplish the proposed training?
- If proposed, will the clinical trial experience contribute to the proposed project and/or the applicant's research training?

Training Potential

- Are the proposed research project and training plan likely to provide the applicant with the requisite individualized and mentored experiences in order to obtain appropriate skills for a research career?
- Does the training plan take advantage of the applicant's strengths and address gaps in needed skills? Does the training plan document a clear need for, and value of, the proposed training?
- Does the proposed training have the potential to serve as a sound foundation that will clearly enhance the applicant's ability to develop into a productive researcher?

Institutional Environment & Commitment to Training

- Are the research facilities, resources (e.g., equipment, laboratory space, computer time, subject populations, clinical training settings) and training opportunities (e.g. seminars, workshops, professional development opportunities) adequate and appropriate?
- Is the institutional environment for the applicant's scientific development of high quality?
- Is there appropriate institutional commitment to fostering the applicant's mentored training?.

https://grants.nih.gov/grants/guide/pa-files/PA-19-195.html

Review criteria

Score (1=high, 9=low) for each criterion [applicant, sponsor(s), training plan, training potential, institutional environment]
"Overall impact" score is not necessarily an average of the individual criterion scores

Overall Impact or Criterion Strength	Score	Descriptor
High	1	Exceptional
	2	Outstanding
	3	Excellent
Medium	4	Very Good
	5	Good
	6	Satisfactory
Low	7	Fair
	8	Marginal
	9	Poor

Scoring starts here

Review criteria

- Fellowship applicant
- Sponsors
- Research training plan
- Training potential

It's about

- *your qualifications (prior work & preliminary data, likelihood you will go on to be successful in an independent career)*
- *your sponsor's qualifications to mentor you in the proposed research AND to get you to the next stage of your career*
- *the quality of your research training (and, thus, the quality of the research and experimental design)*
- *the potential for new training that will launch you to the next phase of your career*

Notice what's absent: Significance & innovation (primary criterion on an R01)

- these will factor into the research training plan criterion
- but feasibility and training potential trumps significance for a training grant

Tips

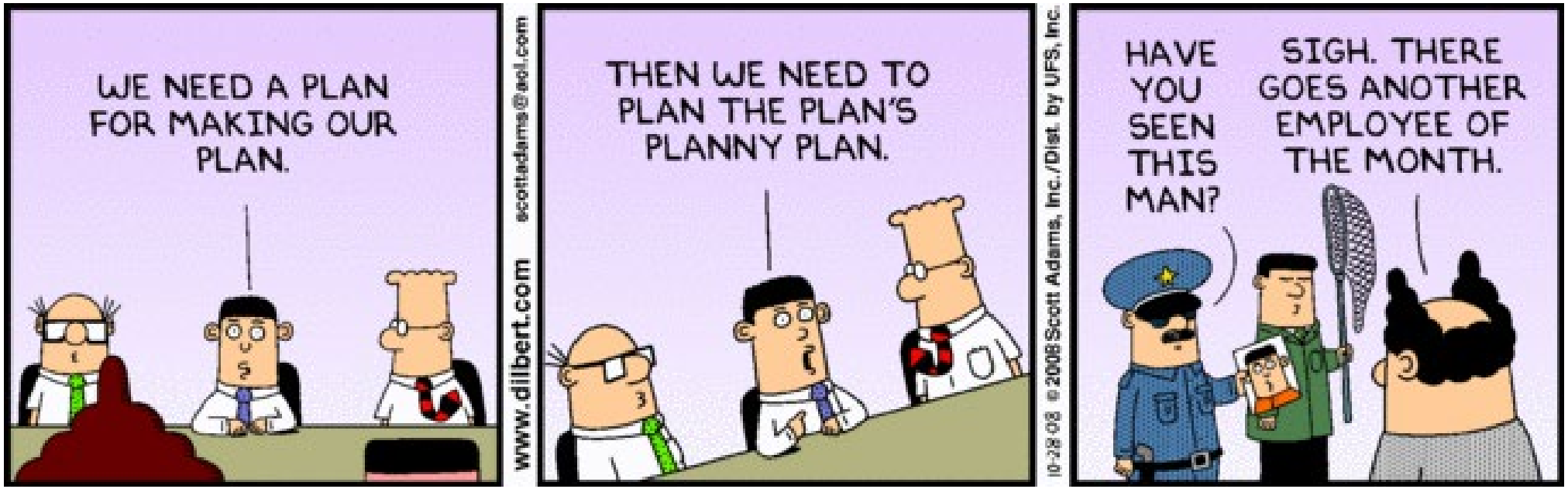
- Focus on the scoring criteria when writing your proposal
- Avoid giving reviewers easy things to triage your grant over (see common pitfalls below)
- Reviewers will argue for a grant when there is disagreement; but they can't argue for every single grant… make your grant worth fighting for
- If reviewers just don't like your grant, or don't get it, but can't put their finger on why, they are more likely to nitpick on smaller things. Keep this in mind when reading your reviews, i.e., read between the lines. See Hot tips: Responding to feedback in a resubmission

The psychology of grant review

Sharon L. Milgram, Director NIH OITE

- Reviewers are:
  - Over-committed, over-worked, and tired
  - Inherently skeptical and critical
  - Often only peripherally interested in your work
- Make their job easier with:
  - Well-organized, clearly written prose
  - Lots of section headings and breaks in the writing
  - Repeat important points at several places in the application
  - Well designed flow diagrams, charts, figures
- And avoid irritating them by:
  - Exceeding page limits, using small fonts and narrow margins
  - Putting information in the wrong section
  - Omitting or mislabeling references/figures
  - Submitting an application that is sloppy or full of typographical errors

Organizational Process (Before You Write)

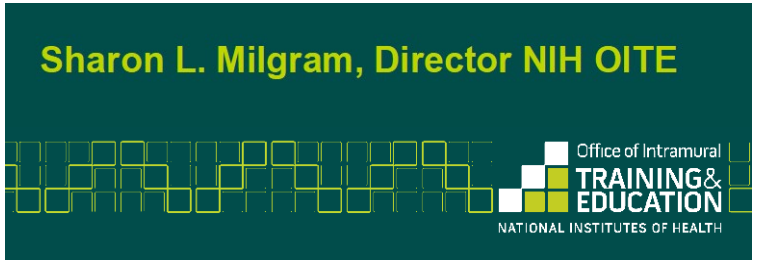


The Organizational Process

"Many of us when confronted by a writing deadline, skip the organizational phase of writing. This is akin to leaving on a trip to unknown parts without a road map, hotel reservations, or plans of any sort."

Successful Scientific Writing by Matthews and Mathews (Cambridge University Press)

The Organizational Process – Early Decisions



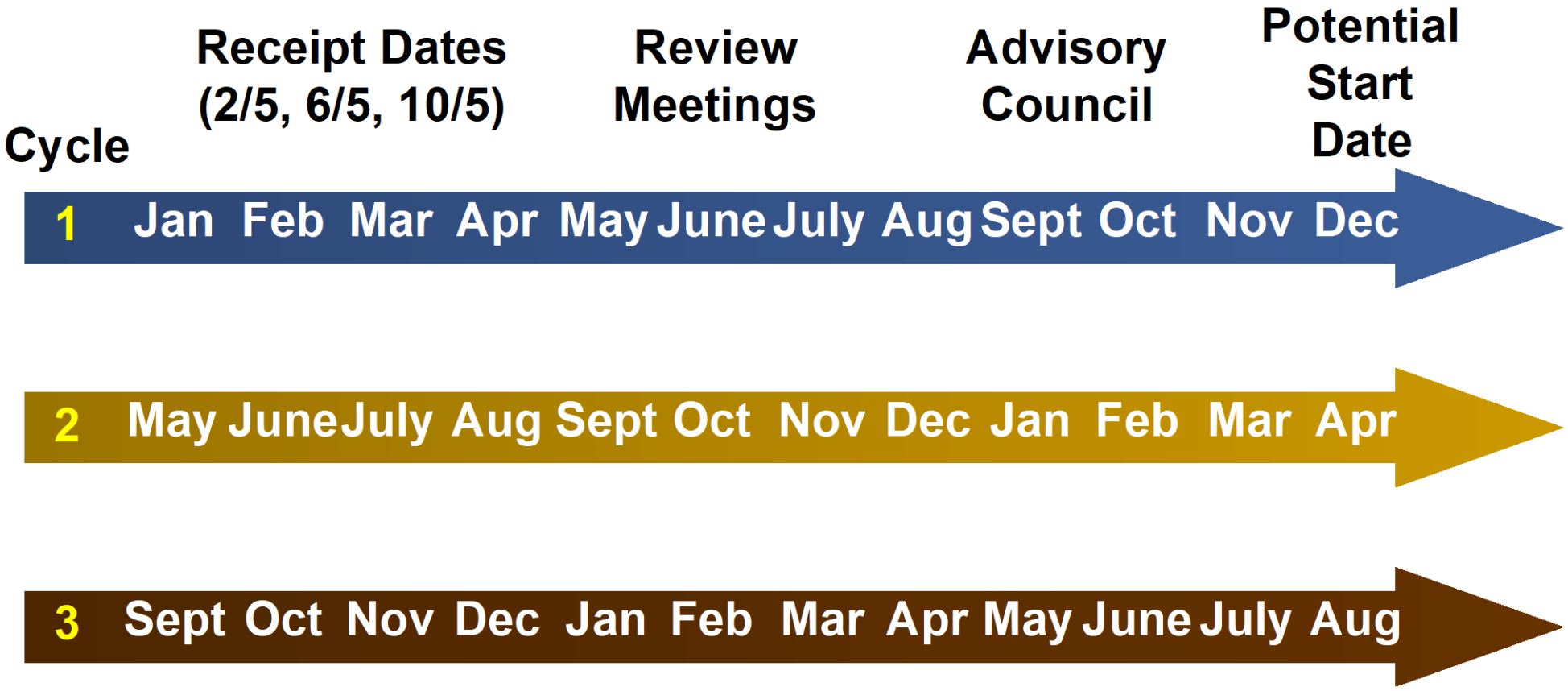
- Select the appropriate funding mechanism:
  - NRSA F31 (note there is also a diversity NRSA)
  - NIH Blueprint Diversity Specialized Predoctoral to Postdoctoral Advancement in Neuroscience (D-SPAN) F99/K00

- Admin issues:
  - Download and carefully read all instructions and deadlines
  - Important to get latest forms and materials - especially now
  - Register for government internet-based application and award systems, particularly the eRA Commons
  - Talk with lab/department administrators about budgeting, all required approvals, and routing procedures
  - Begin approvals process well in advance of the deadline

The Organizational Process

Sharon L. Milgram, Director NIH OITE

Three NIH Grant Cycles Per Year



The Organizational Process – Early Science Prep

- Read the literature broadly - not deeply; save important papers for a deeper read later

- Engage your lab, mentors, colleagues, and collaborators in the brainstorming process

- Find outside experts to talk with - but go prepared

- Talk with the relevant NIH Program Officer(s) (best done after you have a specific aims page, but no harm to seek out at SfN, for example)

- Begin early to define, organize and plan the content
- NOTE: Early means 6 - 9 months before the deadline

The Organizational Process – Early Science Prep

Sharon L. Milgram, Director NIH OITE

Office of Intramural TRAINING & EDUCATION
NATIONAL INSTITUTES OF HEALTH

- Look hard at your publications - any that need to be submitted NOW?
  - Insufficient publication record is a common concern during review
- Identify ‘need to have’ preliminary data
- Identify methods you need to learn more about or develop expertise in
  - Ideally will will know, or know someone who knows, all the methods you propose
- Make lists of reagent, cell type, animal, or human subject issues you need to deal with
  - Critical reagents and compliance must me in-hand

General Tips (more Hot Tips later)

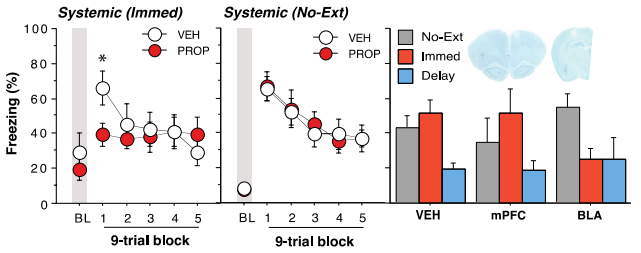
- Read instructions, create timeline, and…..START EARLY!!
- Notify campus grant admin of your intent to submit; they help with compliance and budget
- Grant admin requires final product at least 1-week before sponsor deadline
- Give your mentor plenty of time to read and give feedback (drafts, drafts, drafts….) get your grant to your mentor one week/page of grant before the deadline (6 pages 6 weeks before internal deadline)
- Early (and frequent) drafts give your mentor sufficient time to provide constructive feedback…..

General Tips

- <u>Pay attention to detail!</u>
  - Comply with all formatting requirements (font, margins, page length, character spacing, etc)
  - Grammatical/spelling errors are unacceptable
  - Writing must be clear, succinct, to the point
  - Grab reader's attention—highlight transitions/sections
  - Figures should be beautiful, informative, and efficient (don't try to compress too much info at the expense of size clarity)!

General Tips

- Make the proposal easy to read and "pop"
  - Reviewers are fatigued—don't make them work to read your proposal
  - Line breaks and distinct **bold** section headers help
  - *Serif or sans serif font?*
    - There are huge debates on this—SM prefers serif (Georgia 11)
  - *Full or left justify?*
    - More debate—SM prefers full justification
  - *Citations: numbers or names?* More debate
    - SM prefers names (reduces biblio checking by reader)
  - *Figure crafting.* Multi-panel, color figures excite the eye!



; propranolol infusions did not affect delayed extinction *(adapted from Giustino et al., 2017).*

stress-induced cognitive deficits involve the direct action of catecholamines on mPFC neurons (Arnsten, 2015), these data reveal that the stress-induced extinction impairments, such as the IED, involve ß-noradrenergic receptors in the BLA. This is consistent with other work showing that the IED (Hollis et al., 2016) and other memory impairments arising from stress effects in mPFC also require the BLA and ß-noradrenergic receptors (Roozendaal et al., 2004). Moreover, the LC is the primary source of NE in the BLA (Rinaman, 2011; Aston-Jones and Waterhouse, 2016). Overall, these data support the premise that noradrenergic regulation of the BLA contributes to the prefrontal cortical dysregulation associated with stress-induced memory impairments, including the acquisition and retention of long-term memories of extinguished fear. However, the *neural circuit* by which noradrenergic transmission in the BLA perturbs mPFC firing is unknown.

INNOVATION

Prevailing models of prefrontal-amygdala interactions posit top-down prefrontal control of amygdala output to regulate the expression of conditioned emotional responses, such as freezing behavior. Specifically, PL projections to the BLA have been implicated in the expression of conditioned fear, whereas IL projections to the BLA engage an inhibitory network in the amygdala that suppresses fear responses (Milad and Quirk, 2012). However, it is well known that BLA neurons have robust projections to the mPFC and these projections have been implicated in both the conditioning and extinction of fear (Senn et al., 2014; Burgos-Robles et al., 2017; Klavir et al., 2017). For example, Senn and colleagues have found that the balance of activity among PL- and IL-projecting BLA influences the magnitude of extinction retention (Senn et al., 2014). Hence, long-range amygdala-prefrontal projections provide a direct neural circuit for the noradrenergic regulation of mPFC firing via the BLA. Here we propose that stress-induced impairments in both mPFC function and extinction retention are mediated by these amygdala-prefrontal circuits.

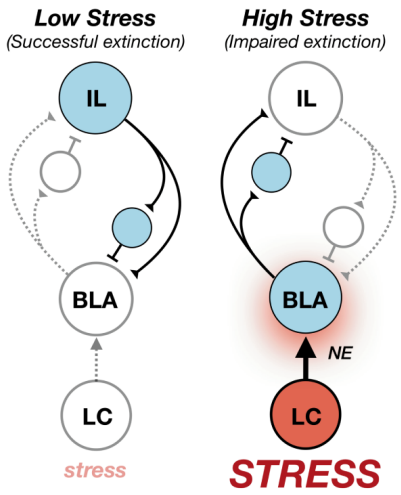


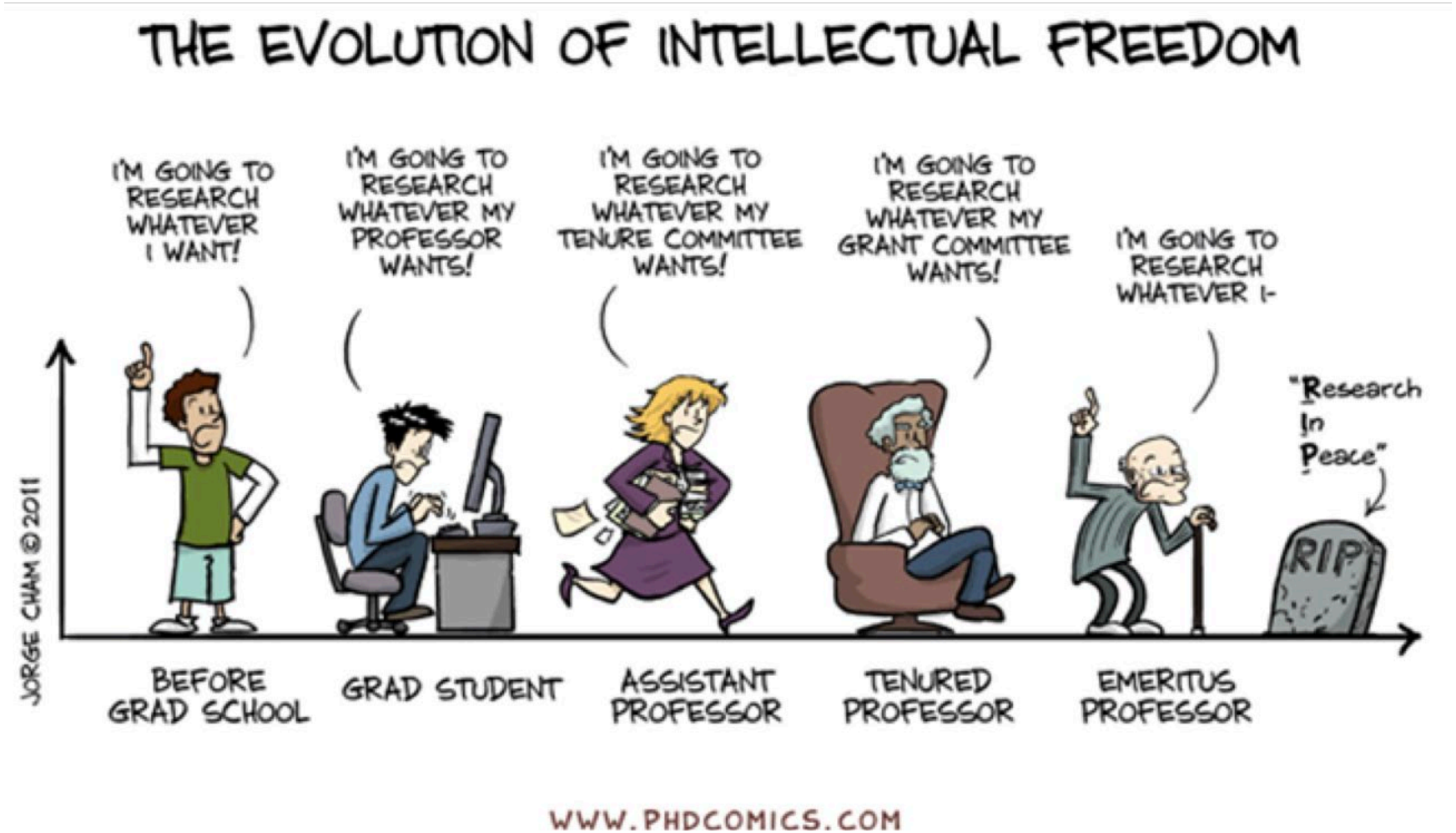
Figure 5. Amygdalo-prefrontal circuits regulating fear extinction. *(Left),* Under low- stress conditions, infralimbic cortical (IL) neurons and their projections to the basolateral amygdala (BLA) mediate extinction learning and retention. Plasticity in this pathway reduces the strength of IL input onto BLA principal cells to dampen fear responses (Cho et al., 2013). *(Right),* However, under high stress conditions (e.g., immediate extinction), we propose that norpinephrine (NE) released by locus coeruleus (LC) terminals in the amygdala excites BLA neurons projecting to the IL. BLA neurons strongly depolarize inhibitory interneurons to dampen IL firing (McGarry and Carter, 2016) and impair extinction learning and retention.

To evaluate this idea, it is important to consider that the primary influence of BLA stimulation on mPFC spike firing is *inhibitory* (Floresco and Tse, 2007; Dilgen et al., 2013; McGarry and Carter, 2016). Indeed, BLA neurons projecting to the IL make strong excitatory contacts onto both parvalbumin (PV) and somatostatin interneurons that, in turn, make synapses onto IL principal cells. BLA excitatory inputs onto mPFC neurons are relatively weak, hence this synaptic circuitry results in massive feedforward inhibition of IL firing in response to BLA input (McGarry and Carter, 2016). Because BLA neurons preferentially target cortico-amygdala neurons in IL (layer 2), the BLA is positioned to limit activity in reciprocally connected neurons in IL that have been implicated in extinction learning (Bukalo et al., 2015) (Cho et al., 2013). Indeed, we propose that this inhibitory BLA->IL circuit mediates the stress-induced dysregulation of IL firing that mediates extinction deficits such as the IED (Figure 5). In the context of these and other data, ***our specific hypothesis is that stress-induced NE release from the LC recruits BLA neurons to dampen activity in IL principal cells to impair the acquisition and retention of long-term extinction memories***. This is an innovative hypothesis that is a significant departure from current models of top-down prefrontal-amygdala interactions invoked to explain stress-induced impairments in memory and cognition. Importantly, we propose that the bottom-up

General Tips

- Successful grant writing requires fortitude, patience, and perseverance
- Many challenges both before and after you hit submit
- Grant writing can be overwhelming, but there are many resources for help and support
- Although challenging, many people find the process extremely rewarding

The question, idea, and hypothesis



Where do I start?

Actively involve your mentor and/or others with proposal writing experience

- What's your question and hypothesis?
- What's the best way to test this question?
- What do you want to learn to launch you into the next phase of your career? (conceptual & technical)

- **<u>Exercise</u>**: What is your ***big idea***?
- Can you say it/sell it in 6 words?
- Start with a 1-page summary: brief background, hypothesis, and draft aims to crystallize your thoughts

What makes a strong research proposal?

- ***Compelling*** question
- ***Clarity*** of thought & expression
- A strong, ***testable hypothesis***
- ***Logical*** and non-interdependent steps (aims) to address that question
- ***Rigorous*** experiments to answer the question

Nandita Mullapudi

- A question that is within the scope of your sponsor's funded research (ideally NIH funded)
  - The NRSA pays for you, not the science, so you need to propose a project that is within the scope of what is already funded in your lab
  - Indeed, it is an implicit requirement that the sponsoring lab have funding (preferentially NIH funding) to support the proposed work.

The question, idea, and hypothesis

Tom Kash @superkash · Sep 20

Replying to @KateWassum

in our grant writing class, the first thing is to get people up to the board and have them write big question, hypotehsis and aims. essentially a chalk talk. whole class participates, great for obtaining clarity of thought.

1 15

Tom Kash @superkash · Sep 20

it takes a while. but in teaching, we have found that if you start with clarity, writing is 'easier'

3

Mattia @Ciavenasc · Sep 21

Replying to @KateWassum

Describe the topic and the unmet need. Define the overarching question. Define the question that you aim to answer with each experiment/analysis. Be respectful of your colleagues that are going to read it: you won't away with poorly written or hastily put together proposals

1

Laurens Witter @gigaseal · Sep 20

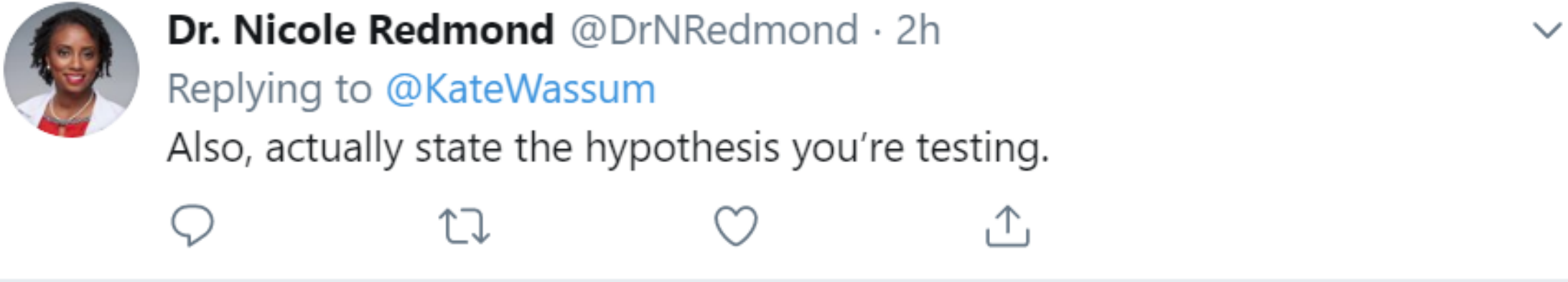
Replying to @KateWassum

In the midst of writing two now.structure: 1. Why is it important 2. What will you solve 3. How will you solve it. Then each aim: 1. Rationale, 2. Methods/approach 3. Expected outcome 4. Alternatives if 2 fails. Everything needs a backup plan. Make it 100% failsafe.

1

The question, idea, and hypothesis

- The question and hypothesis are critical
- They should be clear and concise
- Imagine someone getting up and saying this grant proposes to ask XXX and is testing the hypothesis that XXX. They will do this by XXX.
  - This is what reviewer #1 will have to do, make it easy for them to sell your idea
- Ideally. your data will be informative regardless of whether your hypothesis is supported



The question, idea, and hypothesis

What makes a good research question?

If you put this to leading researchers you are likely to get many different answers. So ask them! You will learn a lot from the process and from interacting with them. I think a good research question has to be *obviously good* to people from outside your research area. It has to be big enough for others to appreciate immediately why anyone should spend years of their life using large amounts of money from the public purse or charities to answer such a question. For many researchers, the question also has to be intellectually stimulating—if possible, thrilling! But at the same time a good research question has to be one which is likely to be answered within the time frame of the grant. It has to be a practical proposal, not something so grand that it would take decades to unlock.

Masud Husain

https://pn.bmj.com/content/15/6/474

The question, idea, and hypothesis

Coming up with a good idea:

- Talk to your mentor
- Talk with PIs, postdocs, colleagues within and just outside your field
  - Don’t steal anyone’s idea though…duh
- What big question(s) have not been answered in your field?
- Are people eager to know the answer(s)?
- Go to conferences, read papers, get on Twitter, see what’s missing.
- Look at NIH reporter to see the types of things getting funding

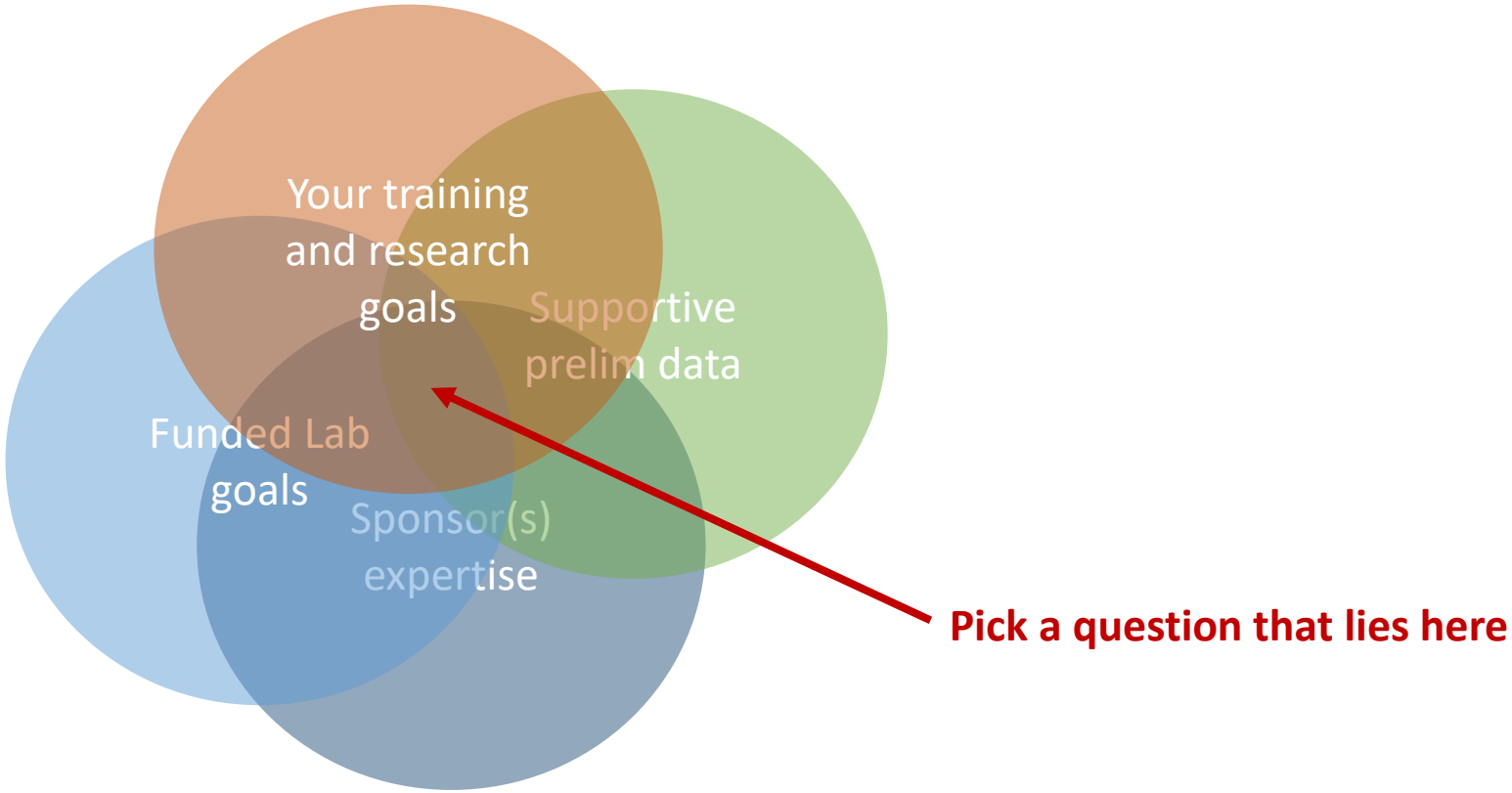
The question, idea, and hypothesis

Coming up with a feasible idea:

- Think about feasibility.
- Look at NIH reporter to assess the typical scope of work for a successful NRSAs in your field/career stage
- Think about your time frame (how many years you are asking for funding)
- See also notes below on how to avoid being overambitious

The question, idea, and hypothesis

Make a mental Venn diagram of your training goals, questions of interest to you, funded research questions of the lab, technical expertise of your sponsor and co-sponsors, and methods/concepts your prelim data support. In the middle will emerge some questions you can tackle…find the most significant one of these and do it.



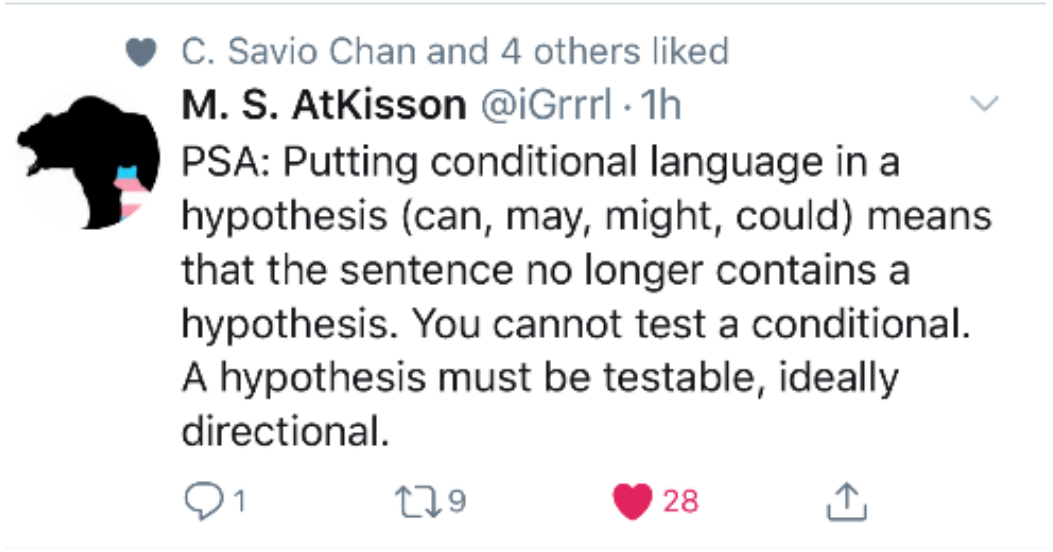
The question, idea, and hypothesis

The Heilmeier Catechism

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What is new in your approach and why do you think it will be successful?
- Who cares? If you are successful, what difference will it make?
- What are the risks?
- How much will it cost?
- How long will it take?
- What are the mid-term and final “exams” to check for success?

The hypothesis

- Is related to your question (but is not your question)
- Is testable/falsifiable
- Is clear and simple
- Is specific
- Is important
- Is well rooted in the literature (but not incremental)
- Testing it will produce important information regardless of whether it's supported
- Will be tested by your aims
- Is feasible to test within the proposed timeframe



The question, idea, and hypothesis

Make it hypothesis driven

It is well worth jotting down what your hypotheses are, for your own sake. Most studies are vulnerable to the criticism that they are 'exploratory' and do not have specific hypotheses that are being tested. Even if your study is largely exploratory, make some explicit hypotheses about what you might be directly testing, based on proposal. It is absolutely essential that you write down clear hypotheses, unless the Call is specifically for an exploratory study, which is very rare. 'Fishing expeditions', no matter how good they might be, do not fare well with reviewers or grant panels. I often use direct questions incorporating the hypotheses I want to test as subheadings in an application. That way no one is in doubt about what the hypotheses are.

Masud Husain

https://pn.bmj.com/content/15/6/474

The hypothesis

A hypothesis & prediction are not the same thing

Hypothesis: a potential explanation of a biological event

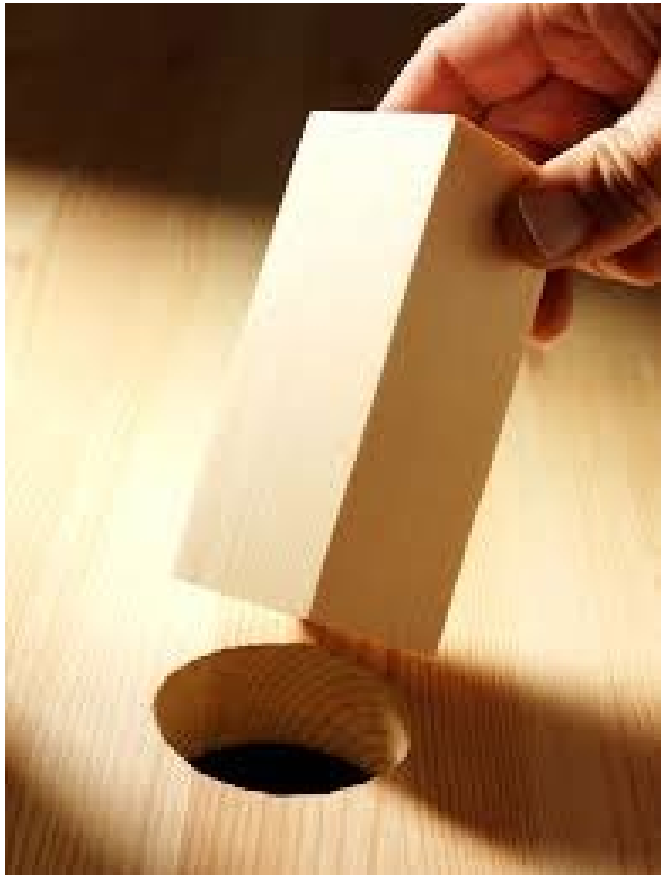
- *Projections from the orbitofrontal cortex to the basolateral amygdala regulate the encoding of reward value.*
- *Hypoactivity in nucleus accumbens causes apathy symptoms in depression.*

Prediction: the specific expected result of an experiment based on the hypothesis

- *Inactivation of orbitofrontal cortex to the basolateral amygdala projections will prevent reward value encoding.*
- *Medial prefrontal cortex activity is attenuated in subjects diagnosed with major depressive disorder with symptoms of reduced apathy, relative to health controls.*

Challenges in creating a strong question/hypothesis/plan

Don’t try to fit a square peg into a round hole (Nancy Smith- UCLA)



- Do not build a question and hypothesis based on the experiments you plan (or your PI told you) to do

- Start with the big question and develop a hypothesis and propose the experiments that best answer the question and test the hypothesis

I’ve got a good question, now what?

The approach, experimental design

- Logical steps that include specific experiments to address your question and test your hypothesis
- Non-interdependent (this is often a fatal flaw)
- Ideally your experiments will not produce entirely descriptive information
  - Description of the phenotype of a KO mouse
    - *Reviewer would say: lacks mechanistic insight*
  - Recordings of activity in brain region in different behaviors
    - *Reviewer would say: lacks information on causal function*
  - RNA-seq of one or two brain regions in several different states
    - *Reviewer would say: lacks causal analysis, mechanism of transcriptional regulation*

The approach, experimental design

- Experiments must be rigorous, well controlled and systematic
  - Read top, well-respected papers in your field. Notice the methods, controls, validations and use this info to craft your experimental design
- Converging evidence, use multiple methods to address the same question from different angles. This overcomes the imitations of any one single method
- Avoid artificial (or entirely artificial) manipulations
  - Think through the physiological relevance of your proposed projects
  - Using entirely optogenetic stimulation probably won't well test your hypothesis
- Include ALL the controls
  - Look to the literature for what is the most rigorous standard
  - ask for feedback from your PI and others in the field
- Include ALL the validations
  - Never propose a method that without showing and continuing to validate it does what its supposed to be doing

The approach, experimental design

Think through the project

e.g., If you want to ask A, then you have to do X, Y, Z (based on your reading of the literature) can you show you can do X, Y, and Z, if not then get a collaborator who is expert in A, or don't do A

Make sure you experiments test your hypothesis

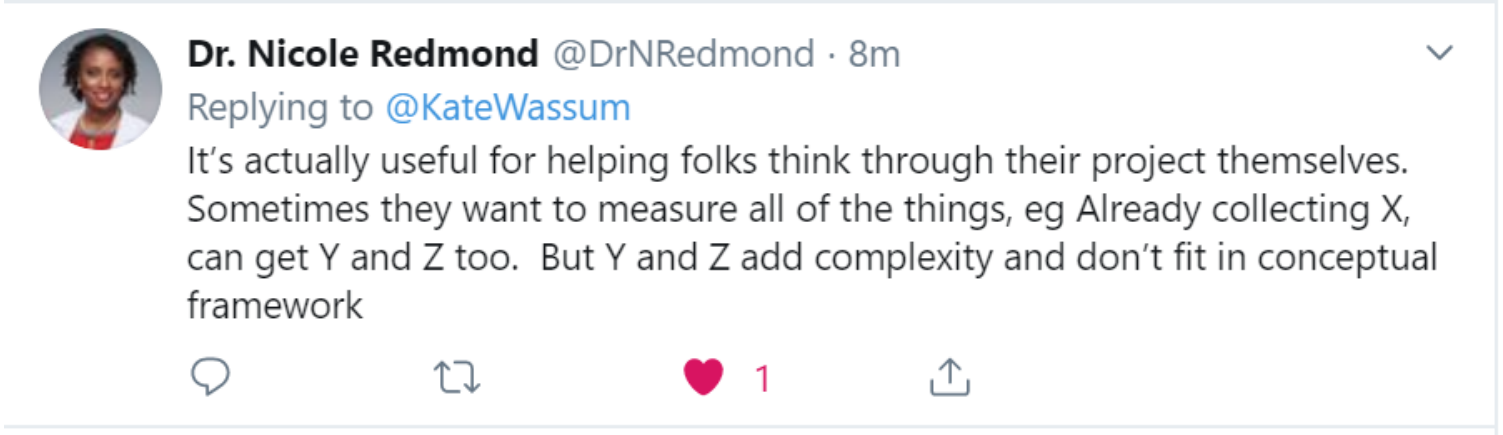
e.g., if I do A I might find X and on the basis of X I could interpret Z. Is Z a true/false for your hypothesis? If not, then you need to adjust your experiments to make sure you are testing your hypothesis (or adjust your hypothesis)

Don't propose a correlational analysis for a hypothesis that requires a causal analysis.

e.g., X mediates Y, so I will record X. recording X doesn't test mediation of Y.

Think through the statistical analyses

This may help you identify missing controls, incongruence, or an overambitious design



The approach, experimental design

- Must be feasible!!!
  - You have a sponsor/co-sponsor that is expert in the concept method
    - If your lab doesn't have demonstrated expertise in an area, get a co-sponsor who does)
  - Your sponsor's/co-sponsor's lab has demonstrated success in the method (published or preliminary data)
  - You can learn to do it (this is based on your personal statement)
  - You can do it within the time frame proposed

- You will likely design, then redesign your experiments; make sure you update your question/hypothesis to suite your final set of experiments i.e., make sure your experiments actually test your hypothesis.

- Address potential pitfalls and propose alternative strategies.
- Propose experiments that fall within the timeline. Never ‘over-propose’.
- Have somebody else review it before you submit.
- Include schematics/figures to explain concepts.
- Do not try to capture multiple thoughts in the same sentence.

Raj R Rao
Professor & Department Head,
Biomedical Engineering
University of Arkansas, USA

3 x 7.50 in

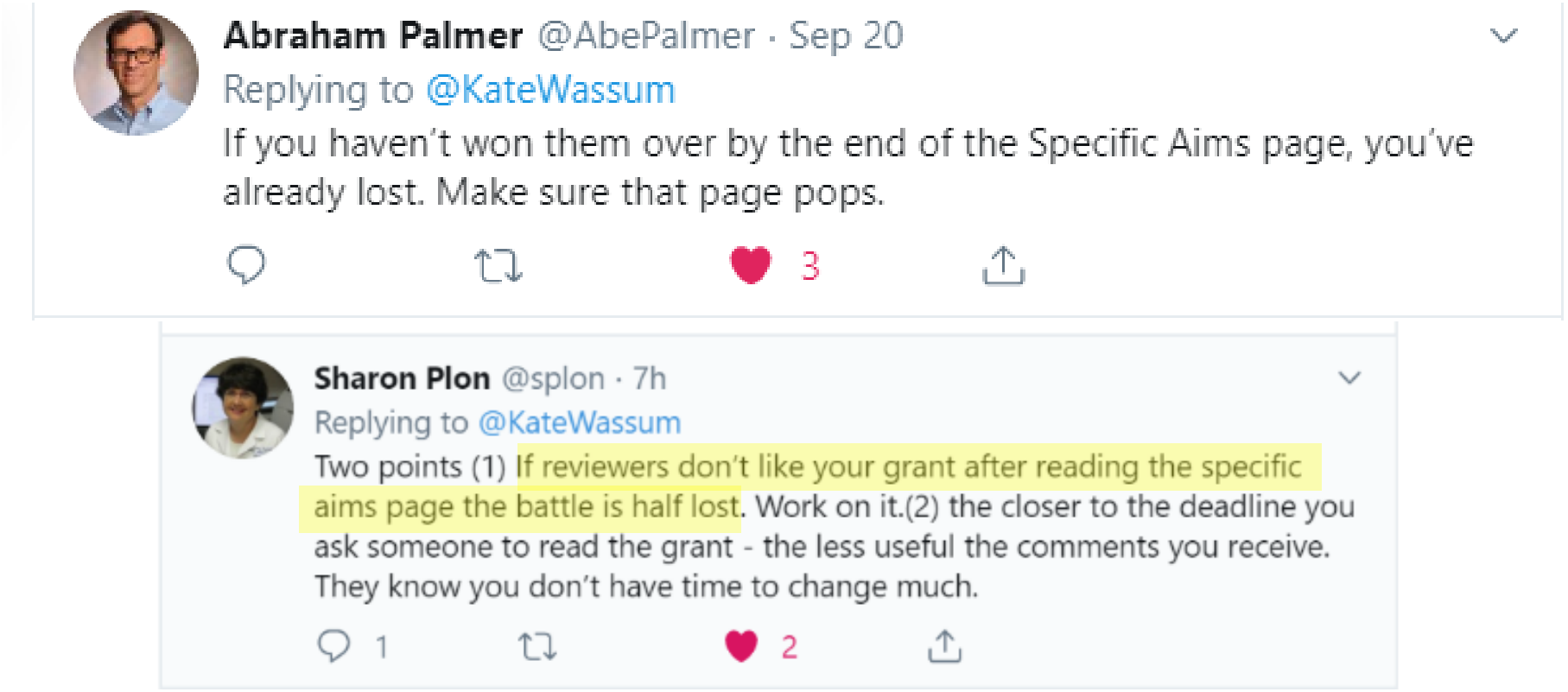
I’ve got the idea, hypothesis, and approach, what do I actually *write*?

Specific Aims
(1-page to rule them all)

Specific Aims page

Limited to 1 page

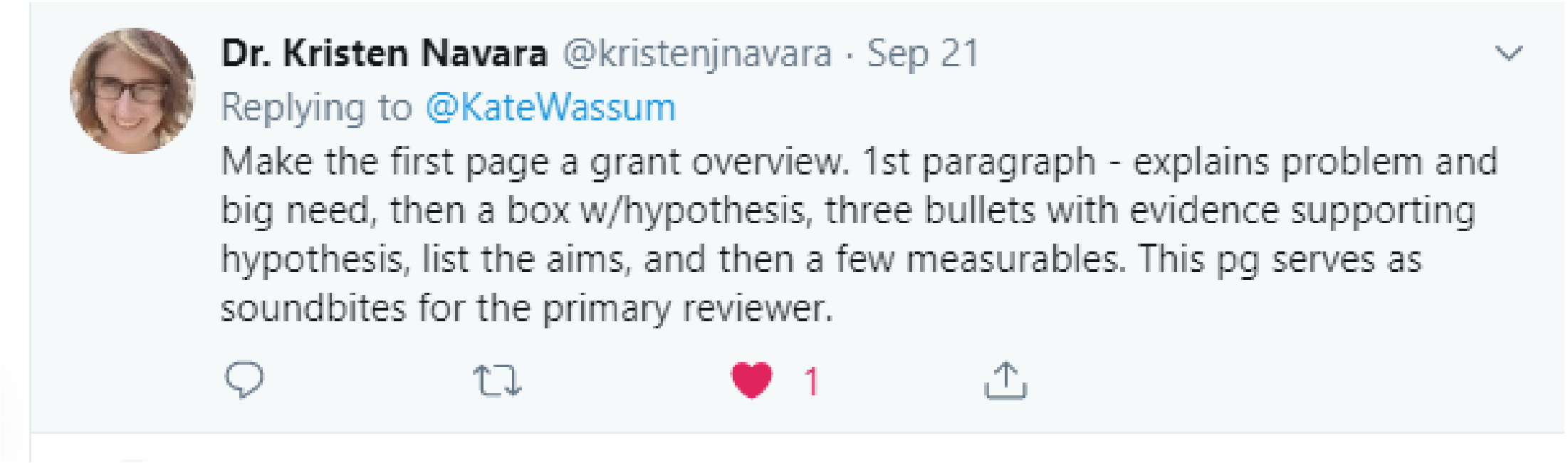
The Fellowship Applicant must describe concisely the Specific Aims, broad, long-term objectives and the goal of the proposed research to test a stated hypothesis.



The specific aims are **really important**!!!!

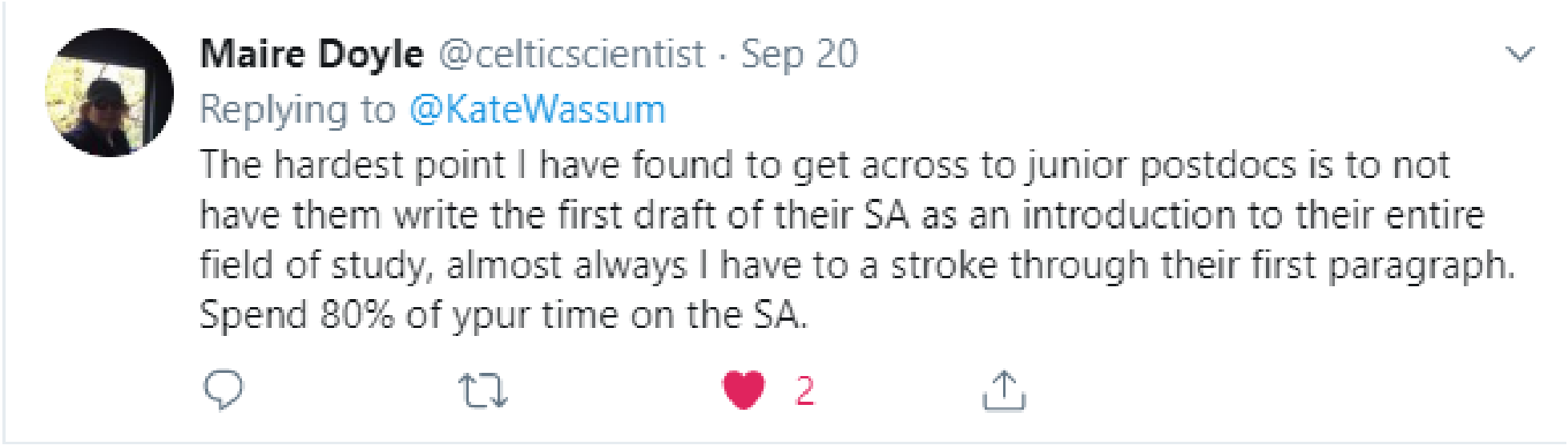
Spend time on them. Ruminate over them. Do them early. Get feedback on them, revise accordingly, THEN write the research strategy.

Specific Aims page



- Your reviewer will look back over your aims when they introduce your grant, have all the key points/criterion there available for them (use **bold** <u>underline</u> *italics*)
- Make sure italicized or underlined statements stand alone…i.e., one can understand them without reading everything around them.

Specific Aims page



- Get to the point, provide only enough background for the reader to understand your broad goal, question/gap in knowledge, hypothesis, and aims.
- No need for citations in the aims, you make claims here that you will support in the main research strategy with citations (I think T. Kash said this)

Specific Aims page

Dr Mike Nitabach
@mnitabach

Well-written grant specific aims should be fully understandable by a senior undergrad major in yr discipline w/o having to look anything up.

12:37 PM · Nov 18, 2019 · Talon (Plus)

37 Retweets **190** Likes

Dr Mike Nitabach @mnitabach · 21h
Replying to @mnitabach
I'm pretty good at self-enforcing this now after years of practice, but in beginning I relied heavily on feedback from people outside my subfield.

2 12

David L. Haggerty @dlhagger · 20h
Replying to @mnitabach
How is anyone supposed to fund anything remotely interdisciplinary using this rule of thumb?

1

M. S. AtKisson @iGrrrl · 20h
IMO/E, this approach serves best for interdisciplinary work. Reviewers will come from many backgrounds, too. They all need to understand. Dump all the jargon: Why is this important? What will you do?

1 1 4

Specific Aims page

The specific aims are critical.

This is often where you will capture or lose your reviewer.

Good specific aims will make a good grant easy to write.

If a grant is not coming together, the problem is very likely within the aims.

Should clearly communicate the:

- scientific problem of importance/urgency (**the "hook"**)
- what is known
- the gap in knowledge/critical need for investigation
- the general and specific goals of the project (as an overview), including training goals

Specific Aims page

- The Specific Aims page is arguably the most important of the application.
- The Specific Aims constitute the template or master plan for the rest of your Research Plan.
- The Specific Aims section should include everything about your application that is important and exciting – without the detail.
- The Specific Aims will be used by the SRO to recruit reviewers for your application.
- Most members of the study section will only read the Specific Aims (and Project Summary/Abstract) before they vote a score.
- The Specific Aims section should be written *to create a partnership with the assigned reviewers*: you provide the conceptual framework upon which they hang the details of what will be done.

Mark Opp, U Washington

Specific Aims Structure

¶1:

1. Something to introduce the broad topic of study—<u>an exciting "hook" to capture reader's attention</u>.
2. Slightly more specific information.
3. The problem, with the connotation of why this is an important problem (the "hook")
4. Thus, the *broad objective* of this proposal is to XXX.

¶2:

1. Something to introduce the more specific topic of study.
2. Slightly more specific information.
3. Limitations of prior research.
4. The gap in knowledge.
5. *Thus my general working hypothesis is XXX*.
6. I will combine ***xxx***, ***xxx***, *and* ***xxx*** to test this hypothesis (***xxx*** = ***techniques*** and ***methods***)

if your hypotheses has more than one aspect, then repeat #1-4 prior to #5, potentially in a separate paragraph.

Aims

1. **Clear, direct statement of the aim in a single sentence.**
2. Specific background information that leads to the specific hypothesis for this aim.
3. I will use *XXX* and *XXX* (techniques/methods) to address the specific hypothesis that XXX.

Most training grants have 2-3 aims

Training Aim

With the proposed project I will acquire xxx skills, xxx conceptual understanding, and further develop my xxx skills and understanding, which will be crucial for launching me to the next phase of my career.

Specific Aims

- Clear cut steps to be used to test your hypothesis
- Related, but NOT interdependent
  - if Aim 1 does not work out, or the hypothesis is not supported, then you can't or wouldn't proceed with aim 2
  - The only case in which you *might* get away with interdependency is if the aim that others depend on has VERY strong preliminary data
- Each aim should have its own sub-hypothesis which leads to specific predictions for the outlined experiment(s)
- Need to have measurable endpoints
- Manageable scope of work (which requires a manageable, testable hypothesis)
- Avoid entirely descriptive aims, supplement with causal where possible
- It is usually a good idea to organize your experiments by objective

Specific Aims

- There must be complete concordance between the aims and your central hypothesis.
- The aims should be brief, informative, headlines that will attract the reviewer's attention.
- Each aim should convey why that part of the research is being done, not what will be done.
- Each aims should concisely describe the rationale, hypothesis, experiments and outcomes.

Specific Aims

- Use ACTIVE, DEFINITIVE words - Determine, Define, Ascertain, Reveal, Delineate, Expose

  - Delineate the XXX function of XXX in XXX process/behavior
  - Determine the role of XXX in XXX.
  - Determine the necessity of XXX for XXX
  - Reveal hyperactivity in XXX during XXX
  - Define the function of XXX in XXX

Be specific in your hypothesis– e.g., hyperactivity is more specific than dysfunction or abnormal activity

Specific Aims

- *Adriana Galvan*: “For each Specific Aim, list a Training Aim”

- Include training aims on the specific aims page, either for each specific aim, or as one clear bullet point e.g.↓

- **Training Aims:** I will further develop my skills in XXX and acquire new skills, including XXX, XXX, and XXX. I will also receive extensive training XXX and XXX concepts/theory. I will receive non-technical training in data presentation and dissemination, oral communication, and XXX type of neuroscience.


Research Strategy
(Your Aims are your Guide)

Research Strategy

- State the problem
- Why is it important?
- Describe the aspect of the problem you will solve
- Describe both generally and in some detail how you will solve it
- Describe why you will use this approach
- Demonstrate why you are the best person to solve this problem (and why you are in the best lab to solve this… i.e. prove it's feasible)
- Once successful, what will we know?
- And what will you learn….

Your Specific Aims are the road map for the entire proposal. Mirror the organization of the aims; repeat and emphasize the knowledge gaps, your hypotheses, and strategy.

Research Strategy

Limited to 6 pages.

Must include:

- **Significance** of the proposed studies, including the background leading to the present application
- **Approach** (including preliminary studies, if any) to provide experimental support of the proposed hypothesis.

The applicant must describe the background leading to the proposed research, the significance of the research, the research approach (design and methods) for achieving the Specific Aims, the rationale, and expected/alternative outcomes of the proposed studies. It is beneficial to include pertinent preliminary data obtained by the applicant in the current or prior laboratory.

Research Strategy - Main sections

- Significance
- Premise & Approach
  - General approach
    - Behavior/general approach
    - Subsections with specific background info for premise
  - Aim 1-x
    - Rationale
    - Procedures
    - Data and statistical analysis
    - Predictions and implications
    - Alternative strategies (both technical and conceptual)
- Other important (and *scorable*) considerations:
  - Estimation of group size (e.g., your power analysis)
  - Rigor & reproducibility
  - Sex as a biological variable (not required for training grants, but including it won't hurt and some reviewers look for this)

Research Strategy: Significance

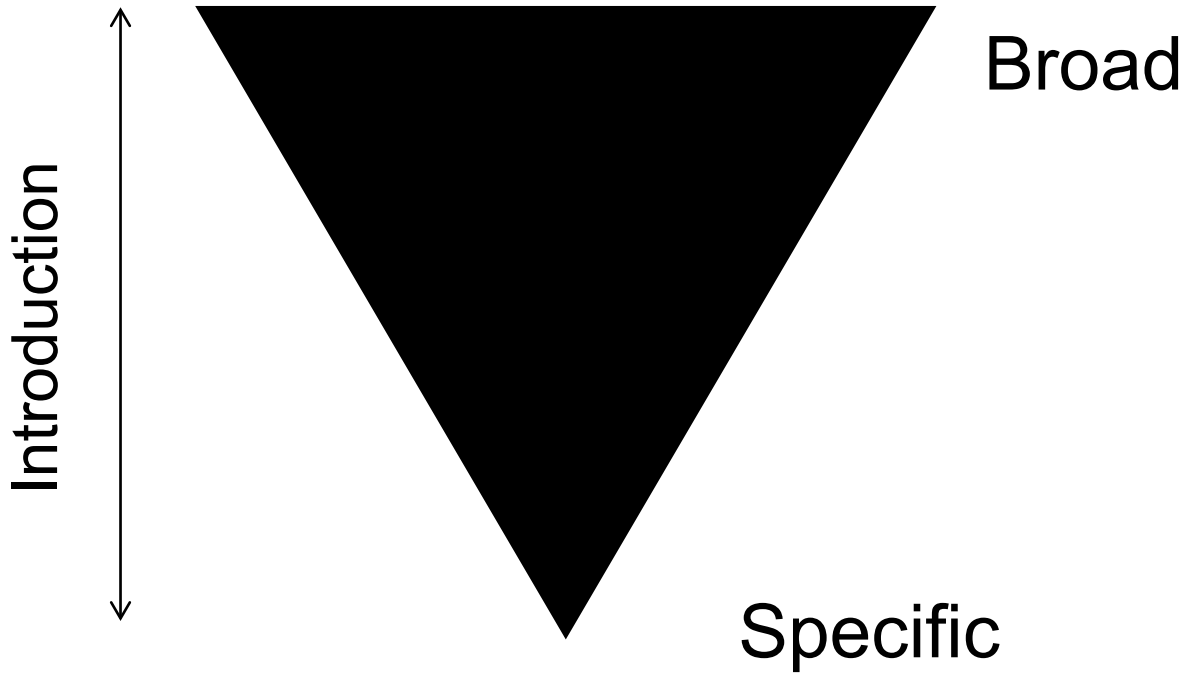
Research Strategy - Significance

Significance

- Broader context
- Explain what gap you will fill
- How will filling that gap enrich the field
- Describe impact on concepts/technologies that are central to the field

It is NOT a background section, there will be some broader context and background, but detailed rationale/background info should go in the general approach section.

Research Strategy - Significance



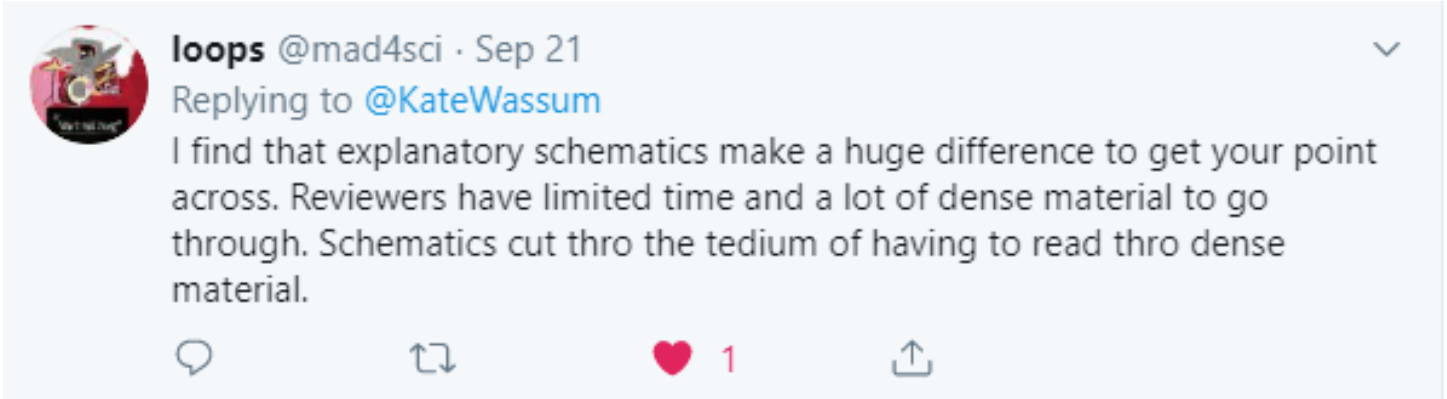
- Get to the main broad objective by the end of the first paragraph (usually I like the first paragraph to lead into this objective)
- Then get to your more specific objective(s) and hypothesis
- then it's ok to get slightly broad again… e.g., to use the inverted triangle to explain the significance of your proposed project, but then to broaden again when you describe the relevance for health/disease

Research Strategy – Significance

- **Emphasize *rigor of prior research*** (formerly scientific premise)—is your proposal based on a solid foundation?

- Provide evidence grounded in either preliminary data or previously published data from your lab or elsewhere that supports the premise for your proposed research.

- Include a **diagram** or **model** on the first page that well encapsulates your hypothesis and, potentially also, your approach to test it.



Research Strategy - Significance

- Suggest ~3/4 pages, definitely not more than 1 page (though there is not explicit requirement)
- Include references, but don't describe specific studies or preliminary data in detail; give the broad picture relevant for one to understand your question and the potential impact of answering this question. Again—emphasize rigor of prior research.
- Goal is to get the reader excited about your proposal, to show them the work will be impactful and important
- This is NOT an introduction/background section - that comes later
- For basic science NRSAs, address: "Implications for understanding and treating (insert institute goal here e.g., addiction, mental illness)"
    - But be honest if you're doing basic science, don't overclaim impact to disease. Be clear that you are not attempting to model or study a specific disease state, but then explain why the basic information you are collecting will be important for understanding that disease state and that ultimately understanding disease is your goal
        - E.g., this proposed research is not attempting to study the neural or psychological processes underlying addiction, though that is my future goal. The goal here is to provide a framework/biological architecture/groundwork for such studies by providing mechanistic insight into the XXX neural systems/substrates of XXX behavior known to be dysfunction in XXX disease.

Research Strategy - Significance Structure (mirror and reinforce aims!!)

¶1:

1. Something to introduce the broad topic of study – use an attention-grabbing, exciting "**hook**"
2. Slightly more specific information.
3. The problem/gap in knowledge with the connotation of why this is an important problem
4. Thus, to achieve XXX knowledge/effect, the *broad objective* of this proposal is to XXX.

¶2:

1. Something to introduce the more specific topic of study.
2. Slightly more specific information.
3. Limitations of prior research. (could be #4)
4. The gap in knowledge. (could be #3)
5. Main objective of the proposal
6. Any more information info one needs to understand your hypothesis (not details)
7. *Thus my general working hypothesis is XXX*.
8. I will combine ***xxx***, ***xxx***, *and* ***xxx*** to test this hypothesis (***techniques*** and ***methods***)

¶3: Implications for understanding and treating institute goal (e.g., mental illness)

1. A statement about dysfunction of the behavior, process, system you are studying in one or more disease states, with citation
2. How what you are going to study will help understand and/or treat these disease states/what your hypothesis means for understanding the disease state.
3. Anything you are doing to increase translational relevance (e.g., using translationally relevant behaviors, studying circuitry known to be disrupted in specific disease states).
4. How your work may lead to new treatment options (but don't inflate)

Research strategy: Approach

Research Strategy – Approach

- Your goal here is to outline the ***relevant*** background information and explain your approach to test your hypothesis, in both a general way and with more specific information on the experiments
- Recommend including several subsections:
  - A general approach section, where you, in specific sub-headed sections,
    - outline the background information, gap in knowledge, limitations of prior work and rationalize your hypothesis
    - describe the approach you will take to solve this problem, and why this is a good approach
    - If you're using the same behavioral task throughout each aim, I suggest explaining it here
  - A section for each Aim, with
    - Rationale for each specific hypothesis and approach
    - Procedures
    - Predictions and alternative strategies
    - Preliminary data (if not in significance or general approach)

Research strategy: General Approach

Research Strategy - General Approach

- Recommend ~2-3 pg for this (depends on how much subsequent rationale/premise you put within each aim); some investigators abbreviate this section and include as 1-2 paragraphs in Aims subsections

- **DO** use subheadings to divide this section into the most relevant background parts
- **DO** cite primary research articles (rather than reviews)
  - **Don't describe findings in great detail unless necessary - tell the punchline**
- **DO** put your work in the context of prior literature
- **DO** provide multiple citations for core concepts/methods
- **DO** describe the limitations of prior research and how your proposed work will improve on the existing body of knowledge
- **DO** end each subsection with the approach you will take to address the limitation/gap you have revealed
- **DO** include preliminary data from you and your lab that is supportive of your hypotheses and the technically feasibility of your proposed project (if prelim data is supporting technical feasibility only, or is a pilot, usually I would put this with in the aim itself, rather than the general approach section)
- **DO** cite your lab's prior work on the topic (it can be helpful to highly references from your sponsor(s) lab(s) in a different color
- **Do** use this section to describe and rationalize general strategy (i.e., behavioral task) that will be fundamental to each aim

Research Strategy - General Approach

- **Do NOT** assume the reviewer will know the background information. They probably won't, and if they do, they want to know that you know
- **Do NOT** assume the reviewer will *not* know the background info. They will not like if you mischaracterize a study or have inaccuracies
- **Do NOT** write review article. If too long, the reviewer will get bored, lost, wonder what the point is and get frustrated.
- **Do NOT** discuss any topics that you will not pursue experimentally. If you do, it will prompt the reviewer to think you will pursue these ideas, and they will be wondering why you aren't pursuing them.
- **Do NOT** overfit the prior literature to your hypothesis
  - This could result in mischaracterization of the prior work
  - This could cause your hypothesis to seem already known, obvious, and thus less impactful
- **Do NOT** inflate the lack of knowledge or significance of the topic this can cause a negative impression
- but **Do NOT** undersell the importance of your proposed research
  - How do you strike the balance? Basically be accurate and honest about the state of the literature and the gap in knowledge and the impact your study will have. Ask for feedback and specifically ask people if you are under or overselling

Research Strategy - Preliminary Data

- Preliminary data are CRITICAL

- Should be placed throughout your general approach section or embedded in Aims subsection (where most appropriate) (generally not a fan of a separate preliminary data section)

- Data from your sponsor(s) lab(s) AND data that you have collected
  - In legend, make clear which figures are your data and which are from your lab's data
  - One way you demonstrate your capability to perform the proposed experiments

- The further along you are in your position, the more prelim data will be expected of you. For example, a 4th year grad student will be expected to have more prelim data than an early 2nd year.

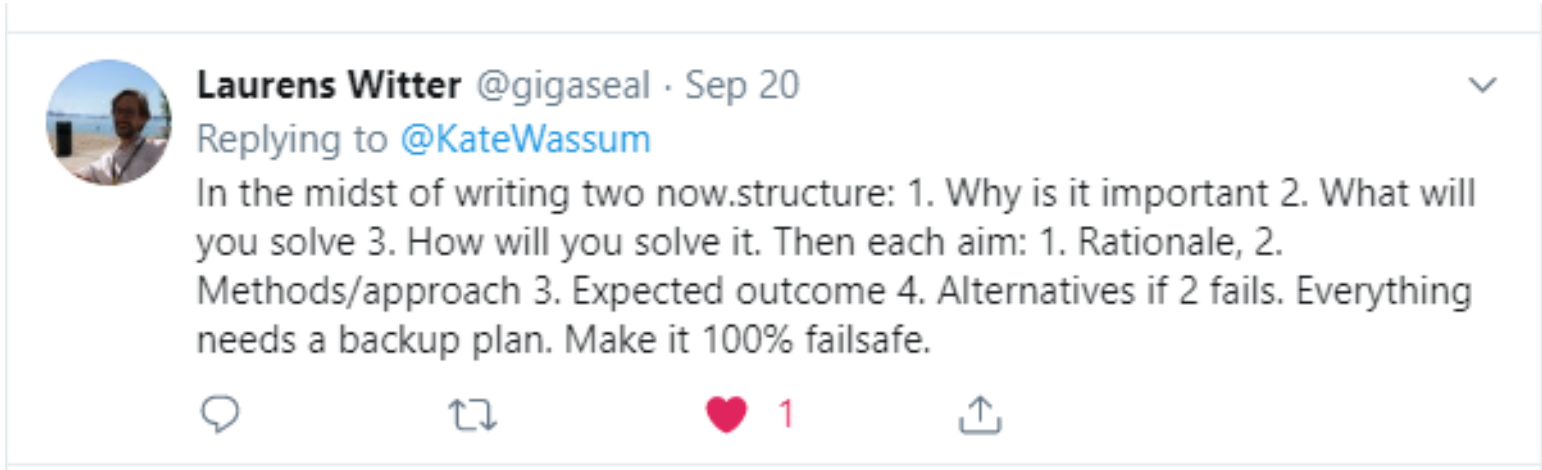
Research Strategy - Preliminary Data

- Include prelim data that support your hypothesis
- Include prelim data that support the feasibility of EVERY method
- When your data are published, you can cite them, though consider making a figure of published data if they are fundamental to the hypothesis
- Make sure your figures are clear and readable
  - Do not make them too small
  - Should look like figures you see in strong publications
  - Ideally report the *N* (and show individual data points) on a graph and statistics (unless your *N* is too small for this)
- Prelim data should show evidence of strong rigorous science
- Prelim data should be related to the proposed project
  - If you are including prelim data that is unrelated to the proposed project, but is needed to support technical feasibility, make this VERY clear

Research strategy:
Aims Subsections

Research Strategy – Aims Subsections

- The goal here is to explain your specific hypotheses for each aim and what you will do to test it, with details on your controls and procedures
- To explain why you selected this approach
  - And maybe why you didn't select other approaches
- And to detail what you think will happen and what you think this will mean
- And further to explain your alternative strategies
  - Possible findings other than those predicted, what this would mean, and what you would do to address it
  - Possible technical challenges and how you will address these



Research Strategy – Aims Subsections

- Break up your rationale & approach by aim
- Include your statistical analyses
- Include any methods validations
- Anticipated difficulties and workarounds
- Include diagrams/flowcharts

Research Strategy – Aims Subsections Structure

- Rationale
  - Any additional needed premise (that isn't in the general approach)
  - Specific hypothesis for each aim (a sub part of your overall hypothesis)
  - How will test this hypothesis we will use xxx because xxx to test xxx. We selected xxx bc xx
  - Include preliminary data referencing feasibility
  - Predictions
- Experiment procedures
  - Details of what you are going to do
  - Why you are doing each thing and what the controls are should be clear.
  - Include the N calculation e.g., [N=12/group (6 male, 6 female) x 2 viruses (hM4Di v. mCherry) x CNO points (training v. test) = 48 rats]; controls should be super clear
- Validations
- Data analysis, you will use. Be detailed.
- Predictions and interpretation. including specific statistical analyses
  - given our hypothesis we expect xxx and will interpret as xxx. This will be further bolstered by evidence of xxx.
- Alternative strategies
  - Possible findings other than those you predict, what they would mean, what you will do
  - Technical pitfalls, why you think they won't happen, and what you will do if they do
  - Possible limitations of the methods that might cause issues and what you will do to address them

Research Strategy – Aims Subsections

Kate Wassum 🧠👩‍🔬
@KateWassum

THIS is good grant writing advice.
You need to explain what you're going to do, but too many methods details will derail your message.

M. S. AtKisson @iGrrrl · Sep 18

An Approach (NIH) or Experimental Plan (NSF and others) is not a Methods section. I'm pretty sure you don't need to give the relative humidity and temperature of your cell culture incubator unless it differs from standard (it does not). 1/6

Show this thread

M. S. AtKisson @iGrrrl · Sep 18
Replying to @iGrrrl
If you dive into the methods without context, the reader can't know why they should care. Most often I see, "[Detailed methods.] This will allow us to learn X." Order of information is backwards. 2/6
1 6

M. S. AtKisson @iGrrrl · Sep 18
Start with why. My usual rubric is, "Because we need to know X, we plan to do Y, using approach Z. We expect to see A, which we think would mean B." Start with why. 3/6
1 6 30

M. S. AtKisson @iGrrrl · Sep 18
(My approach to discussing preliminary data is almost identical: Because we wanted to know X/had question X/ to test hypothesis X, we did Y. Exactly, we used approach Z. We found A, as shown in Figure 1, which we think means B (supports hypothesis/experiment is feasible).) 4/6
1 9

M. S. AtKisson @iGrrrl · Sep 18
The rubrics disappear when you use them to provide context and appropriate detail. The goal is to show your thought processes so clearly that the reviewer can follow them. First hurdle in grant writing? The reviewer understanding what you want to do and why. Why first, though 5/6
1 11

M. S. AtKisson @iGrrrl · Sep 18
And the caveat: NO rubric, framework, outline provides the magic beans of grant funding. They're simply tools to help you convey an interesting idea with a very feasible and exciting plan. 6/6
1 13

Research Strategy – Aims Subections

When describing your procedures, put citations for your or your sponsor's lab - make clear that your lab has done this before. Where your procedures are also demonstrated in your preliminary data reference that too.

e.g., I will do xxx and yyy as in my labs prior work (CITATIONS) and in my preliminary data (Fig. X).

Consider putting your sponsors' citations in a different color so it is clear to the reviewers what work is coming from your sponsor's lab - this can increase feasibility and make clear your sponsors can provide all necessary training.

Research Strategy – Aims Subsections

Explain the methodology **-** not just what will do, why will do
Explain why you selected your approach over other alternatives
Use diagrams!

Write **confidently** about approaches that work,

Do not use phrases such as 'In the event X does not work…'.

Show your confidence by strengthening the likelihood argument (Many researchers including myself/lab have already shown that…).

Although based on our labs experience/preliminary data we have confidence in XXX, if we find XXX problem we will XXX.

Explain the alternative outcomes to show that you have thought through the experiments, and make sure the expected and alternative outcomes produce a win-win situation.

Research Strategy – Aims Subsections

Expected outcomes & alternative approaches:

- If you have identified potential problems or weaknesses… address them.
- If you see a weakness, reviewers will likely see it too and it’s better to have addressed it and to say you have a plan than to not address it
- Offer alternative approaches to show reviewer you have thought about pitfalls.

Research Strategy: Other scorable criteria you need to include

Research Strategy - Sex as a Biological Variable

- You’re not obligated to address this in a training grant, but some reviewers will want to see it, so use both sexes and make that clear.
- State what you will do if you find sex differences add power, report them both, look for heterogeneity of variability
- If you’re proposing to study something with known sex differences, explain what these are and what findings you might have
- If you’re absolutely only going to use one sex, explain why

- If sex is part of your question you are obviously obligated to well address this

Research Strategy - Rigor and Reproducibility

- Explain the measures you are going to take to reduce the potential for bias in your data and ensure the reproducibility of the work
  - E.g., blinding, automated scoring, multiple raters for hand scoring, running in multiple cohorts, counterbalancing all factors, reporting and keeping factors consist (e.g., time of day), building in internal replication, validating all your tools

- Look at your PIs R01s for common text for this

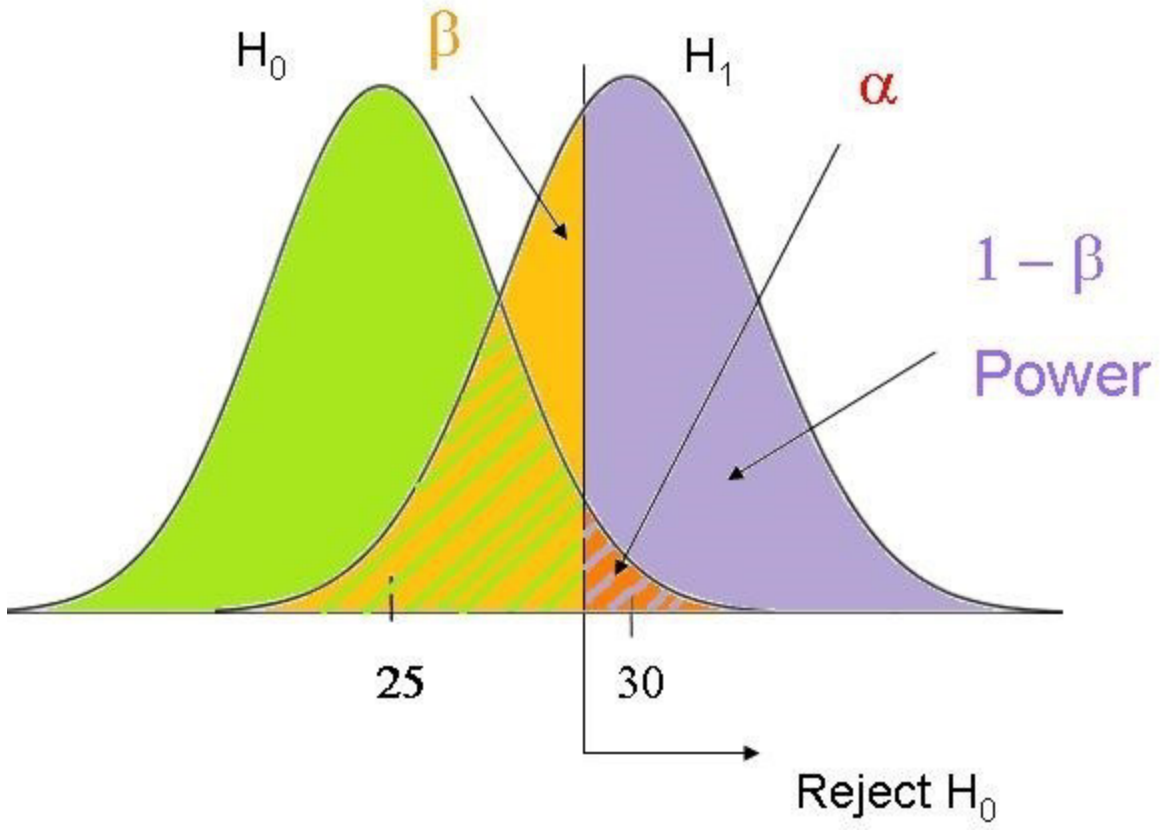
- Not a place to detail everything you're doing, but rather to remind the reviewers that you are mindful of all the controls, potential bias, validations, etc. that contribute to rigor.

- In total - sex, group size estimation (power analysis), and rigor & reproducibility should take up ~1/2 page

Research Strategy – Power Analysis

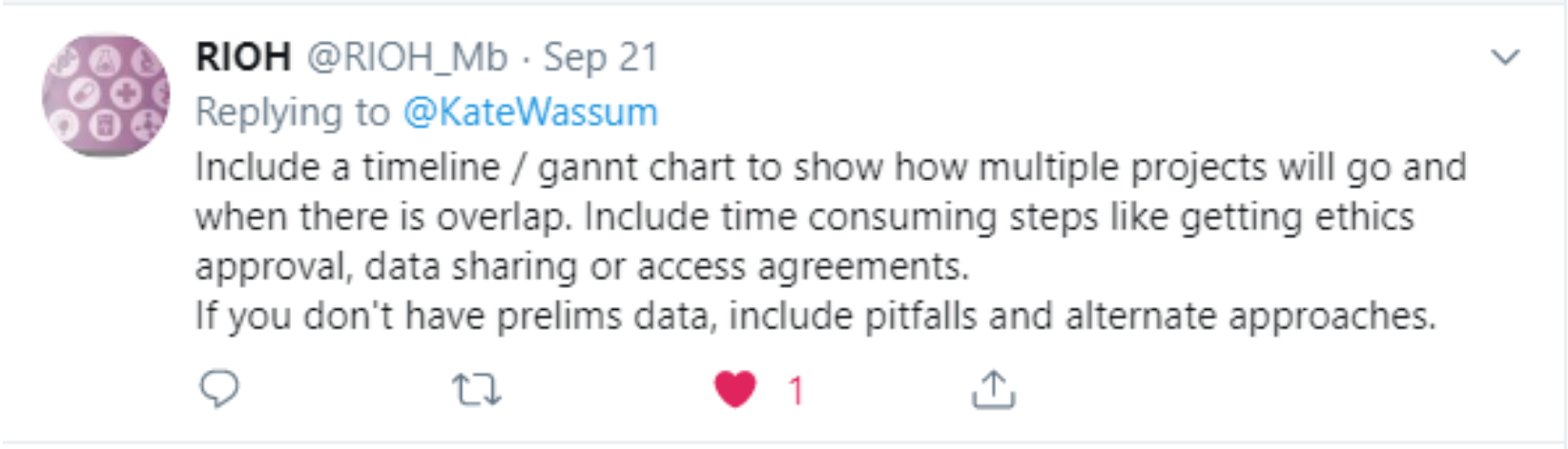
- You need to statistically justify how you determined the number of subjects in your experiments
- Run a power analysis, explain what data that was run on (e.g., prelim data, existing lab data with similar methods) and get the *N* you need for sufficient power and propose to use that *N*
- Also explain if you are including extra N because you are using both sexes or expect attrition

- Free tool: http://www.gpower.hhu.de



Research Strategy: Timeline

- Detail a plan for executing your experiments, troubleshooting, analyzing data and publishing your work
- Think about how long things will take you (in the course of a day and over months)
- Be realistic, even perhaps slightly pessimistic
- Should likely include an actual diagram timeline, with interim and final endpoints
- Leave grace periods
- Be details and thoughtful about this. It is a crucial factor in feasibility (both the reviewers' assessment of feasibility and your ability to know what's actually feasible)



How long is all this going to take?

Timeline for preparing the grant

- Start talking about your research and training goals ASAP when you start in grad school
  - Build an Individual Development Plan (IDP) with your PI
- Regularly talk with your PI about plans for the NRSA and preliminary data you'll need
- Begin writing 3-6 months before the deadline

Timeline for preparing the grant

- Internal deadline is 1 week before submission date (varies by institution).

- Research administration needs a complete draft at this point, with every required document.
  - *TAMU is moving to a PI-based submission system (CAYUSE).*

- So your personal deadline is significantly earlier than the NIH deadline.

- Also – leave time for unexpected events– the PDF doesn't compile well, you get sick, your PI is out of town, etc.

Timeline for preparing the grant

	Task	Deadlir
1.	Prepare Specific Aims, Significance, Innovation.	
2.	Send material from point 1 to colleagues/program officer. Request Biosketches from members on grant.	
3.	Prepare cover page component, Project/performance site component, key personnel.	
4.	Prepare Facilities & other resources and Equipment.	
5.	Modify ideas according to input received.	
6.	Prepare Research Strategy-Approach Aim 1 (minus Justification & Feasibility).	
7.	Prepare Research Strategy-Approach Aim 2 (minus Justification and Feasibility). Ensure all is correct in colleagues' Biosketch(es).	
8.	Prepare Research Strategy-Approach Aim 3 (minus Justification and Feasibility). Prepare your Biosketch.	
9.	Develop Justification & Feasibility sub-sections (Review of Relevant Literature) for all Aims.	
10.	Develop Human/Verterbrate animals section (ask your advisor for templates).	
11.	Develop the Budget component. Develop the Bibliography/References Cited section.	
12.	Prepare Project Summary/Abstract, Project Narrative, Title, Cover letter. Obtain letters of Support.	
13.	Prepare Appendix. Prepare checklist	
14.	Assemble complete draft. Proof, correct.	
15.	Submit complete draft to colleagues (pre-review committee) and Internal school routing system.	
16.	Revise grant based on comments received.	
17.	Submit grant	

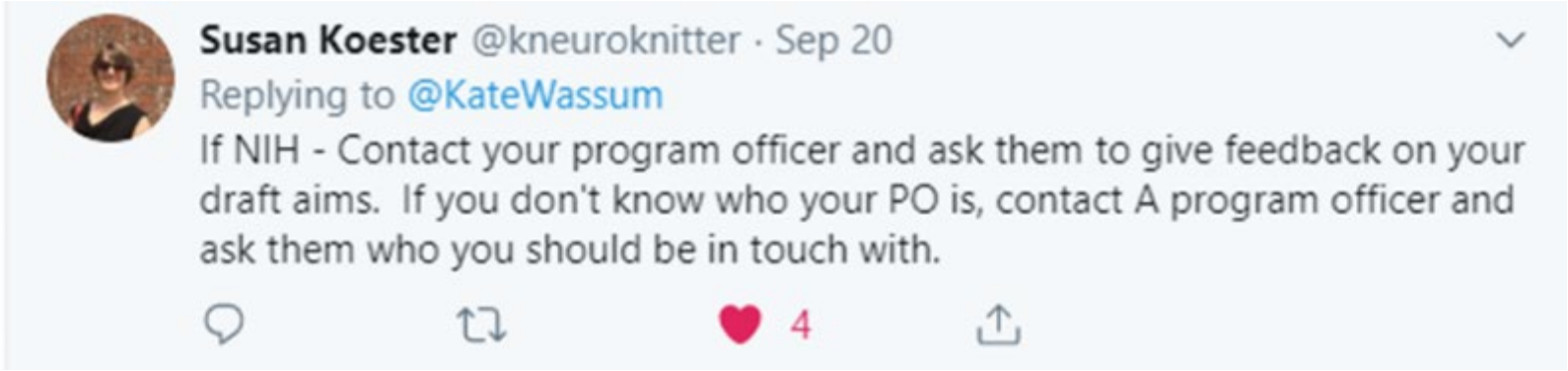
Reach out to your program officer (PO) with Specific Aims

Before you begin preparation of your proposal, reach out to a program officer!
They will tell you:

- whether your idea is appropriate for a particular funding mechanism
- whether the science falls in line with the program priorities of the institute
- they will also give you feedback on drafts of aims

You can ask them questions, e.g., about how to deal with your PI not having an R01, or whether your aims are overambitious

Send them a well POLISHED specific aims page at least 1 month before the deadline… ideally 2+
They might not respond right away, follow-up in a week. You'll likely schedule a call with them to discuss. Listen to your PO!



Timeline for writing the grant: Strategies for writing efficiently

- Recognize what time of day you write/think best and protect those times for writing

- Try to arrange your schedule so that you have large (3+ hrs) blocks for writing

- But also learn to write productively when you've got shorter blocks of time (bc let's be real, its hard to find big chunks of time when you're taking classes, teaching, doing expts, having a life, etc.)

- Things you can do if you have <1hr and/or are writing while doing something else:
  - Make a figure or add citations to a section
  - Write 1-2 paragraphs that you have previously outlined
  - Draft a letter of support or add some methods details
  - Hunt down specific references

- *The point is, do easy/quick things when you have short amounts of time, maximize your time to hasten the process*

Timeline for writing the grant: Strategies for writing efficiently

- Give yourself plenty of time to **THINK**! (Take a long walk, find a quiet place to sit, go for a run, do yoga—whatever works for YOU!).

- Before writing the significance and approach, read and re-read your aims over and over (and get feedback from PI and others).
  - Does your rationale make sense? Does your hook grab you? Is your hypothesis clear? Do the aims and experiments test the hypothesis? Are the aims independent yet collectively inform the hypothesis?

- If your aims are not airtight (and if the roadmap is not clear), then it will be challenging to write the research strategy.

Timeline for writing the grant: Strategies for writing efficiently

- Use strategies that work for you—but here are some thoughts:
- Use an outline (and follow your specific aims roadmap).
- Write first, edit later. Get your thoughts on paper, it doesn't have to be perfect, you can fix it later.
- Cite as you go or at least bookmark with a link or PMID. Don't spend lots of time hunting down a citation--it will slow you down.
- If you're stuck, use a place holder (e.g., xxx) to mark details to fill in later
- When writing methods sections, get it down first, then go back to fill in details

Timeline for writing the grant: Strategies for writing efficiently

- Before completing a writing session, take 5 min to jot down bullet points of where you were going next so you can more easily pick up the next time
- Set a timer (e.g., for 15 min) and write continuously until it goes off
- If you feel yourself going off on a tangent (e.g., looking up a paper) set a timer for a short amount of time (e.g., 5 min) and when it goes off decide if you need to continue down the tangent…this will reduce the chances of going down a rabbit hole

Grantsmithing, Grantspersonship,& Grant Writing Skillz

Grantsmithing, Grantspersonship, & Grant Writing Skillz

The writing of a successful grant, independent of the science. A proposal with poor grantsmithing is unlikely to be funded, no matter how good the science is.

Gets brought up a lot when discussing training grants written by novice grant writers

How to be good at grant writing

- Start ahead
- Think through
- Have a strong, vetted outline
- Get feedback; *Listen* to feedback (both what they are saying and not saying)
- Don't make excuses
- Revise your grant accordingly
- Leave time after drafting for it to sit so you can come back to it fresh
- Use strong grammar, style, and formatting
- Make sure your aims and significance pages are strong
- Avoid common pitfalls

Common Pitfalls

Common Pitfalls

Proposal lacks significance

- Address an important question:
  - More than just an incremental, descriptive, or procedural advance
  - Interesting to those beyond your niche
  - Provide mechanistic insight
- Highlight a clear AND important gap in knowledge
- Have a compelling rationale
- Don’t assume the reviewer will understand the significance
- Just because it hasn’t been done, doesn’t mean it should be!
- Shop your idea before writing it up… do others think it’s significant
- Write a strong specific aims and significance page
- Sell your idea
- Make relevance to disease clear
- Don’t overfit prior work to justify your hypothesis
- Get feedback on the writing of your significance/specific aims
- (But for training grants, don’t sacrifice feasibility for significance)

Common Pitfalls

Proposal lacks significance

David @Foreman1David · Sep 22

Replying to @KateWassum and @leafs_s

You're writing a sales pitch, so think about your idea as a product. Who is it for? Will they like it? Why? (aka what's the value it adds). Most importantly: will their representatives be reviewing it? & can I make sure they are? Often v tricky in translational research.

1

Dr. Alyssa Arentoft @AlyssaArentoft · Sep 21

Replying to @KateWassum

Commenting mostly to follow, but I do have a simple tip: be your own PR. Take a late version of your grant and imagine you're handing it off to a PR professional. Sit down with it. How can you best sell your story?

Common Pitfalls

Approach doesn't include a testable hypothesis

- Make sure your hypothesis is testable… and that you also actually test it with your proposed experiments
- Think it through… well ahead of time

Weak or absent preliminary data

- You need strong prelim data, there is no way around it
- Don't submit a grant without strong prelim data… which may mean waiting a cycle
- Make sure the prelim data fits the proposed research
- Consider what prelim data you *and your lab* have when thinking of your question, hypothesis, and approach
  - there are likely several questions/approaches you can propose, try to pick ones that you and/or your lab have prelim data for

Common Pitfalls

Overambitious aims

- Think about all the experiments you'll do, including all controls, validations, follow-ups, coursework, writing, etc.
- Make a timeline early and use this to know what's feasible
- Anticipate what you can do, then cut it by 1/3
- Keep the *N* manageable
- Ask your PI and others in your lab what is feasible
- Keep your hypothesis feasible to test
- Have your sponsor and LOR writers comment on your ability to tackle ambitious projects
- Have backup plans for everything
- Test one hypothesis, don't propose to do everything

Common Pitfalls

Overambitious aims

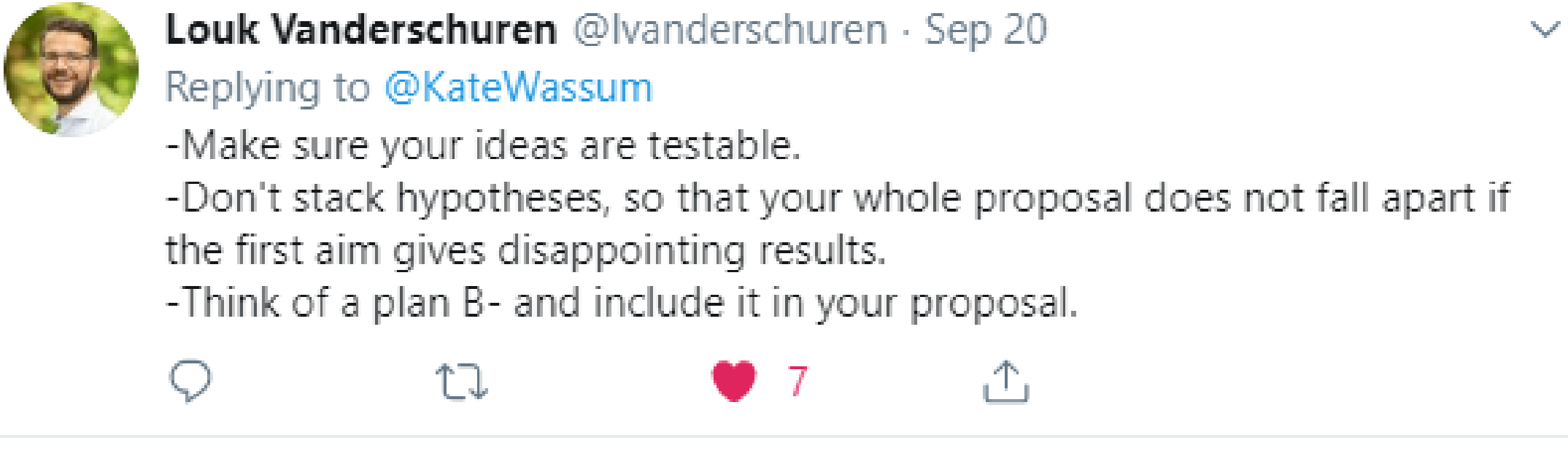
- Address potential pitfalls and propose alternative strategies.
- Propose experiments that fall within the timeline. Never 'over-propose'.
- Have somebody else review it before you submit.
- Include schematics/figures to explain concepts.
- Do not try to capture multiple thoughts in the same sentence.

Raj R Rao
Professor & Department Head,
Biomedical Engineering
University of Arkansas, USA

Common Pitfalls

Aims that hinge on the success of previous aims, i.e., inter-dependency

- Have aims that are related, but do not depend on one another
- If it seems like they might depend on one other, explain why they do not
- Have supportive preliminary data if there is any potential dependency



Common Pitfalls

Untested or overly complex methodology

- Use feasible methods
- Make sure that EVERY single method you propose has a sponsor who is expert in the method
  - These don't have to be at your institution
  - But make sure every sponsor is well integrated and if they aren't at your institution, that you have a plan for training with them
- Do not propose untested or presently unavailable methods. No matter how tempting, don't do it.
  - Keep in mind that you are not 100% beholden to what you write– if a new, better method comes up after you propose your project, you can use it.
- If you're proposing complicated methods have your sponsors and LOR writers give examples of how you've tackled similarly complex things in the past
- Have preliminary data for each method, ideally some that you collected
- Have a strong training plan with details of how you'll receive training in difficult methods

Common Pitfalls

No statistical justification for N

- Include a power analysis in the research strategy

Investigator/or mentor lacks experience or collaboration

- Make sure you have a mentor/sponsor for every single method you propose. All the needed expertise should be covered
- If your mentor has not yet placed someone in a faculty position, get a senior PI that has as a co-sponsor
- If your mentor is pre-tenure, regardless of the above, get a senior PI as a co-sponsor
  - I'm not saying that junior people don't mentor well, this is definitely not true, but some reviewers will say this… so just prevent this by having senior PIs
- Highlight how great your mentors are in your selection of sponsor part
- Have all your cosponsors well integrated in the training plan, e.g., regular meetings, how you will spend time in their lab etc.

Common Pitfalls

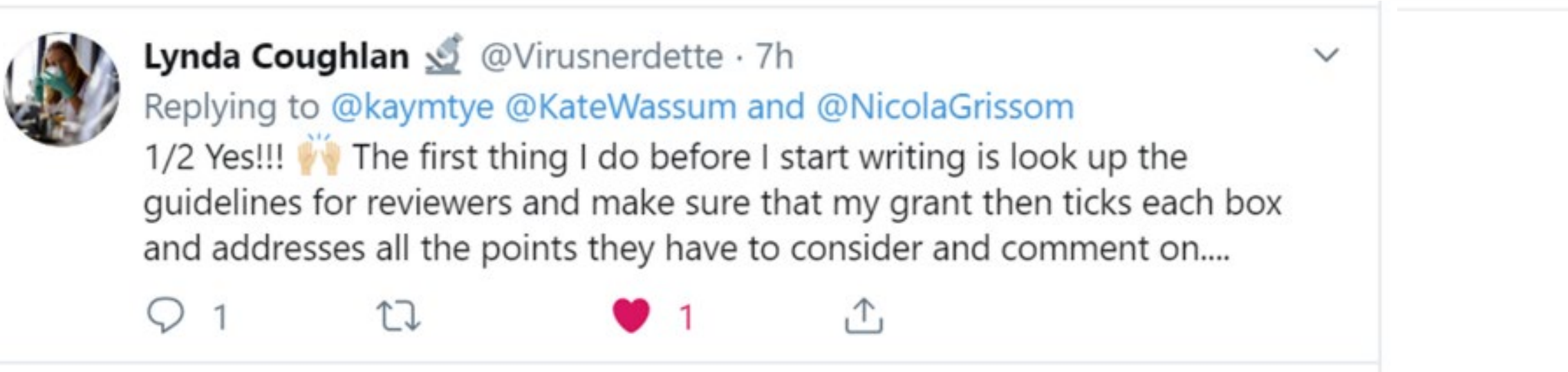
Mentor doesn't have funding

- Make sure your sponsor has funding that is 1) for the general question you research is on and 2) for the ENTIRE training period
- This should ideally be an R01
- If it isn't for the whole proposed training period, then need to describe plans of how they will fill the gap and highlight their track record of funding
- If they don't have funding, considering getting a co-mentor with such funding
- If they don't, talk to your PO about whether it would it would be advisable to put in an NRSA

Common Pitfalls

Didn't follow the guidelines

- Look up the most up-to-date- guidelines; follow the guidelines!
- Double check that you have followed the guidelines
- Use a recent, successful example



Common Pitfalls

Weak candidate

- Make sure you and everyone else highlights how awesome you are, don't undersell yourself

- Take ownership of your prior research. Say "I did …". Own it, love it, show it.

- Show your intellectual ownership of your prior work
- Do NOT undersell yourself (it has to be said again)

- If you've been in the lab for more than a year or so, you should include preliminary data you collected

- Good grad school grades go a long way to mitigate some crappy undergrad grades. Letters can also do a lot to mitigate potential concerns over grades by stating how smart you are--ask your letter writes to comment on this. Concerns over grades are unlikely to be score driving, make the rest of your application great and this can overcome some bad grades from your undergrad. Don't be discouraged to submit based on your prior grades.

Common Pitfalls

Weak candidate

- Have prior publications, abstracts, and presentations (yes even if you are a early grad student)
- If you don't have these ↑ have your LORs explain why
  - E.g., the candidate doesn't have any pubs because publication rate is slow is their research area, a publication is expected later this year
  - The candidate doesn't have abstracts because their PI was not able to financially support their meeting travel, but I can attest to the their strong intellectual involvement in their prior work by xxx examples
  - *Have your letter writers put you in the context of your environment*

- Use BioRxiv to post work that is about to be submitted, so you can put them on your biosketch, submit abstracts to upcoming conferences (in person or virtual)
- But this is just easy metrics for reviewers to write on their form, so don't be discouraged from applying if you don't have a pub yet.
- Strong prelim data can mitigate concerns about lack of prior publications

Common Pitfalls

Training will not get the candidate to the next stage– training potential, training plan, and the experiments themselves

- Have an individualized training plan (IDP), that includes details on
  - Technical training (listed and detailed for every technical component)
  - Intellectual training
  - Career development
    - Networking
    - Data dissemination
    - Opportunities for feedback
    - IDP and discussion of career opportunities, postdoc placement
  - Professional development
    - Mentoring of mentoring
    - Teaching mentoring (but don’t teach too much)
    - Conferences; data dissemination
    - Writing training
    - Training in grant writing, plans for subsequent grants (postdocs esp.)
    - For postdocs sponsor might mention what you can take with you
    - Training in peer review

Common Pitfalls

Training will not get the candidate to the next stage – training potential, training plan, and the experiments themselves

- Do not overschedule the training plan--reviewers look for feasibility and a realistic schedule
- Work collaboratively with your mentor on the training plan--reviewers take this piece very seriously
- Incorporate time for histology, data analysis, troubleshooting, writing etc.
- Include formal coursework, workshops, training in stuff you don't have experience in
- Sponsor statement should include a timetable of training milestones
- Your training plan should go 'above and beyond' the typical pre or post doc training

Common Pitfalls

Training will not get the candidate to the next stage – training potential, training plan, and the experiments themselves

- Make sure that you are learning new methods, skills, tools, concepts, techniques
- Have a training aim in your specific aims
- Describe what new you are learning and how this will get you to the next stage (make it easy for the reviewer to see this)
- Learn the latest techniques
- Explain how the methods you are learning might be flexible allowing you to apply to new things in the future
- If you're expanding on existing expertise, explain what is new

Common Pitfalls

Training will not get the candidate to the next stage – training potential, training plan, and the experiments themselves

- If you're experiments aren't significant or well designed, this can give the impression of poor training. Avoid this
- Have a strong mentoring plan that includes all cosponsors
- Be sure you have meetings proposed with your co sponsor at least monthly

- The lab size should seem 'just right'.
  - If it's a big lab, sponsor should note that more senior/independent trainees will work with you (in addition to PI).
  - If it's small they can highlight how they have one on one time to train and work with you individually.
- There needs to be a lot of face:to:face with the sponsor. Like a lot. 1x/week is not enough. And also need to describe what happens in these meetings.

Common Pitfalls

Training will not get the candidate to the next stage– training potential, training plan, and the experiments themselves

- You have to propose to learn new stuff (while at the same time showing you're capable of doing said things)
- This new stuff has to get you where you want to be in the future (and that should be a research position)
- Describe how what you are learning will allow you to ask more questions in the future. It can help to show that a technique you are learning will be 'flexible'… applicable to more than one problem
- Describe why you're learning these things and what you plan to do with them beyond your current position.
- Describe how what you're learning will compliment what you already know
- Don't assume the reader will get it. You need to walk them through it.
- If you already have experience with the method, describe what new stuff you will learn, new analysis, new circuit, new viral approach, new behavior, application in a new way etc.
- Training potential requires an on-point sponsor statement
- Less rigor and feasibility in the research plan will diminish training potential

Common Pitfalls

Ill-defined question/hypothesis

- See above and below strategies for achieving clarity in your question and hypothesis.
- Keep the aims feasible and focused, each with a clear specific hypothesis and prediction, related to the overarching hypothesis
- Make the future directions clear, if we learn this, what will be next
- Explain how you will interpret your data and design experiments that will produce data that with clear interpretations (avoiding confounds, and alterative possibilities)

Common Pitfalls

Proposal is unclear (due to jargon, style etc)

- See below tips on clarity and style
- Don’t use uncommon acronyms
- Avoid jargon and have someone outside your field read and say back to you what they understood and what they didn’t so you can find areas to improve language
- Self-edit, take time away, read in a different color/font, and/or aloud to help find areas that are unclear
- Use spell check and grammar checkers
- Keep one concept/sentence
- Have grammar checker in word highlight runon sentences

Common Pitfalls

Experiments do not address hypothesis

- Make sure your experiments address your hypothesis
- Don’t make your hypothesis have a causal implication then use a correlational analysis
  - Correlations can’t tell you about mediation, function, necessity, sufficiency, regulation
- Think through your hypothesis, if you had all the expertise and methods in the world, how would you test it, how close are your experiments to this
- Think through your predicts from your experiments, what can you really say about these, does this address your hypothesis?

Common Pitfalls

Methods are unclear

- Receive feedback early and often
- Don’t assume the reader is familiar with your proposed methods
- Explain why you are doing a specific method
- And why you selected this, perhaps why over other common approaches
- Use diagrams and flowcharts to explain your techniques and approach!!!
- Include data and statistical analysis

Common Pitfalls

Problems with experimental approach

- Inappropriate level of experimental detail
- Feasibility of each aim not shown
- Lack of appropriate controls
- Not directly testing hypothesis
- Correlative or descriptive data
- Experiments not directed towards mechanisms
- No discussion of alternative models or hypotheses
- No discussion of potential pitfalls
- No discussion of interpretation of data

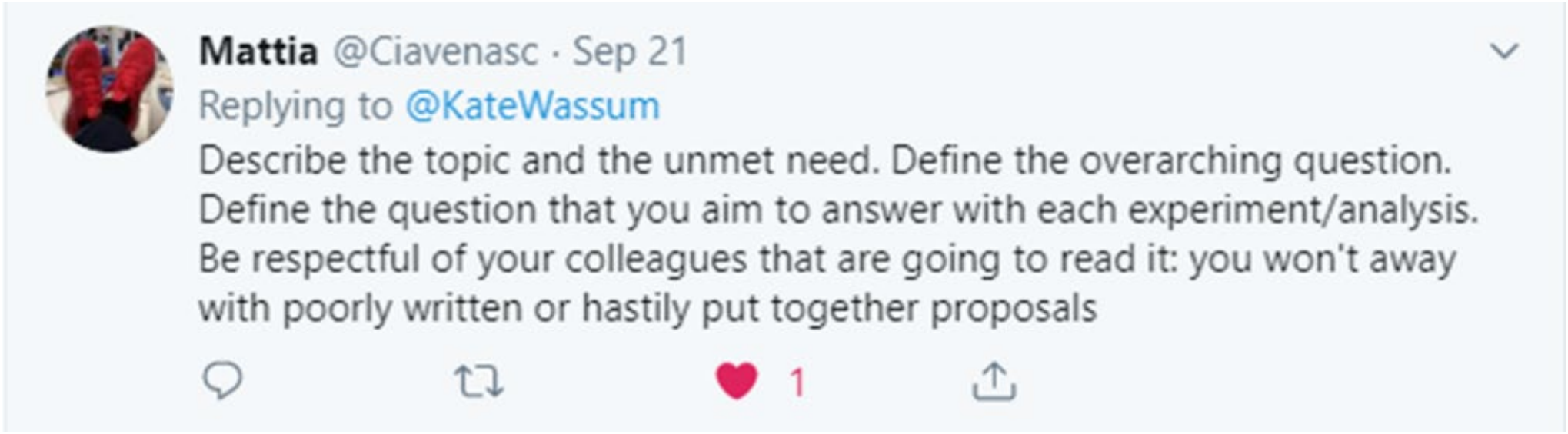
Common Pitfalls

Making the reviewer work for it

- Look at the review criterion, make it easy for the reviewer to lift their comments from your text
- Don’t assume the reviewer will be in your subfield, or will get why your proposal is interesting, or why you need to learn these new things. Assume nothing
- Don’t make the reviewer work for it. This means taking the time to ensure your through process is clear, logical, and flows.
- Your reviewer should be able to get your hypothesis and approach and see the strengths of your proposal from reading it for 10 min.

Common Pitfalls

Making the reviewer work for it



Common Pitfalls

The submission is unclear, written in haste or just poorly put together

No hypotheses or poorly articulated ones

Inadequate track record or expertise in this area

- Of the candidate: poor grades, lack of evidence for productivity (e.g., prior publications)
  - Write a strong statement about your experience
  - Have prelim data that you generated
  - Have your letter writers address any weaknesses (grades, lack of pubs)
- Of the sponsors
  - Get a co-sponsor for every single method and concept in your proposal
  - And make sure they are well integrated into the training plan
  - And that they read your grant (bc if you have errors in their area of expertise, it will be clear they aren't actually involved)

- Far too ambitious
  - Develop a realistic timeline, have a hypothesis that is realistic to test, cut experiments that aren't critical to test your hypothesis, talk with your mentor about what is feasible, keep the N in check (look at successful examples in your area)
  - Demonstrate you can handle difficult techniques with prelim data
  - Have your mentor comment on feasibility
  - Consider your time to graduate (eg don't propose a 4 year project in year 3)

Masud Husain

https://pn.bmj.com/content/15/6/474.full

Common Pitfalls

Great ideas but no preliminary data
you have to convince reviewers that your proposal will work. Feasibility is MAJOR topic of conversation for training grants.
-You need prelim data for everything

Incremental research, not a step change
-this is less of a thing for training grants, incremental can be ok, but it still needs to be significant and advance teh field, otherwise it might be deemed as not good trainng, or just leave the reviewers feeling blah about it. Tell others your idea– esp outside your field, and get their hot take. This does't have to be Pis, it can be your colleagues in grad school

Masud Husain

https://pn.bmj.com/content/15/6/474.full

Common Pitfalls

I read this as: write a grant that will get funded, don't write an esoteric grant, one that is overambitious, or too complicated, one without sufficient preliminary data. Write the grant that avoids all the common pitfalls, is clear, and has the best chances of being funded.

Hot tips

How to handle all the tips & advice

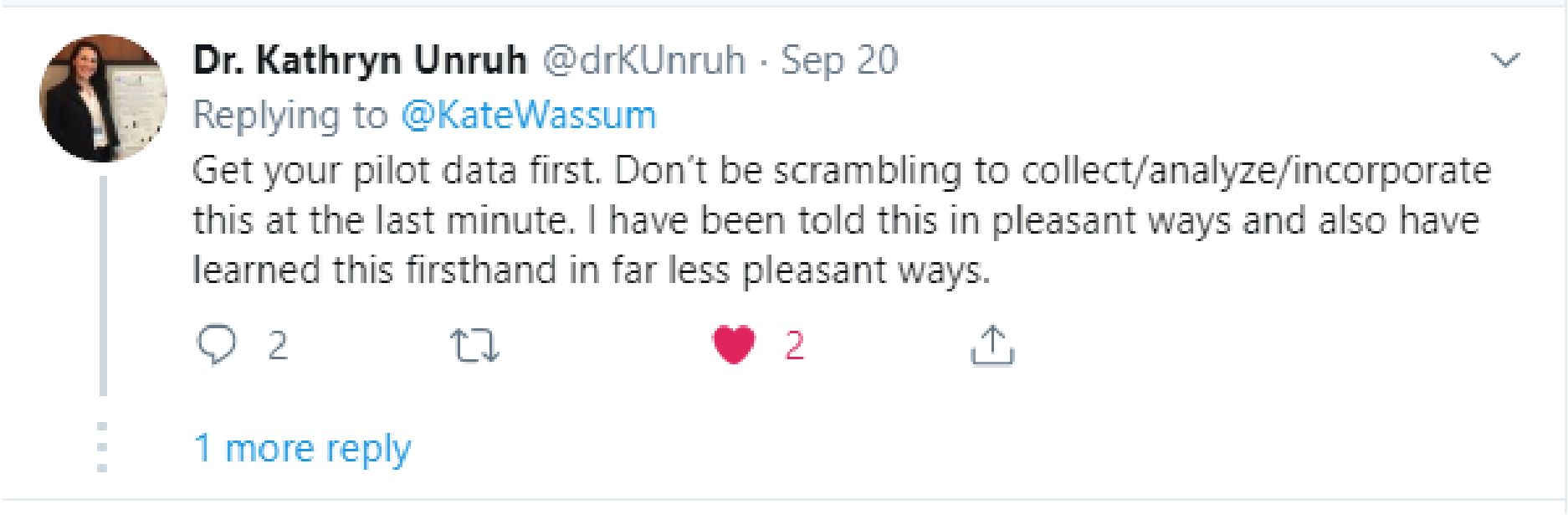
- Ask lots of people/read lots of blogs etc (see resources below).. Look for consistency in advice, think about what will work for you, triage things you don't agree with

- Know that there is not a single, correct way to write a strong grant.

- Moreover, no one person (including me) has all the answers

Hot tips
Timeline

Time your prelim data



But don't wait too long until it's perfect.. Talk to your sponsor about when it's go time

Plan your prelim data so you have backup projects, things that are likely to produce so you'll have some prelim data to support a proposal but the time you need to submit

Start early

- Start EARLY
- Formulate hypothesis/aims
- Assess preliminary data
- Collect budgetary quotations
- Request letters of support / reference
- Identify people who can read/help
- Look up administrative requirements

Start early

I start at least 9 months before the deadline and try to identify the specific question, and place it in context of what we know and current theory.

Over the next several months, in fits and bursts, I flesh out the specifics, and try to have 3 broad objectives, and several sub objectives. And then I spend a lot of time of figures, both illustrative and preliminary data.

Judith Mank

Professor & Chair in Evolutionary Genomics

Department of Zoology, University of British Columbia

Start early

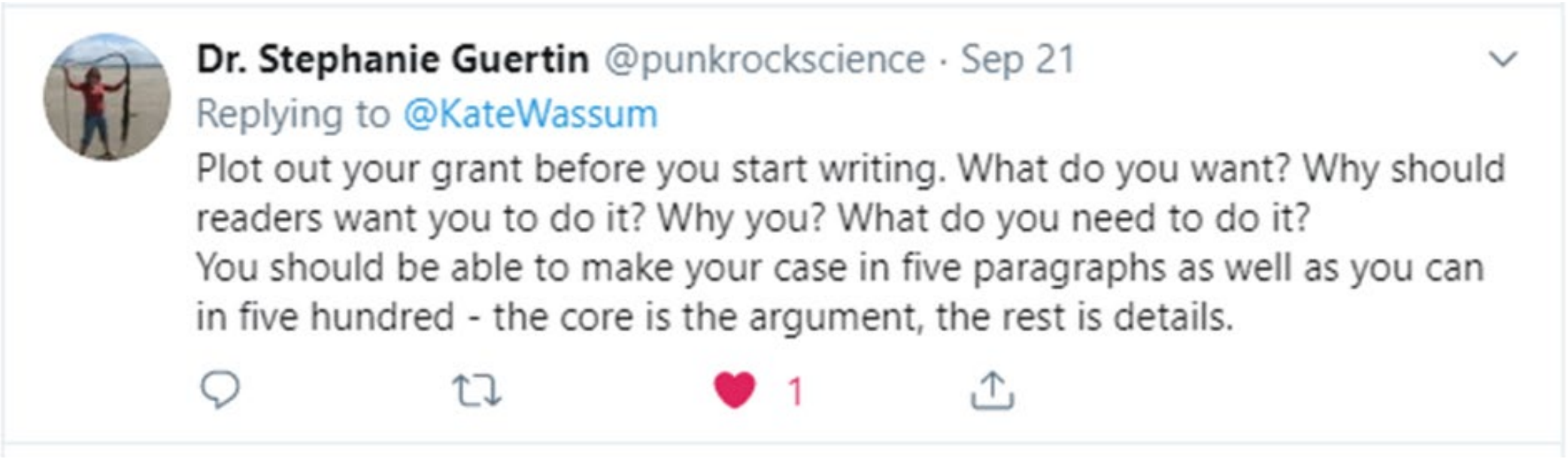
How to get started?

- Brainstorming
- Literature review
- Read a paper, ask what next?
- Q&A at Seminars

- Ideas whiteboard/list
- Develop logic and flow
- Seek inputs from colleagues
- Read the guidelines **thoroughly**
- Contact a program official
- Determine the possible review committee

Hot tips
Outlining

Write an outline for your grant



Write an outline for your grant

- What we know
- What we don't know (critical gap in knowledge)
- Question
- Hypothesis

- Significance
  - What we know
  - What we don't know
  - Why we need to know this
  - The major question and hypothesis

- Preliminary data
  - From lab
  - From you

- Aim 1: title
  - What we know (brief, you will flesh out later)
  - Hypothesis
  - Preliminary data (what you have, and what you still need to support your hypothesis and feasibility)
  - Expt 1.1: goal
    - Prediction
    - What you will do, with N, and controls
    - Validation
    - Potential alternative strategies
  - Expt 1.2 (ditto)

- Aim 2: ditto the above

Don’t cheat the space limitations

Hot tips
Figures

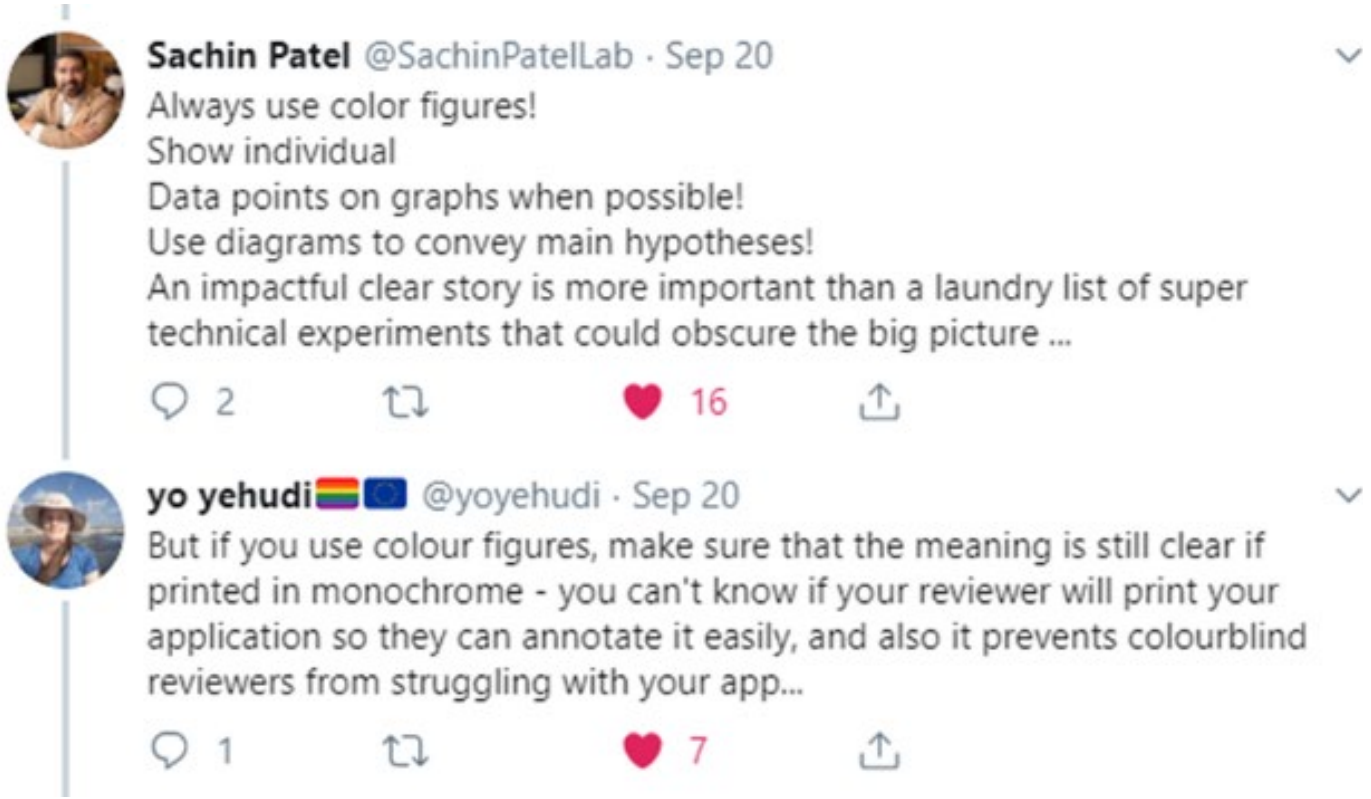
Make beautiful, clear, publication-quality figures

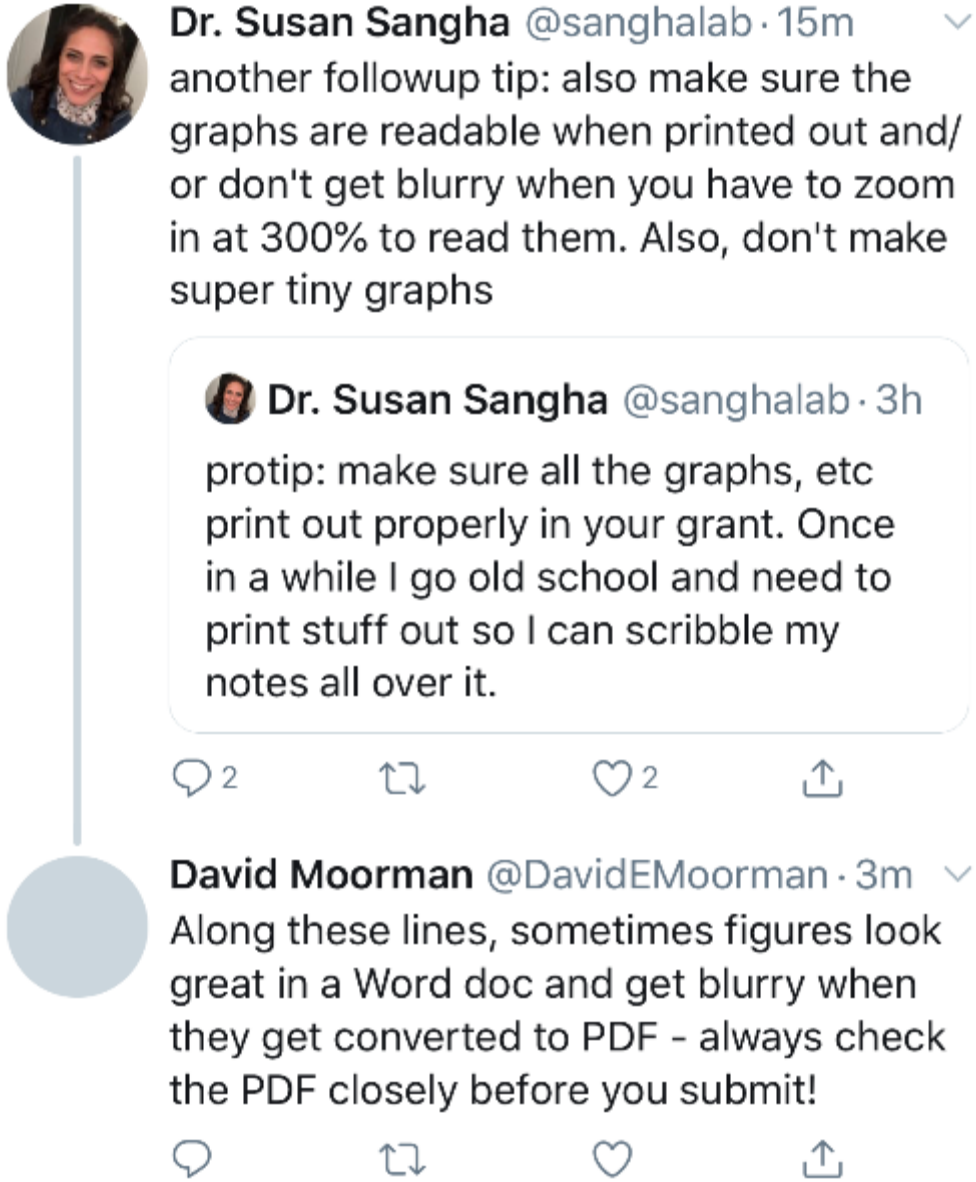
- Preliminary data is a vital aspect to a successful grant
- It needs to be made into clear, straightforward figures
- The figures should be publication quality
  - Look at figures in the top journals in your field and emulate these styles
- Where possible, include the individual data points and statistics
  - Unless it's a pilot with very low N

- Include all the relevant data… don't say "data not shown" unless it's not relevant, in which case why are you writing about it?

- Write a BRIEF clear legend (in a smaller font- arial 9pt)
  - Do not cram methods details in the figure legend
- Prepare the figure as if the reviewer won't read the legend
- Describe the figure in the text, as if they reviewer won't read the legend, or look at the figure

Hot tips: clarity in figures





Make beautiful, clear, publication-quality figures

- Make the figures big enough to see (imagine an 85 year old reviewing your figure)
- Be careful with the space in the figures (i.e., don’t have a huge bar in a bar graph)
- But don’t pack the data too densely
- Make sure the writing on the figures is big enough to read (again… 85 year old)

- Spend time on the figures… it’s often a good break from writing that will allow you some space from your text (see editing below)

Hot tips
Clarity

What not to do

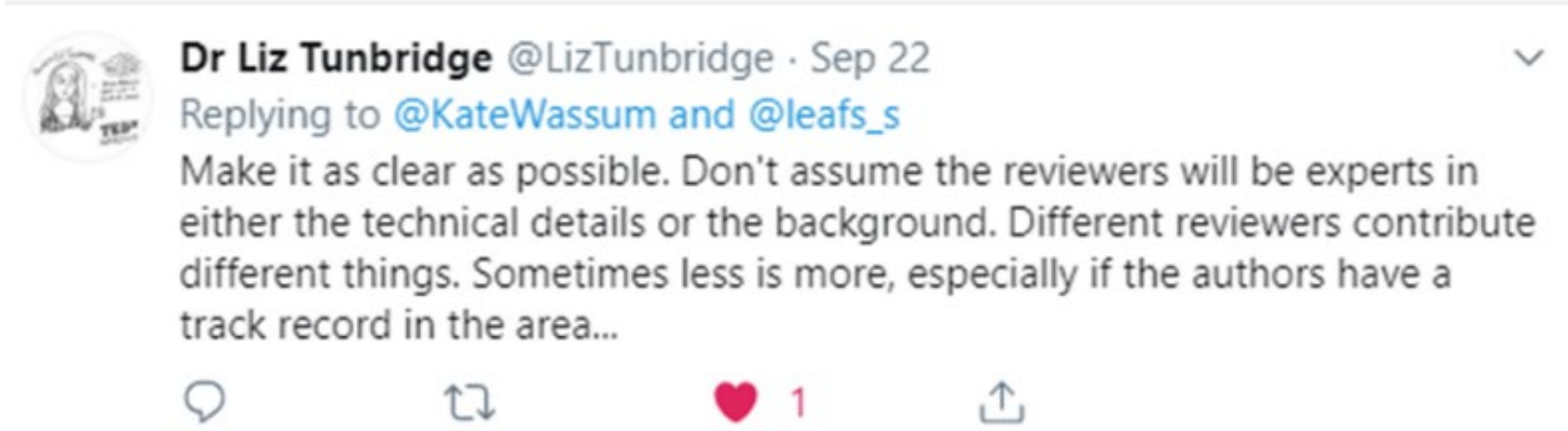
DON'T

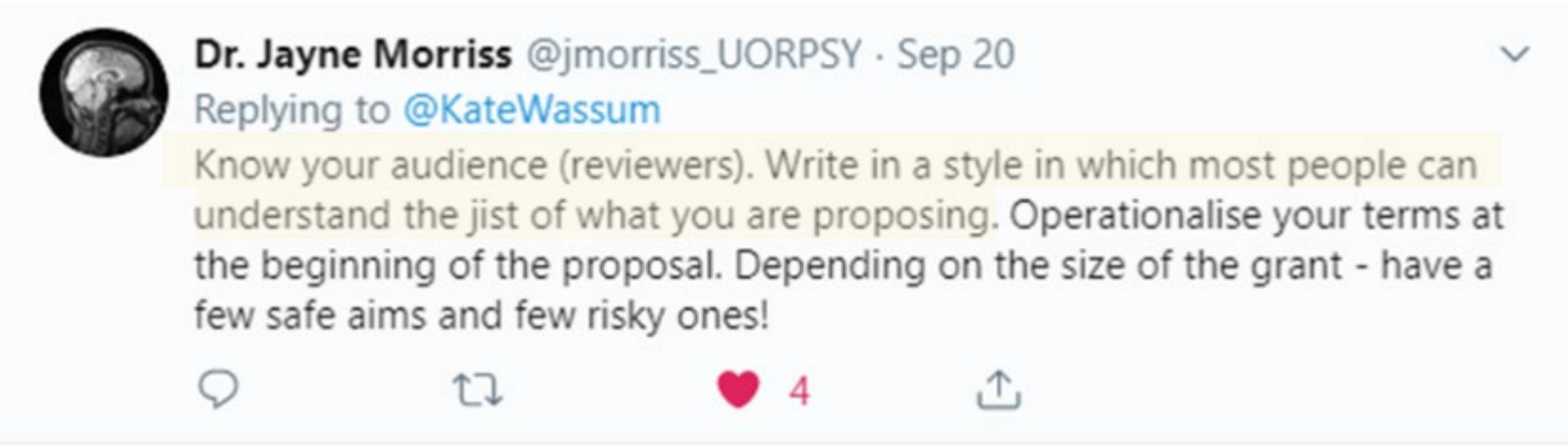
- Use vague statements or generalizations
- Over-promise
- Be sloppy
- Ignore what's already known
- Make the reviewer struggle to understand

Do not write as if your reader is in your field

Write your grant for reviewers who are unlikely to be in your immediate fields.
…for me to give a high score to the proposal, the first thing they need to do is to make the proposal understandable.

Chih-Horng Kuo
Principal Investigator
Institute of Plant and Microbial Biology
Academia Sinica, Taiwan

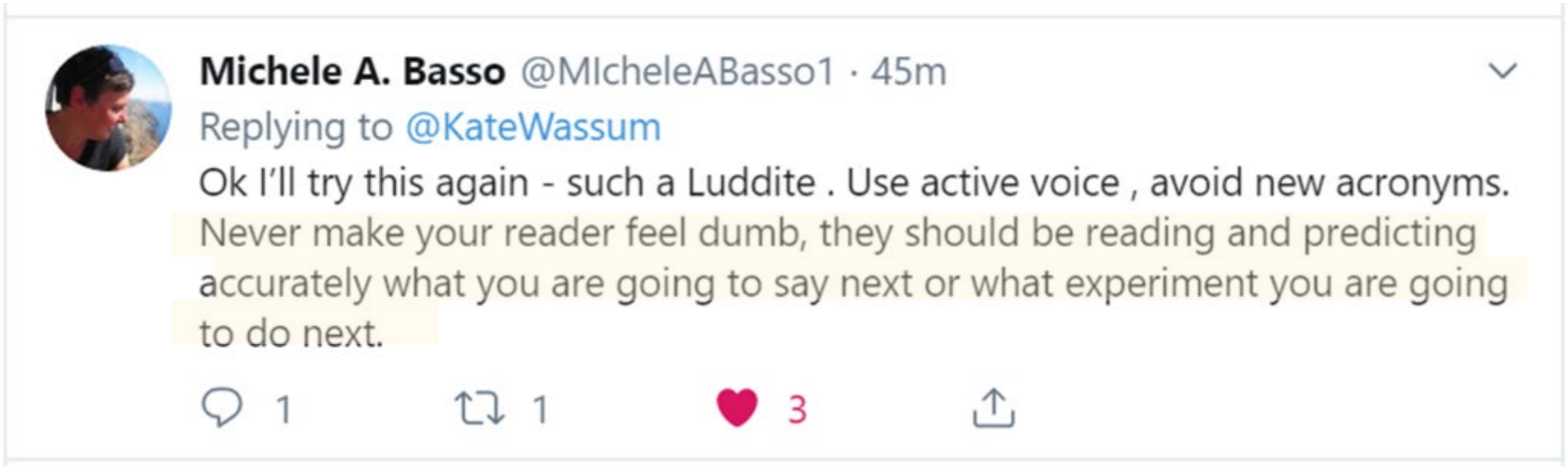




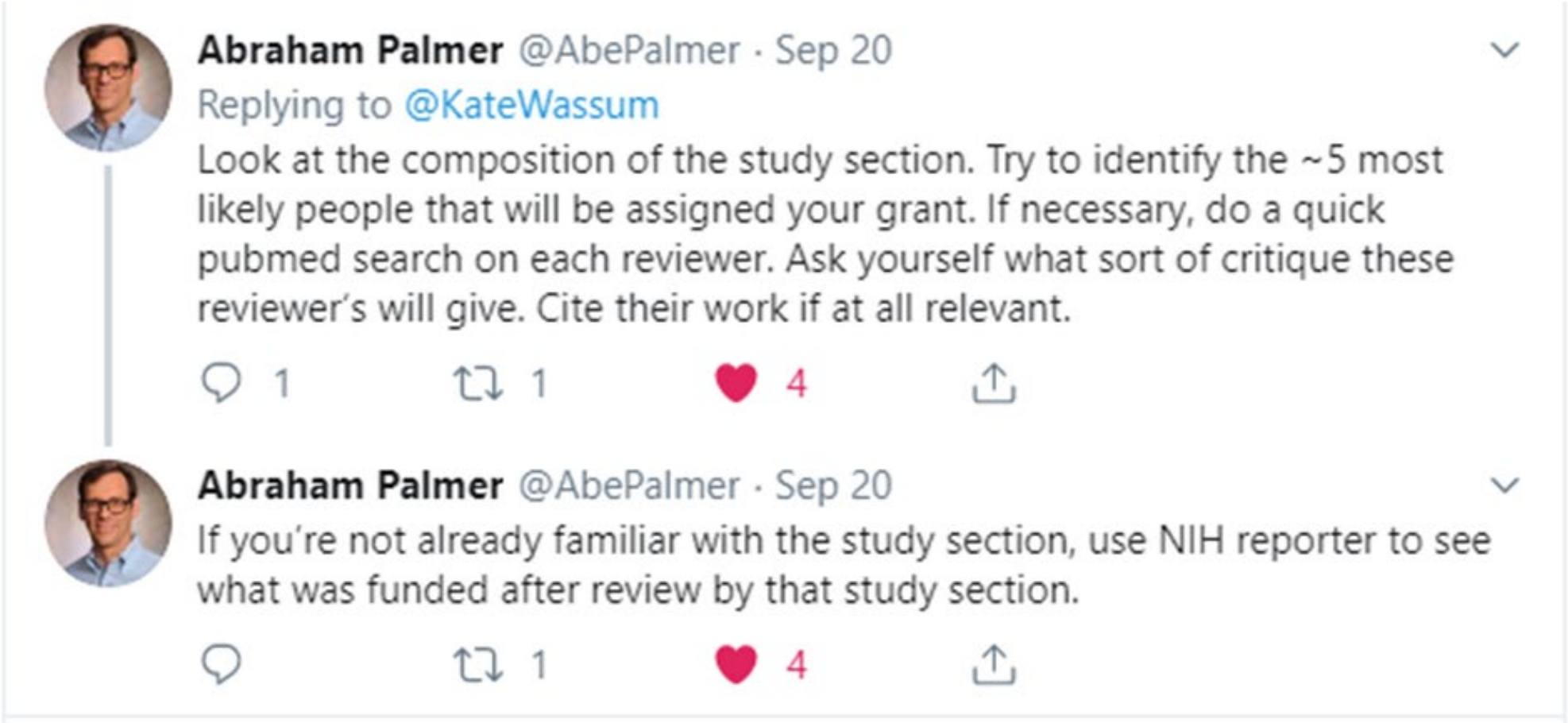
Do not write as if your reader is in your field

The reviewer is unlikely to attribute lack of clarity in understanding to themselves, rather this will reflect poorly on you. So make things clear for them.

Feedback from others is the best way to learn what is clear and what is not.

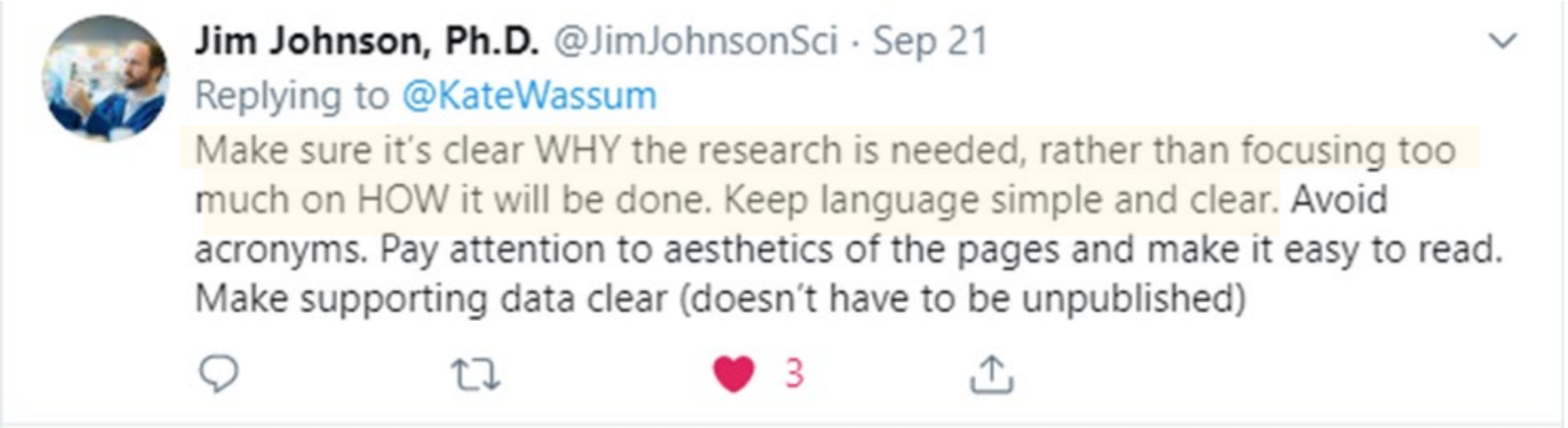


Know your reviewers



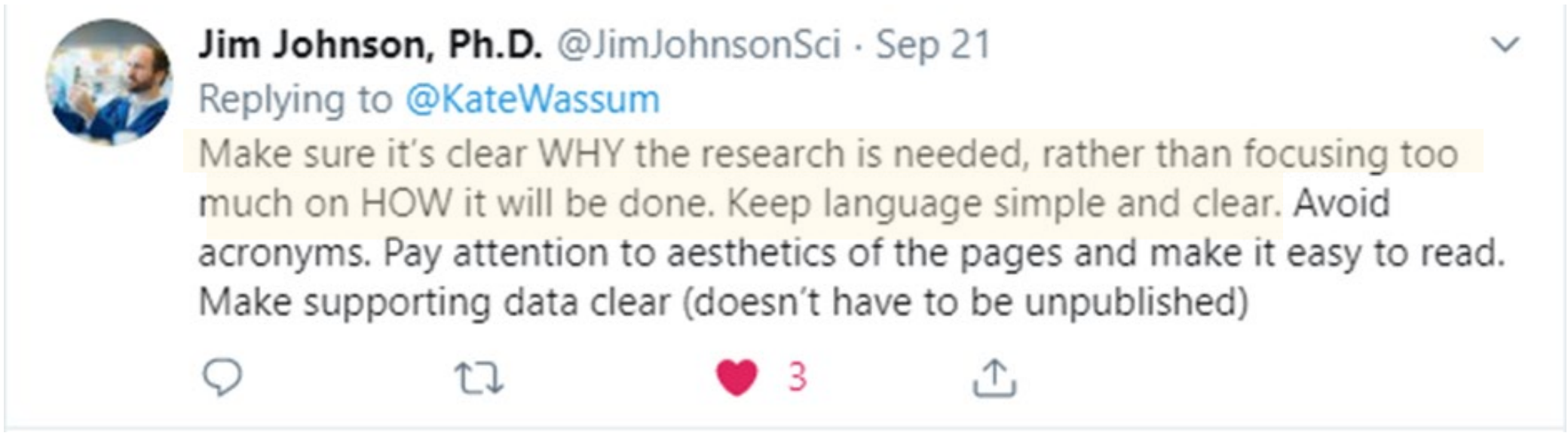
**But keep in might there is no guarantee that your proposal will go to these people, so ensure that it could be understood by anyone on the panel. It is often the case that the 3 people on the panel you think are most well suited to review your grant did not review it*

Make the WHAT & WHY clear



Introduce main concepts right away, then back them up
both on the paragraph level and on the whole grant level

Make the WHAT & WHY clear



Make the WHAT & WHY clear

Especially in the specific aims:

For example: "Mice will receive an intracranial injection of vehicle or bicuculline in the subiculum, and we will measure time to reach the hidden platform in a Morris water maze test". This tells us HOW you will do it, but not what you are doing or why you are doing it. It focuses on the process, not the product.

Instead:
We will test if activating the subiculum (with intra-subiculum injection of bicuculline) increases spatial memory in a Morris water maze task.
or: we will test the role of the subiculum on spatial memory. To this end, we will increase activity of the subiculum (with intra-subiculum bicuculline) and test ....

Micky Marinelli

You will need to describe your methods, but in the aims, procedures section, after you've already convinced the reviewer it's a good idea and approach

Make the WHAT & WHY clear

State the product before the process (WHY, WHAT, how)

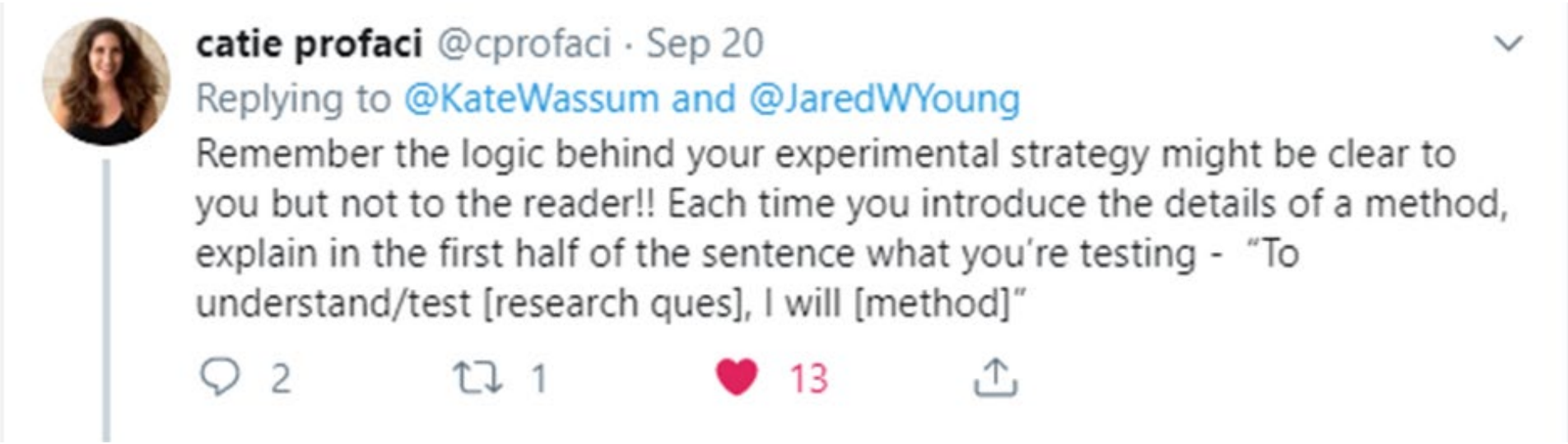
Less clear: We tested the effects muscimol on latency to find the hidden platform in the Morris Water Maze

More clear: We tested if activating GABAA receptors (with muscimol) improves working memory

Micky Marinelli

You can follow this logic when describing your methods

Make the WHAT & WHY clear



catie profaci @cprofaci · Sep 20

Replying to @KateWassum and @JaredWYoung

Remember the logic behind your experimental strategy might be clear to you but not to the reader!! Each time you introduce the details of a method, explain in the first half of the sentence what you're testing - "To understand/test [research ques], I will [method]"

2 1 13

Don’t omit sets of reasoning, connect concepts

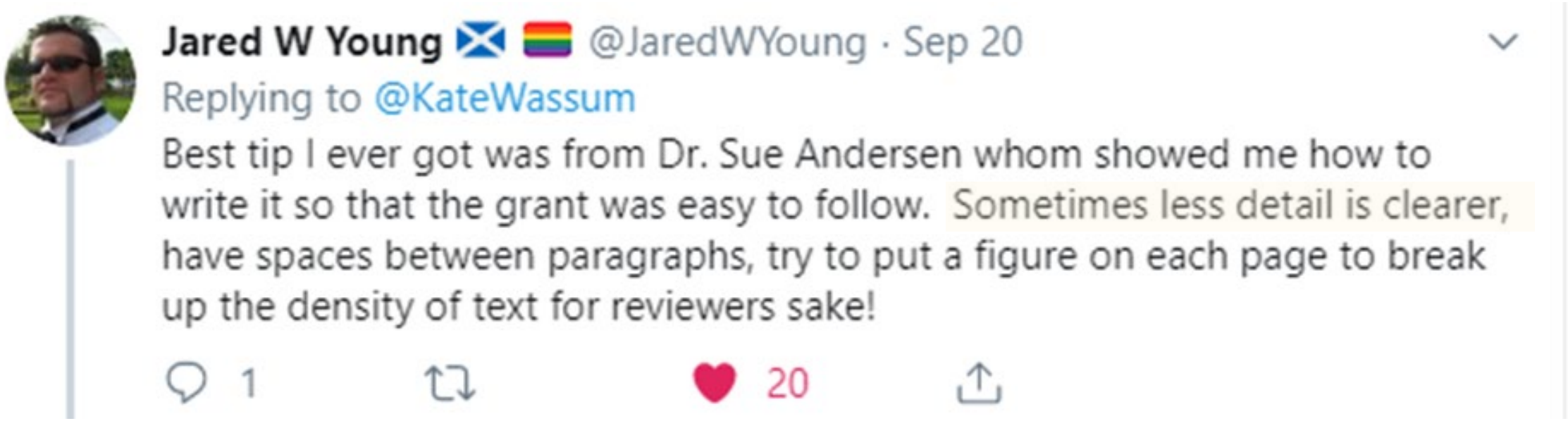
Nicotinic receptors were upregulated, so we hypothesized greater cell excitability

There is a stop missing here, how does nAChR upregulation relate to cell excitability? Your reader might not know

Cakes contain eggs. Eggs elevate cholesterol. Elevated cholesterol clogs arteries. Clogged arteries increase the risk of heart attack.

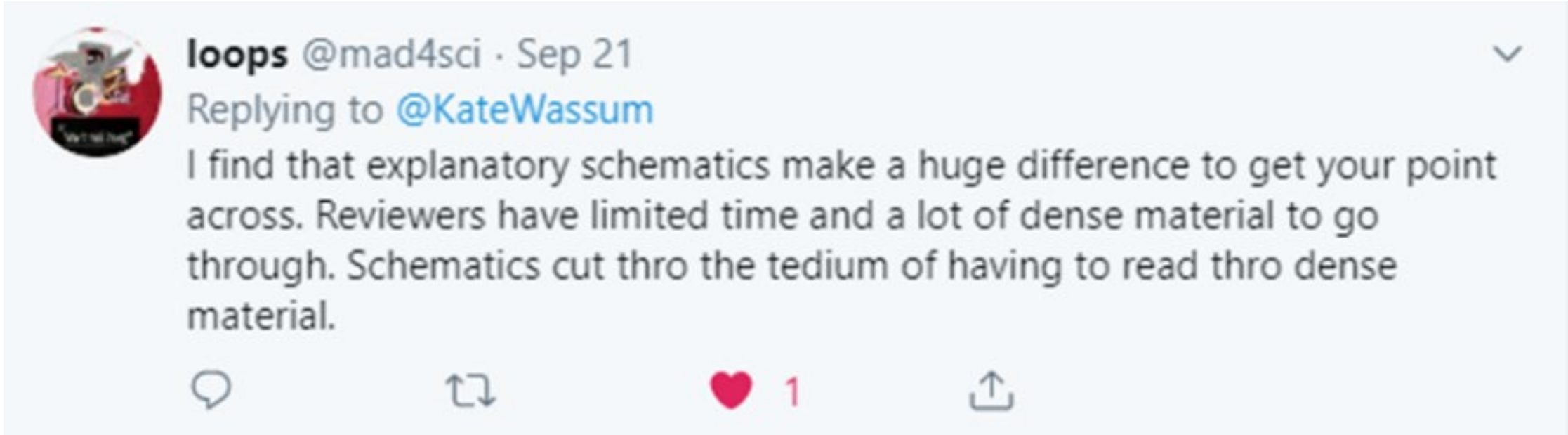
Provide information only if it is useful

- Information should help understand the point
- Information should not lead down the wrong path (no red herrings)
- Don’t let the reviewer think you’re going to do something else – they will get disappointed
- Everything should be targeted at your question, hypothesis, and approach, nothing else



Use diagrams and illustrations

- To explain your hypothesis
- Your approach
- A method



Be concise

Omit unnecessary words

- Less clear: High pH values have been observed to occur in areas that have been determined to have few pine trees
- More clear: High pH values occur in areas with few pine trees

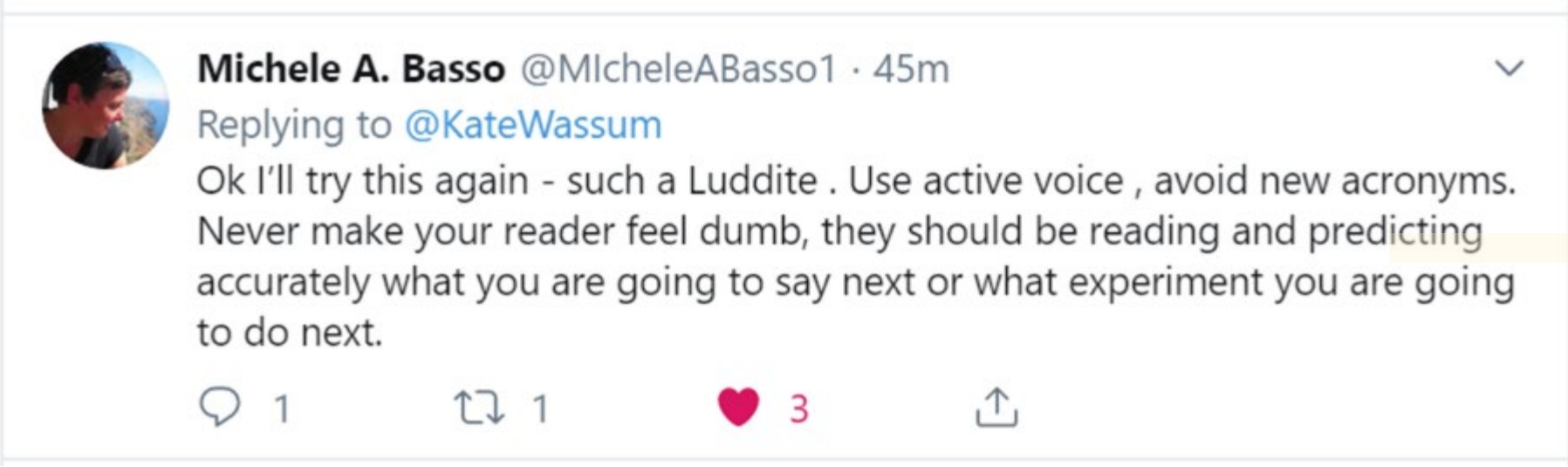
This is best achieved through the editing process… “if I had more time, I would have written you a shorter letter”- some famous writer

Provide a clear, concise story

Tell a great story! the scientific research enterprise can get quite nuanced and myopic. Putting the story you are trying to tell in a narrative context, embedded back into the greater picture to which the proposed work is trying to make a contribution will go a long way to delivering to the readers needs. (Aaron Blaisdell)

Avoid abbreviations, acronyms, and jargon

Only use VERY common accepted acronyms
Don't introduce new acronyms
Avoid abbreviations and technical terms (jargon)
Unclear: HI rats showed similar FR responding and elevated PR responding across SA training. However they did not exhibit incubation at late WDs.



Avoid abbreviations, acronyms, and jargon

Drug Monkey @drugmonkeyblog · Sep 25

Replying to @drugmonkeyblog

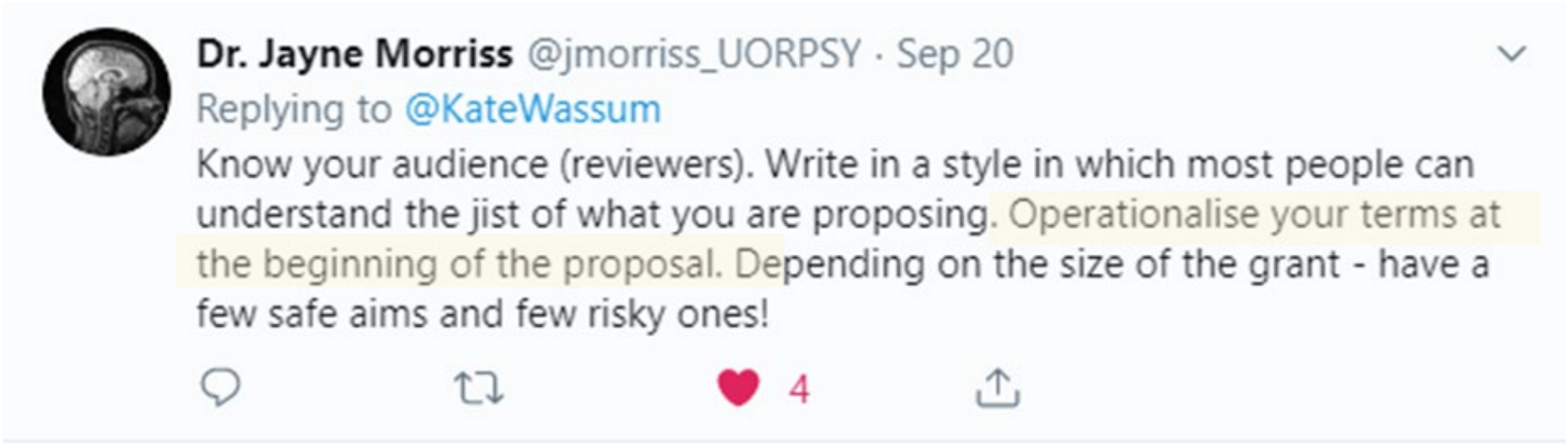
Acronym Abuse: At a minimum, make sure you redefine them once per section, perhaps even once per page.

2 2 25

Use consistent, defined terms

Define your terms (in **bold**) and use them consistently throughout
Don’t use synonyms for your key terms

If you do use common acronyms define them on first use, in bold, so they are easy for the reader to find



Use key phases that clue the reviewer in to important points

The overall objective of this study is…
My broad goal is
It is well known that…
But what is unknown…
The current gap in knowledge is
The limitations of this prior research are
These outcomes are expected to have important positive impact because…
Thus my hypothesis is
I will provide mechanistic insight by
My general approach

We examined… We show that… X is an important addition to…

These are signals to the reader

Some examples of lack of clarity

GR and MR were measured in the DG. No differences were found across groups. NACP was measured in the DG and SVZ. AD mice showed higher NACP than Con mice.
- Too many acronyms

The proposed state-of-the-art technique is expected to advance the field significantly.
- Too value, telling not showing, what is start of the art, what will the advance be

Cocaine can increase cellular pH. Neuronal pH is decreased by morphine.
- Concepts not connected.

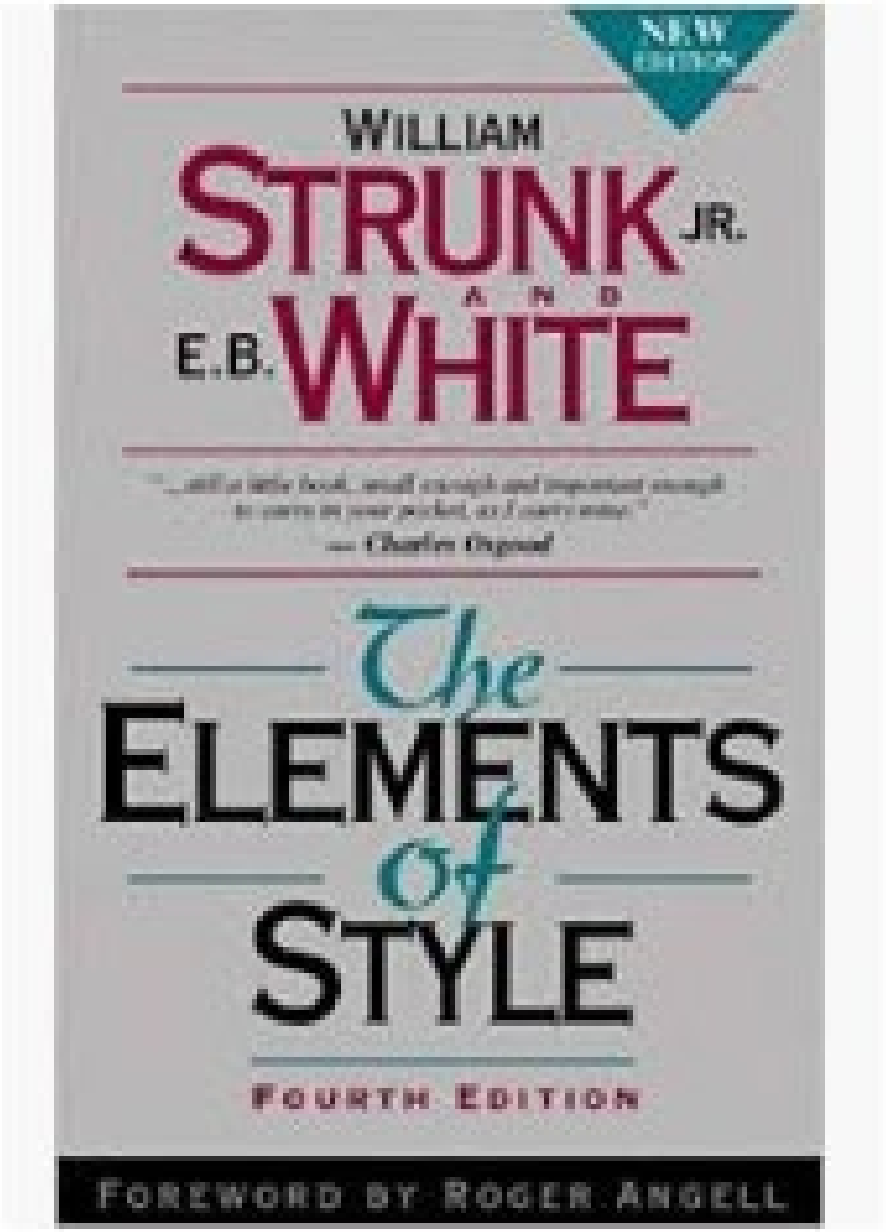
Cocaine alters cellular pH.
- How? Increase, decrease, pattern altered?

XYZ proteins were clustered in distal dendrites, suggesting that they could play an important role in synaptic integration. We also measured learning, using a T-maze. Suppression of ABC facilitated learning.
- Concepts not connected

Metyrapone treatment suppressed locomotor sensitization to cocaine. This suggests that stress could play an important role in cocaine addiction.
- Concepts not connected, missing a logic step.

Hot tips
Style

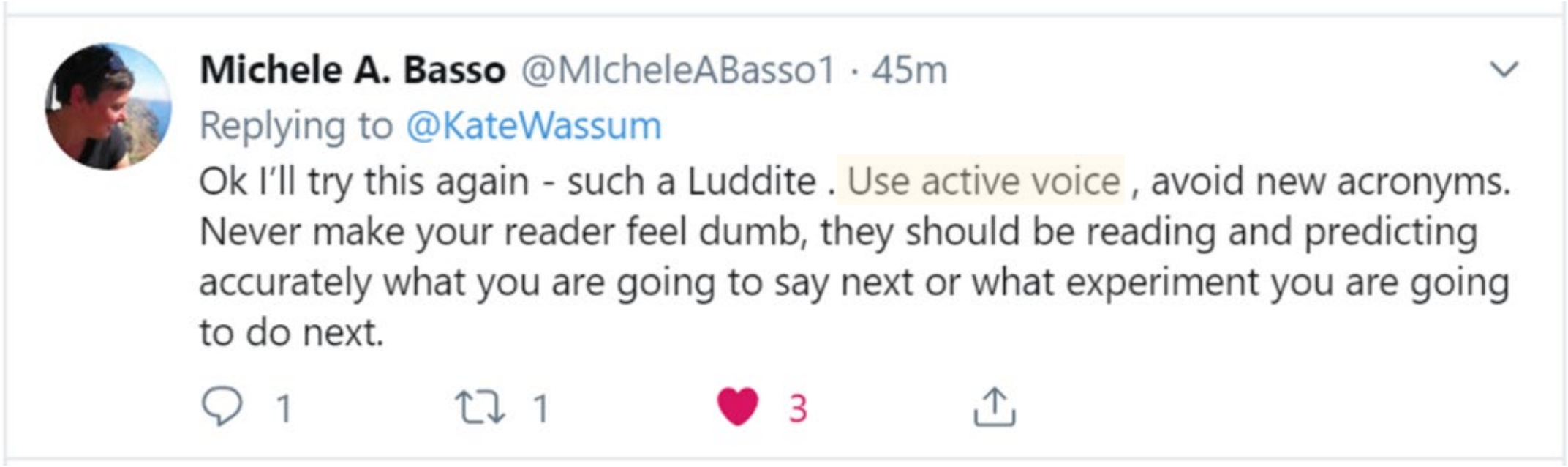
Achieving strong style… read Strunk & White, now, and ongoing



General tips

1. Avoid all jargon. Do not use any abbreviations unless strictly necessary
2. Avoid all unnecessary term(s) (to make text shorter and clearer)
3. Use short sentences and avoid clauses
4. Use consistent terminology
5. Use a consistent order of words
6. Use the active voice (declarative sentences)
7. Make sure that all descriptive words have a direction (avoid: modify, change, etc…)
8. Follow hierarchies/consistent hierarchical structure
9. State the “what” before the “how”
10. Only use ONE concept per paragraph
11. Do not skip steps of reasoning
12. Avoid red herrings
13. Avoid the use of nouns as verbs and avoid clustering terms
(e.g. “lower respiratory tract iron burden”)
14. Avoid “weak” qualifying words (might, may, believe)
15. Avoid “whether” – use “the extent to which” instead
16. Avoid “will” in pitfalls – use “would” instead
17. Make certain you use the correct word when there are two that are similar
18. “Label” sentences (to help understand the purpose of that sentence)

Use Active voice



When using first person, say I, not we for a training grant

Use Active voice

Active vs Passive voice

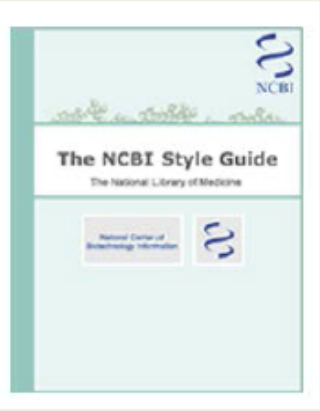
- Active voice:
  - I will collaborate with Prof. xyz, an experienced biostatistician.
  - We will measure blood glucose levels

- Passive voice
  - Collaborations with an experienced biostatistician will be established
  - Blood glucose levels will be measured

Active voice: Emphasizes the doer

Passive voice: Emphasizes the action

Strike a balance- both are useful



https://www.ncbi.nlm.nih.gov/books/NBK988/

https://lagunita.stanford.edu/courses/Medicine/Sci-Write/Fall2014/about

x 7.50 in

Sentence construction

- Use bold declarative sentences
- One concept/sentence
- Don’t use long or runon sentences – use grammar checker for this
- Break up passages with longer sentences with sorter ones
- Use precise & meaningful words (hyperactive v. dysfunctional)
- Use active verbs (analyze v. analysis)
- Avoid negatives (similar v. not different)

- Avoid clustering nouns and adjectives; avoid using nouns as adjectives
  - Less Clear: Red-absorbing pigment spectral curves prevent rat brain cell formation
  - More Clear: Spectral curves for red-absorbing pigment prevent the formation of brain cells in rats

Paragraph construction

ONE concept per paragraph
1-3 backup statements for each concept

Use short, simple sentences (~20 words, if writing))--- there is a feature in word to identify these for this

Use the same tense in the same sentence and for the same type of information

Hot tips
Formatting

Formatting won’t get you a grant, but it is important

A clean well formatted grant is important
It won’t increase the chances that a poorly designed or written grant will get funded
But it will lessen the chances of an otherwise very strong grant by creating a negative impression

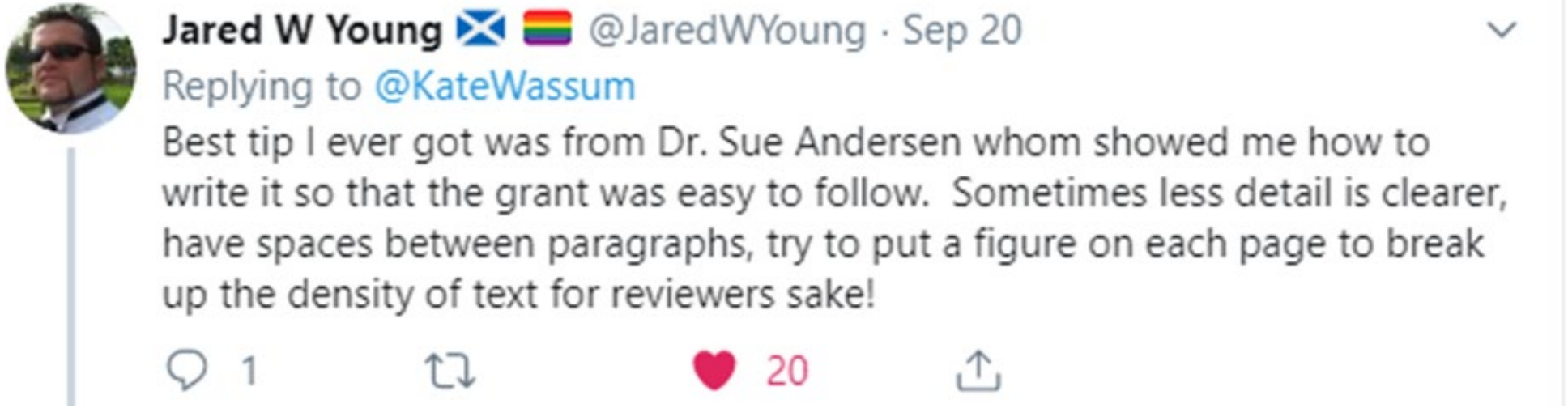
https://twitter.com/drugmonkeyblog/status/1176885188267130880?s=20

Use hierarchies & labeled subsections

- As in the structures defined above, have sections, with subsections, and subsub sections so reviewers can find all the info they need easily

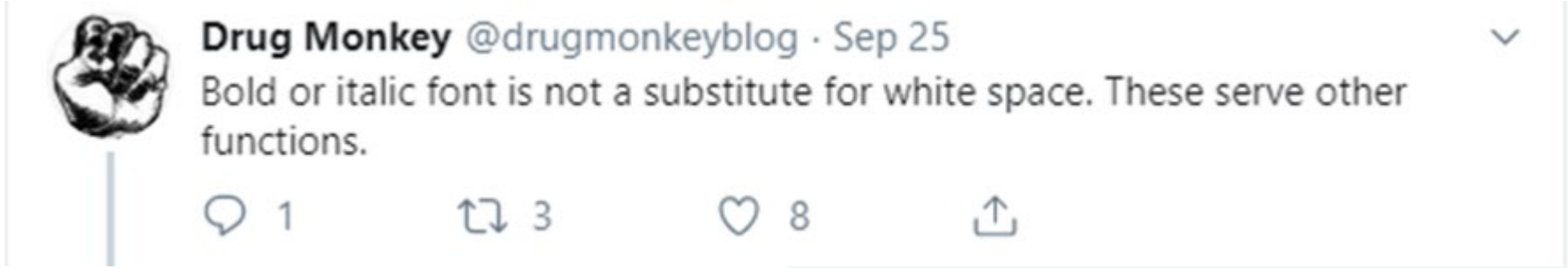
Put spaces between sections and paragraphs

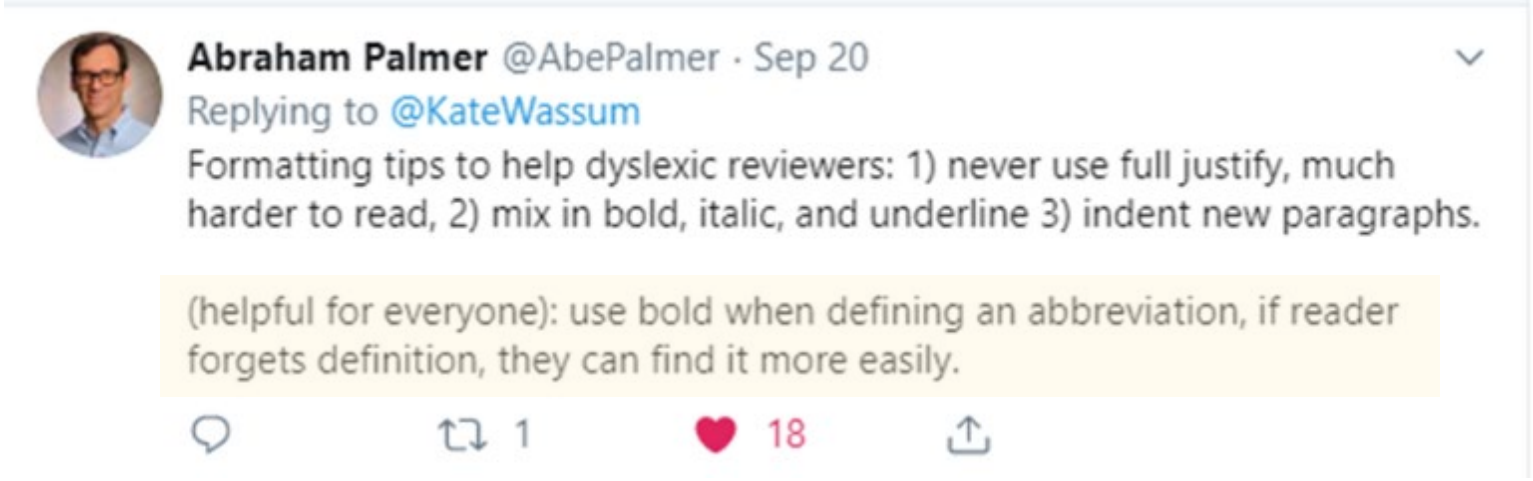
This advice is universal, everyone agrees. Do not write a wall of text. Include white space to break up the page



Use bold, italics, underline

- **Bold** for defining terms and acronyms, anything the reader will need to come back to often.
- *Italics for important points that you want to emphasize*
- *Labels:* or as a label for sub-sub-sections
- <u>Underline, used sparingly, for crucial things like hypotheses</u>





We can agree to disagree…Steve prefers full justification

Don’t cheat the space limitations

Drug Monkey
@drugmonkeyblog

NIH Grant writers: If you are adopting a style variant to save space so that you can jam more words into the page limits you are almost certainly decreasing your application’s chances.

8:44 AM · Sep 25, 2019 · Twitter for iPhone

Drug Monkey @drugmonkeyblog · Sep 25
Figure Legend Abuse: You can use smaller font and get away with it. But then you has better not try to smuggle in methods results narrative and discussion. Keep it simple. Or use the proper font size

3 1 14

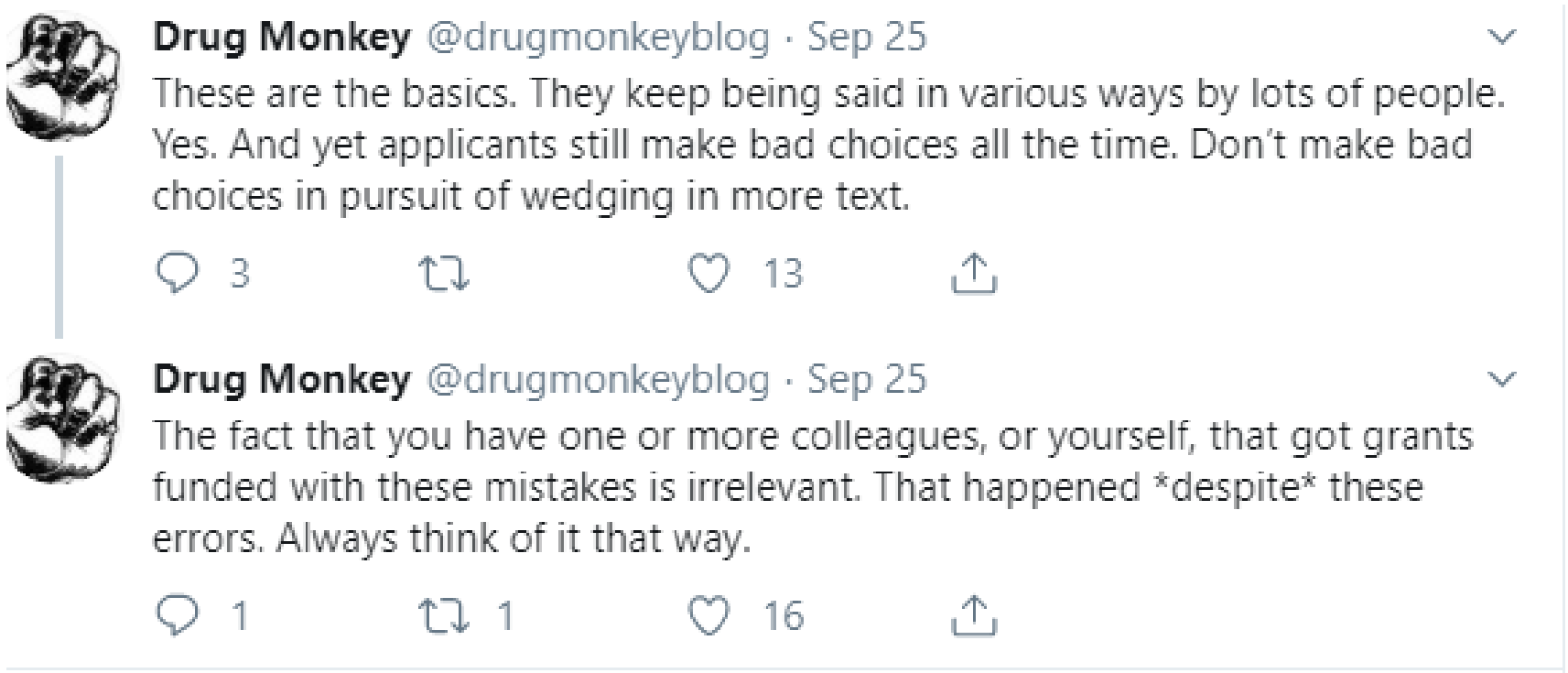
Drug Monkey @drugmonkeyblog · Sep 25
There is no such thing as a “footnote” in NIH grant applications. This is not another way to sneak in a bunch of tiny font text.

1 2

Drug Monkey @drugmonkeyblog · Sep 25
Do not use the Vertebrate Animals section to describe all of your methods in place of a description in the research plan.

1 1 10

Don’t cheat the space limitations



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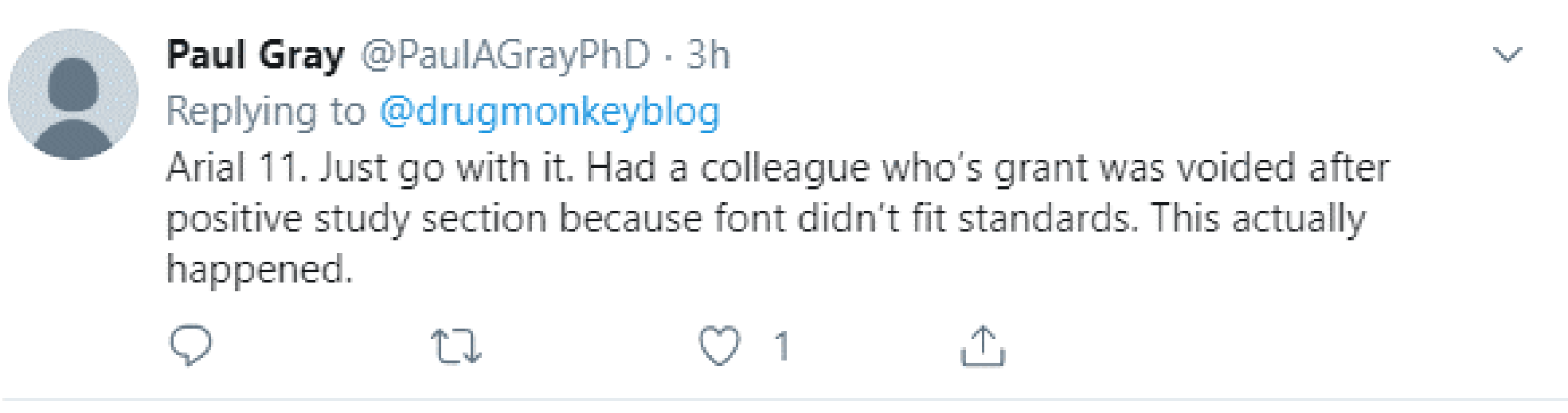
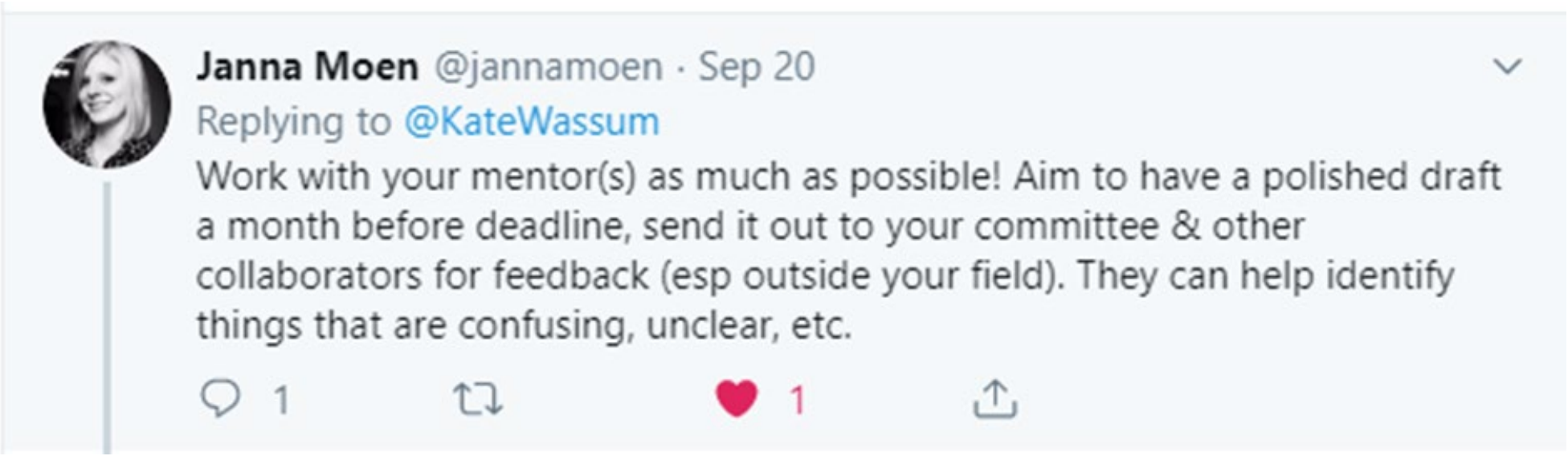


We can agree to disagree…Steve prefers Georgia 11

Hot tips
Get Feedback

It’s your mentor’s job to help you

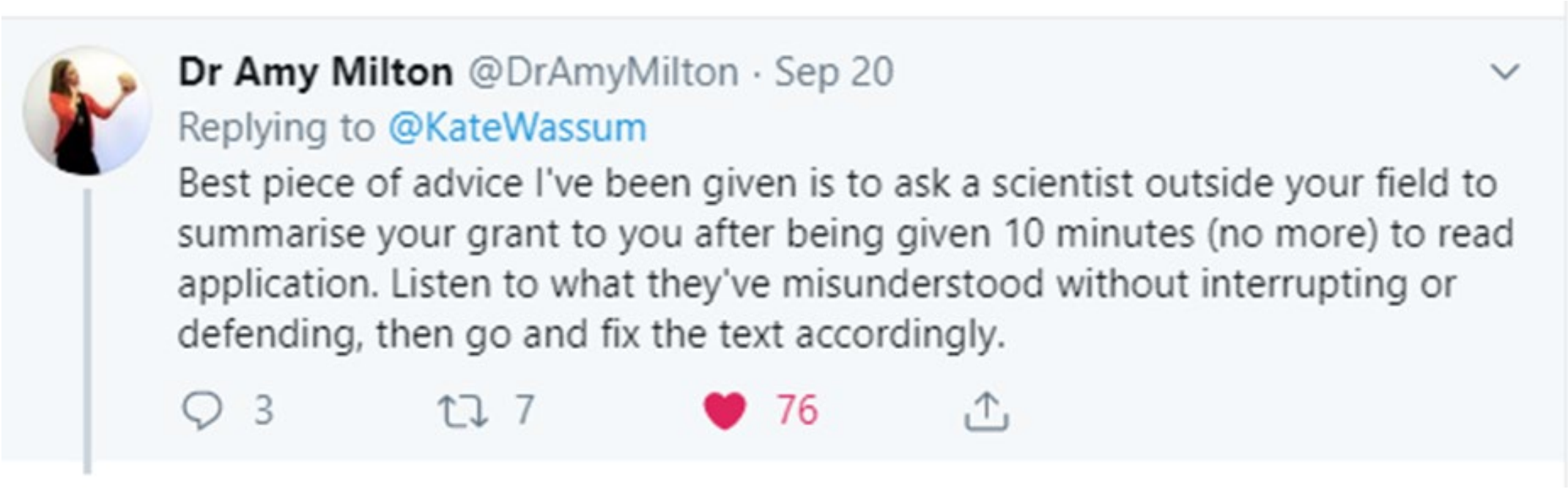


Get feedback from people within your field and with experience

- Feedback is critical to finding flaws, ensuring clarity, and catching errors in logic or design.
- Share the proposal with colleagues, students, and other folk who can give you good, honest feedback.
- The more you vet the proposal prior to submission, the higher the quality of the submission that the reviewers will see.
- Get feedback from other PIs who have experience with training grants.
- Encourage your readers to be honest with you… tell them, ‘don’t worry about hurting my feelings... I appreciate all your thoughts, please don’t hesitate to be critical’

- On the first pass, I find it helpful not to bias your feedback by asking specific questions. Just let them read the proposals/aims/outline and give you feedback, then followup with your specific questions (e.g., did you find this clear?, what did you think about this logic?)

Get feedback with a timeline from someone outside your field



Because your reviewer will likely make a judgment in 10 min

No Excuses! If someone didn’t understand something, that’s on you, not them.

Get feedback outside your subfield

Katie Karlsgodt @KatieKarlsgodt · Sep 21

Replying to @KateWassum

Find a buddy, or group of buddies slightly outside your area that you can rotate around getting and giving feedback from/to. Then imagine it is the 5th grant someone is reading at 2am and think of what would make it easier for them to follow (consistent structure, headings, etc)

1 5

Kate Wassum @KateWassum · Sep 21

YAS!!! Great tips.

I always tell students to imagine the reviewer is reading the grant at midnight, hungry, jet lagged after returning from a long trip, and with two kids screaming in the next room.

4

Get feedback outside your subfield

Jennifer Silvers @JASilvers · Sep 20

Replying to @KateWassum

2 things that sound obvious but took me awhile to figure out: 1) Keep it simple with 1-3 impactful but feasible aims, more than that starts to feel scattered. 2) Ask your colleagues for feedback! My best comments have come from folks in adjacent but not overlapping fields

7

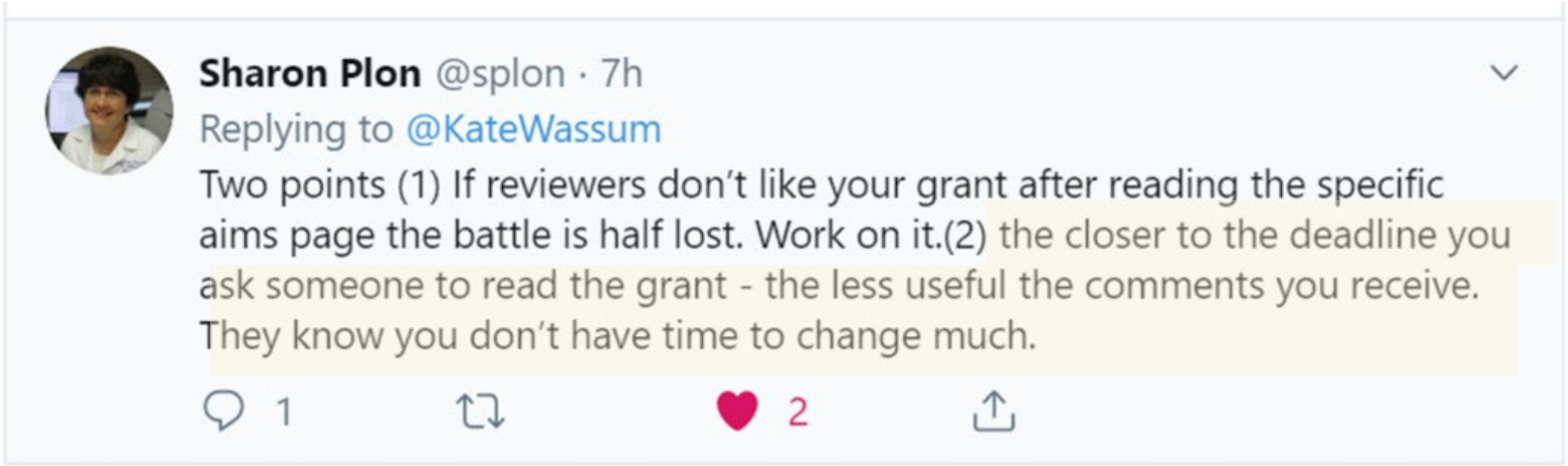
David Barker @DavidBarker_PhD · Sep 21

Replying to @KateWassum

Force them to have someone in science but outside their field flag the *Jargon* for replacing or re writing

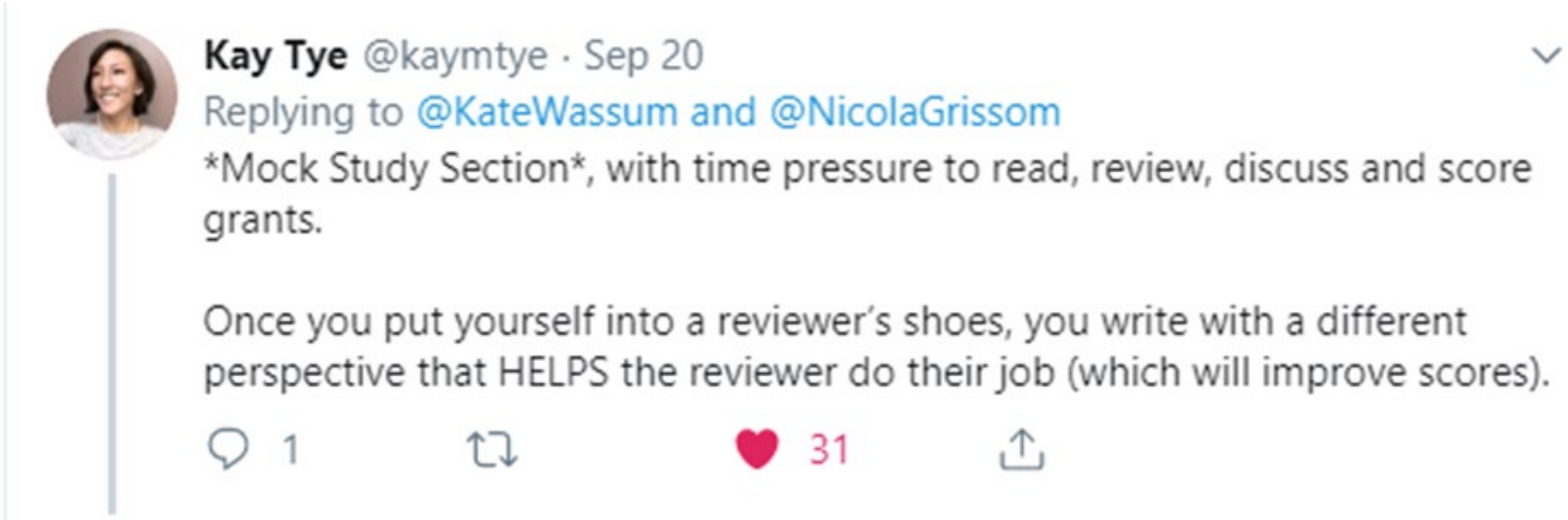
3

Leave plenty of time for feedback



Hot tips
Editing

Best way to be critical of your own proposal, is to find the flaws in someone else's



Leave LOTS of time for editing

NeuroVixen @NeuroVixen · Sep 20

Replying to @KateWassum

Be sure to budget enough time to give yourself a week without looking at it so you can come back with "fresh eyes" and catch mistakes/things that aren't clear/can be improved.

4

Writing is rewriting

Trying to edit online will disrupt your thought process, just get your initial thoughts the screen as quickly as possible to capture what's in your head, including the excitement you feel for the proposed work.

Then edit later

The majority of work in writing a grant is in the editing process.

Writing is rewriting

Edit in multiple stages:

- Content
  - Are you selling it?
  - Is it logical?
  - Are your references correct, is everything accurate
- Clarity
  - Does it make sense?
- Style & Grammar
  - Is it written well
  - Can I make it more concise
- Content again
  - After you make it more concise, is it still accurate and clear

Writing is rewriting

Read the grant out load to yourself and you'll catch awkward prose and missing words, or you might find re-wording is in order to reduce redundancies, flow, etc.

- Word can do this for you

Compile feedback from many, then address each point through your editing

Hot tips
Responding to feedback in a resubmission

Responding to feedback in a resub

Sherry Pagoto ✓
@DrSherryPagoto

It's grant season again! Isn't THIS scenario the WORST:

You submitted a grant, it got a score. You respond to the reviews only for the resubmission score to stay the same or get worse. AGH!! What happened? Here are some common reasons. A thread! 1/14

12:02 PM · Oct 14, 2018 · Twitter Web Client

153 Retweets **350** Likes

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
Replying to @DrSherryPagoto
The No Cigar: The changes you made did not adequately solve the problems that reviewers were concerned about. 2/14
1 1 9

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The One Step Forward, One Step Back: A change you made solved one problem but then introduced a new problem. 3/14
1 7

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The Debate Debacle: You debated the reviewers concerns and consequently made minimal changes. You lost the debate. 4/14
1 7

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The "He/she Is Just Not That Into You": The reviewers didn't feel the project had enough significance in the first place. Fixing a few methodological flaws didn't change that feeling. 5/14
2 8

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The "You Just Can't Leave Well Enough Alone": You added a completely new element to the project (unrelated to the reviews) that opened a can of worms. 6/14
1 5

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The Eagle Eye: You got a new reviewer who caught serious problems the first reviewers missed. While this might seem unfair, from a scientific perspective, is it ethical for a scientist to ignore a methodological flaw simply because another scientist overlooked it? 7/14
1 2 10

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The "Sorry, This Cancer Can't Be Treated": You got a new reviewer who rated certain flaws as more lethal than the first set of reviewers did. 8/14
1 9

Responding to feedback in a resub

Sherry Pagoto ✓
@DrSherryPagoto

It's grant season again! Isn't THIS scenario the WORST:

You submitted a grant, it got a score. You respond to the reviews only for the resubmission score to stay the same or get worse. AGH!! What happened? Here are some common reasons. A thread! 1/14

12:02 PM · Oct 14, 2018 · Twitter Web Client

153 Retweets **350** Likes

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
The bottom line is that your grant was reviewed twice, possibly by the same, possibly by different reviewers, and it did not produce the level of enthusiasm needed to get a fundable score. (CRAP!) 11/14

1 6

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
If you had new reviewers this is even worse news, because not one but two sets of your peers weren't wowed. (DAMN YOU ALL!) 10/14

1 7

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
Lessons learned (from someone who has been on receiving end of all of these highly pleasant scenarios): be very careful in making the decision to put the time into a resubmission. Just because it got scored doesn't mean it has a chance. Things to consider... 11/14

1 11

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
How close was the score? Specifically, what were the scores for Significance? This is a HARD one to move. If the overall score isn't in spitting distance look for enthusiasm expressed in the reviewers comments, such as... 12/14

1 16

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
"Flaws are minimal and easily fixable," "the work is highly significant," "work is likely to have high impact." Is there language that makes you feel invited back? If not, you probably weren't. 13/14

1 4 25

Sherry Pagoto ✓ @DrSherryPagoto · Oct 14, 2018
Finally, consider how fixable the problems are AND whether fixes will introduce more problems, possibly requiring more data--which may mean the whole thing just isn't ready for prime time.

I'm very curious how others have made the tough decision to resubmit or move on! 14/14

8 1 43

Responding to feedback in a resub

Anne Carpenter @DrAnneCarpenter · Nov 5

I think the point he's trying to make is that the SS is not a checklist: fixing the specifics may not fix the bigger picture issues. Getting a fundable score means at least one reviewer was *excited* about the proposal. If you fix the details but not the "meh", it will fail again

1 5 24

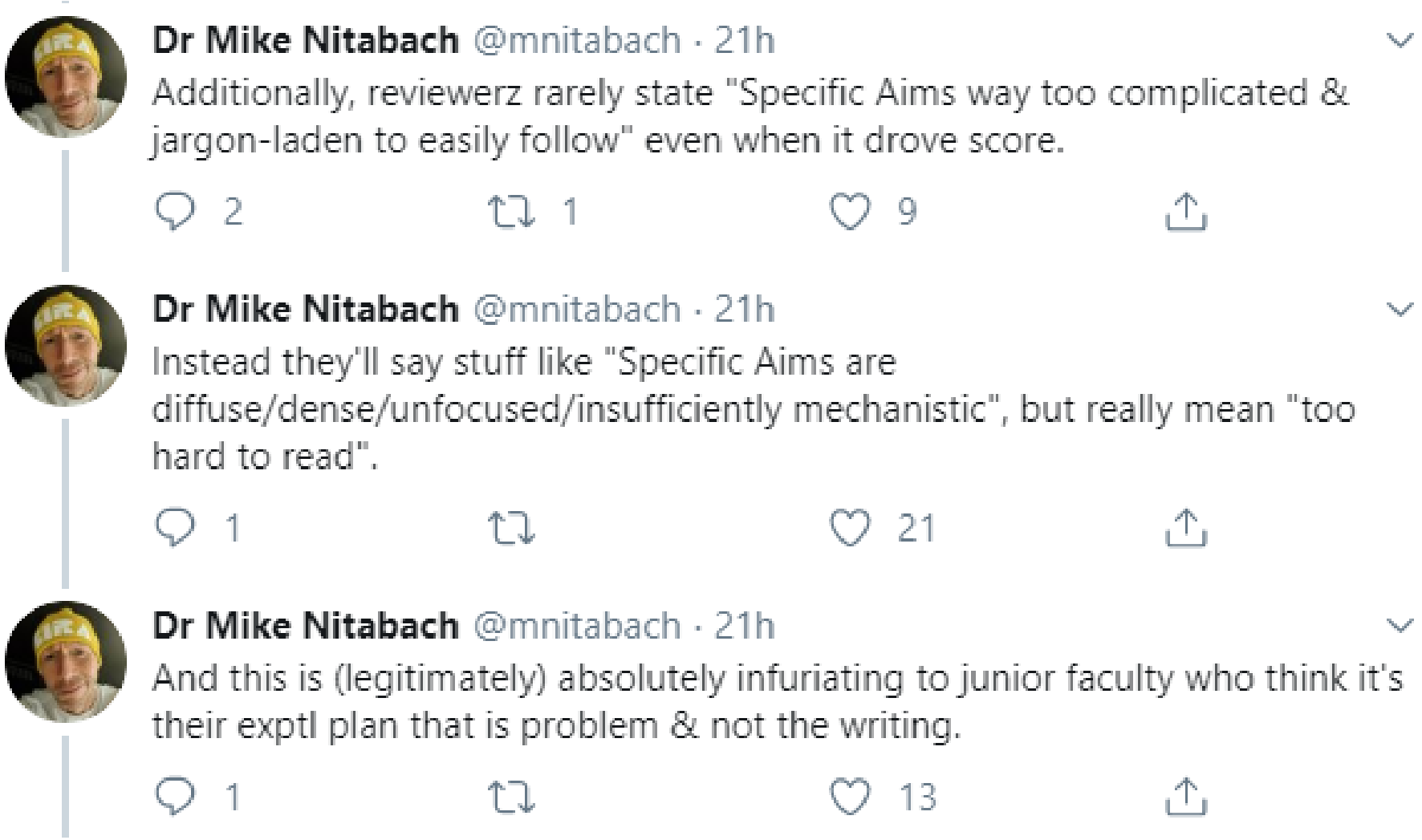
Anne Carpenter
@DrAnneCarpenter

Replying to @pratt_ed @boehninglab and 2 others

I think it is SUPER useful to have someone senior read reviews and "read between the lines" to tell you what issues are really 'score-driving'. It's hard to make a tutorial for this kind of thing! I devoured internet resources when I was getting started to try to make sense of it

8:41 AM · Nov 5, 2019 · Twitter Web App

Responding to feedback in a resub



Super brief primer on the other components of the NRSA

Introduction

Required for a resubmission or revision application, but otherwise do not include
Limited to 1 page.

Goal is to provide your response to the criticisms of the A0

- Highlight the prior reviewer's positive comments (using *"quotes"*)
- Compile and condense the negative ones and include your concise response

Applicant section

Research experience

The goal to show them what you have done, to demonstrate your potential to execute the proposed projects and your high potential to become a successful independent researcher

Also a chance to show them stuff you have done that isn't published and to let them know that you were highly intellectually involved in your undergrad research

When writing about your research experience OWN IT!!!!! You are awesome, show them (don't tell them)

Use strong, declarative, active language…

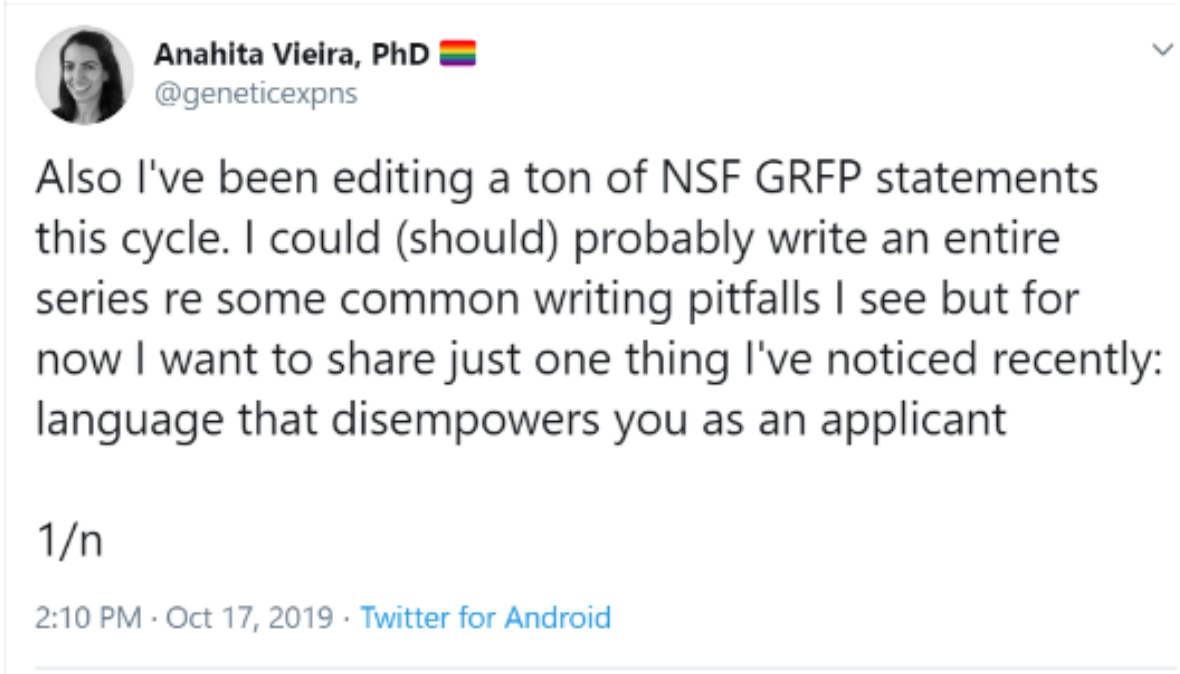
I was interested in X, so I joined X lab, to ask X question. I knew that X, so I formulated X hypothesis. To test this I did X because X. I found X. I interpreted this as X, so I then did X.

Use the end of this section to lead into what you are now doing.

Resist the temptation to just copy and paste your personal statement for grad school.

Doctoral dissertation and research experience

Own it, love it, show it.



Goals for Fellowship Training and Career

Provide details of your overall career goals
And the goals for your current training
Explain how the proposed research and training will enable the attainment of your ultimate career goal

This is where you tell them what your career goals are and how this will get you there. This is CRUCIAL for the Training potential component of the scoring

probably these goals should include ultimately becoming an independent researcher…
with the steps you need in your field to get there

Think hard on what you want to do in the future and what tools/skills/intellectual training you need now to get you there. Design your project and training around these goals.

Can divide into technical (research skills) and intellectual, (conceptual, career, writing, mentoring, etc.) training and career development

Training Plan

Divide into technical (research skills) and intellectual, (conceptual, career, writing, mentoring, etc.) training, and career development

Mentorship: detail how you will receive mentorship from your primary mentor AND your co-sponsors, include co-sponsors for everything on the grant that your lab does not have expertise in (both technical and intellectual)
Postdocs should create a mentoring committee
Describe how often you will meet with everyone and how you will meetin and what these meetings will consistent of
If there are people in lab helping you, explain that

Technical training: Detail all the technical training you will receive, why this will help you achieve your goals and exactly what you will learn and how

Avoid “senior grad student” providing a large part of the training they will leave before you do
Explain differences between prior experience and proposed training, use prior training to show you can do the new training

Intellectual training: detail all the intellectual training you will receive, this should include everything needed for both your project and for advancing in your career. Experimental design, intellectual background relevant to the project, writing, oral presentation
Include training in the institute-specific goals (e.g., drug abuse specific training)

Career & professional development: including all the mentoring you will receve in this. Include that you will create and IDP and will erview quarterly, networking and exposure (conferences, but also other opportunities), mentoring and/or teaching, funding, leadership training

Transition : explain the steps you will take to transition to the next phase fo your careerr

Activities planned under this award

A detailed description of all planned activities under the proposed research training plan, such as

- Coursework
- Seminars
- scientific conferences
- opportunities for interaction with other groups and scientists
- special or unique training opportunities for the applicant that are available in the training environment.

Give a year-by-year accounting including an estimate the percentage of time to be devoted to each activity (in a table)

You can also include your detailed timeline both in text and diagram here if you don’t have space for it in the research strategy

Address feasibility

Activities planned under this award

Fellowship Applicants must describe a tailored research training plan well-suited to the stage of his/her career development to date.

Describe the skills and techniques that the candidate will learn during the award period; discuss the relationship of the proposed research training to the applicant's career goals.

The applicant's plan should be coordinated with the sponsor's plan; it should include substantive detail that adds to the information about time allocations requested.

Should go above and beyond the training of a typical graduate student

Research Enhancement Objectives and Plan

Respective contributions

Written with your sponsor

Describe how you and your sponsor(s) have collaborated to develop the current research and training proposal.

Describe anyone else you worked with in developing this (e.g., colleagues, program officer, grant writing course)

Describe which of the preliminary data you collected and which was from your lab. Limited to **1 page.**

Overall goal is to be honest about how the grant was prepared, but also to show that you did it mostly yourself

Sponsor & Co-sponsor statement

- Research Support Available
  - The sponsor(s) who will directly supervise the applicant’s research, must currently be funded to conduct independent research in the area of the proposed research training (e.g., Principal Investigator on an R01 or equivalent)
- Sponsor's/Co-Sponsor’s Previous Fellows/Trainees
  - The sponsor(s) must describe past experience in the guidance of other research trainees and fellows.

Sponsor & Co-sponsor statement

- Training Plan, Environment, Research Facilities
  - The sponsor(s) must describe in detail
    - their commitment to and proposed role in guiding the individual applicant during the research training experience.
    - the research training plan for the applicant (coordinated with the applicant's own research training plan).
    - include items such as classes, seminars, and opportunities for interaction with other groups and scientists.
    - Training in career skills, e.g. grant-writing and presentation skills are strongly encouraged.
    - elaborate on the research environment and available research facilities and equipment, and discuss the relationship of the proposed research training to the applicant's career.
    - describe the quality and appropriateness of the training environment for the applicant's development including the strength of the institutional commitment to fostering the fellows' training.
    - the quality and availability of facilities and resources (e.g. equipment, laboratory space, computer time, subject populations) for the proposed training. Additionally, the quality of the facilities and related resources (e.g., equipment, laboratory space, computer time, available research support, etc.) must be described.

Sponsor & Co-sponsor statement

- Number of Fellows/Trainees to be Supervised During the Fellowship
  - The sponsor(s) should provide information on other trainees they will be supervising during the period of this fellowship award.
- Applicant's Qualifications and Potential for a Research Career
  - an assessment of the applicant’s qualifications and potential for a research career.
  - address the planned value of the proposed fellowship experience and research training program, and how these relate to the applicant’s needs in preparation for an independent research career.
  - Applicants should provide evidence of their potential for a productive and successful research career based upon the quality of their previous research training and academic record.

Sponsor & Co-sponsor statement

- This is ***VERY*** important component of the research training criterion
- Written BY YOUR SUPERVISOR, NOT BY YOU
  - Srsly, do not let them tell you hey are too busy and can you draft it, it is their job to do this.
- If they don't know what to write… then suggest senior PIs they can ask for advice, or ask those PIs to reach out to your mentor
- It must be consistent with the training goals written by the applicantso you can and should review this with your sponsor to ensure absolute consistency
- It should be written from the perspective of all the sponsors (including co-sponsors), so
  - 1. everyone's info is included
  - 2. it is clear that all cosponsors are well integrated into and contributing to the training plan
    - It's useless to have a cosponsor, but no discussion of how they will give you training
- must include some comment on how they will engage with you for training in the responsible conduct of research

Training in the Responsible Conduct of Research

- plan to obtain instruction in the responsible conduct of research.
- should document prior instruction in responsible conduct of research during the applicants current career stage (including the date of last occurrence)
- and propose plans to receive instruction in responsible conduct of research.
- Such plans must address
  - Format
  - subject matter
  - faculty participation
  - duration of instruction
  - frequency of instruction
  - see NOT-OD-10-019.
- May include career stage-appropriate, individualized instruction and/or independent scholarly activities that will enhance the applicants understanding of ethical issues related to their specific research activities and the societal impact of that research.
- The role of the sponsor/mentor in responsible conduct of research instruction must be described.
- Applications lacking a plan for instruction in responsible conduct of research will be considered incomplete and may be delayed in the review process.
- **limited to 1 page.**

Resource sharing plan

Resource Sharing Plan:

NIH considers the sharing of unique research resources developed through NIH-sponsored research an important means to enhance the value and further the advancement of the research. When resources have been developed with NIH funds and the associated research findings published or provided to NIH, it is important that they be made readily available for research purposes to qualified individuals within the scientific community. If the final data/resources are not amenable to sharing, this must be explained in the Resource Sharing section of the application (see http://grants.nih.gov/grants/policy/data_sharing/data_sharing_faqs.htm).

(a) *Data Sharing Plan*: Not Applicable.

(b) *Sharing Model Organisms*: Regardless of the amount requested, all applications where the development of model organisms is anticipated are expected to include a description of a specific plan for sharing and distributing unique model organisms and related resources, or state appropriate reasons why such sharing is restricted or not possible. See Sharing Model Organisms Policy, and NIH Guide NOT-OD-04-042.

(c) *Genome-Wide Association Studies (GWAS):* Regardless of the amount requested, applicants seeking funding for a genome-wide association study are expected to provide a plan for submission of GWAS data to the NIH-designated GWAS data repository, or provide an appropriate explanation why submission to the repository is not possible. A genome-wide association study is defined as any study of genetic variation across the entire genome that is designed to identify genetic associations with observable traits (e.g., blood pressure or weight) or the presence or absence of a disease or condition. For further information see Policy for Sharing of Data Obtained in NIH Supported or Conducted Genome-Wide Association Studies (go to NOT-OD-07-088, and http://grants.nih.gov/grants/gwas/.)

Project Summary

- 30 lines
- Succinct description of the project
- Background, gap in knowledge, hypothesis, approach
- Stand alone document
- Written somewhat general, for a lay science audience
- Some reviewers use this to make quick decisions about which grants to review in what order
    - It’s not a scorable item, but might give chance the impression of the scorable items

Project Narrative

- 2-3 sentences
- For public release
- General goals of the project

Biosketch - You, the PI

- **5 pages max**
- http://grants.nih.gov/grants/funding/424/applicant-fellowbiosketch.doc
- Include some text in the personal statement part that indiciates why you are well suited to do these projects (with specific reference to your prior work) and how they will help launch your career
- Well describe your prior work, its impact
- Use this page to sell yourself
- If you don't yet have any publications, see if you can post any that are almost ready to submit on BioRxiv before the NRSA submission deadline… this shows progress and is encouraged for Biosketches

https://grants.nih.gov/grants/policy/faq_biosketches.htm#
https://grants.nih.gov/grants/how-to-apply-application-guide.html#format#

Biosketch - Sponsors

- **5 pages max**
- In their personal statement part, your sponsors should include information on their mentoring philosophy and (briefly) experience to highlight their commitment to mentoring
- If a co-sponsor, their personal statement should detail the specific expertise they will contribute

Selection of sponsor and institution

- Discuss how you arrived at selecting the sponsor(s) and the institution.
- Describe why this institution is a good place for you given your research career goals
- Describe why you selected your sponsor’s lab andn how this will facilitate your career and research goals
- Ditto for the co-sponsors
- **Limited to 1 page.**

Description of institutional environment and commitment to training

- This is where you describe how great your institution is for helping you to achieve your training, research, intellectual and career goals
- Describe all the intellectual, physical, and person resources available
- Describe for both institution broadly and for your specific department/area
- There is likely a pre-written version of this from your department you can tailor
- **Limited to 1 page.**

Additional educational information

This includes mission, demographics, number of students who graduated with Bachelors, Masters or Ph.D. in the sciences, total R01 NIH funds received by the institution)

Usually written by the grad student administrator

Facilities

Get from your sponsors, describes all the facilities of your lab and co-sponsors labs
Including shared facilities (like cores)

Make sure its clear that all the appropriate facilities you need to do your work is available
And that you have facilities for biohazards, if applicable

Equipment

Get from your sponsors, describes all the equipment in your lab and co-sponsors labs
Including shared resources

Make sure its clear that all the equipment you need to do your work is available

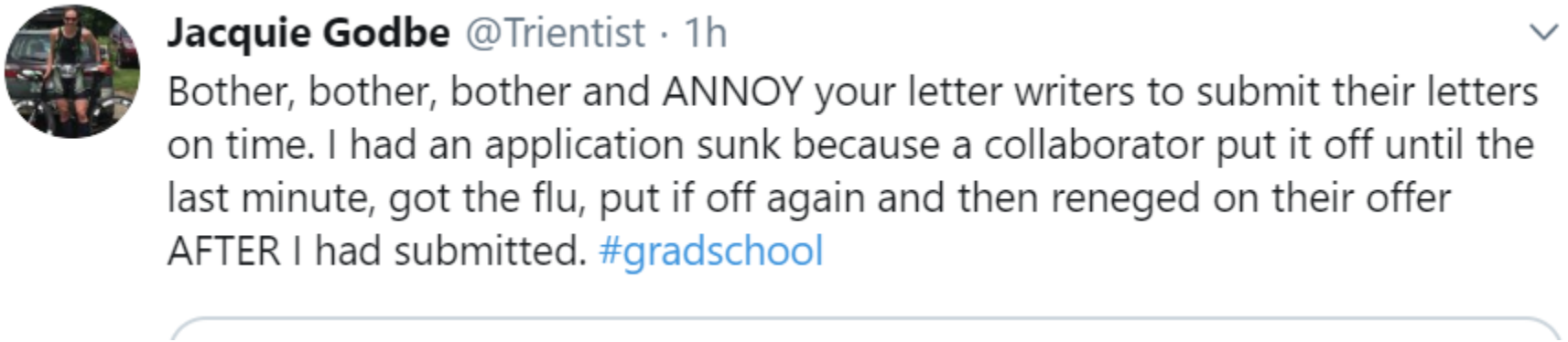
References

Use the correct NIH format:

Letters of support

- These are written from your collaborators addressed to you
- You will likely draft this for them
- It will detail that the collaborator is excited to work with you on the project, how you have interacted in the past and how they will contribute to your training in the future
- Should be consistent with all the training plan information
- Every co sponsor or any PI listed as contributing to training needs to provide a letter

- You will likely write a draft of this for your letter writers. It's not a LOR. It's a document detailing how they will support your proposed research.



Letters of reference

- Will be submitted separately
- At least 3, no more than 5
- Must be strong and describe your potential for an independent career in research
- Should be from relevant prior research mentors (ideally PIs)
- Send your letter writers reminders and suggestions of topics to include in their letter.
    - You may ask specific LOR writers to comment non any weaknesses you feel you have in your application (e.g., low GPA, papers that aren't published yet, lack of pubs owing to negative data, gaps in training)
- Send them your biosketch and specific aims so they can tailor your letter
- If you can't get one from a key prior mentor (like the main person you worked with as an undergrad), have another letter writer explain why (if possible)
- Send them reminders!!!

Letters of recommendation

- You might be asked to draft your own LOR.
- Usually, if someone asks this, they just want to make sure that they cover all the basis and give you the strongest letter possible.
- But don't assume that they will edit it.

Anahita Vieira, PhD 🏳️‍🌈
@geneticexpns

Ever been asked to draft your own recommendation letter? Have no idea where to start? Here's a template to help get you started. 🙃🙃 #acwri

XX FANCY LETTERHEAD HERE XX

[Date Here]

Dear XYZ Selection Committee,

It is a pleasure to recommend Spongebob Squarepants for XX fellowship/program. I've known Spongebob for X years as his thesis advisor and in xyz capacity. Overall, I consider Spongebob to be a mature, thoughtful, detail-oriented individual.

Spongebob received his undergraduate degree from The Pants of Square College where he studied about pineapples that live under the sea. During his time there, he innovated new ways of pitching his pineapple house in the harsh ocean conditions which undoubtedly will serve other creatures who wear square pants under the sea. His work was published in "Pineapples are great materials for houses" Squarepants, S., Cheeks, S., Krabs, M., Star, P. *Under the Sea,* **44,** 123-129 (2015).

Spongebob's interest in innovating new houses didn't stop at his pineapple project. Over time, his ambitions grew beyond the doors of his pineapple house and now he is most motivated to obtain a license to drive a boatmobile. To this end, he is earning his living working at Mr. Krab's Krusty Krab Patty burgers. And he is taking driving lessons from Mrs. Puff. By all accounts, he is her most diligent student. This same spirit of hard-work and ingenuity is something that I saw in Spongebob when he rotated in my lab as a graduate student.

As his advisor, I see that Spongebob will stop at nothing to achieve his goals. Once he joined my lab, he took lead on a project looking at the effects of human activity on his homeland of Bikini Bottom. While others discouraged him from pursuing this line of inquiry, Spongebob demonstrated clear rationale and pursued his intuitions anyway. He now has a significant amount of pilot data demonstrating that humans have, in fact, destroyed the ocean. This work is currently under review at *Under the Sea* journal.

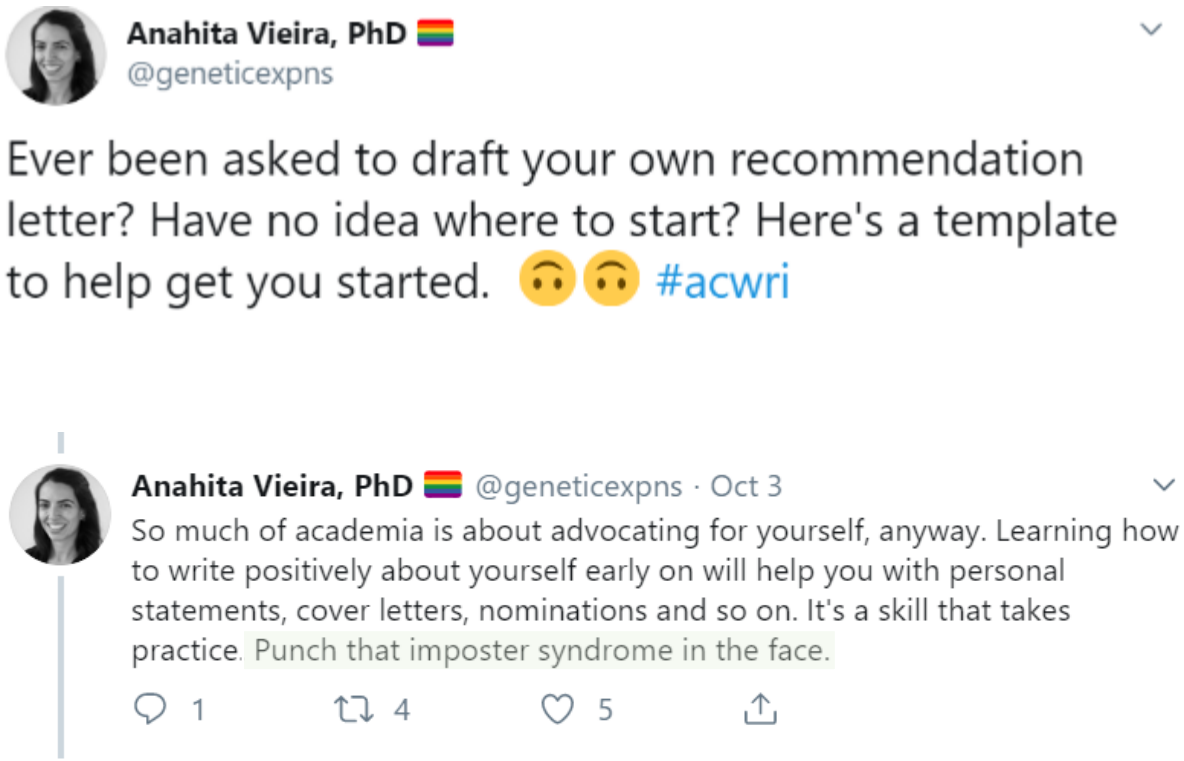
Based on my extensive interactions with Spongebob thus far, I consider his potential to lead his own research group one day to be quite high. Spongebob is more than a scientist. He thinks outside of his square pants and collaborates with others well so that he can achieve his goals. Based on his personal qualities and technical talents, I consider Spongebob to be highly deserving of an xyz fellowship and I recommend him without hesitation.

Sincerely yours,
Dr. Lady Boss

https://mobile.twitter.com/geneticexpns/status/1179856205067374592?s=12

Letters of recommendation

- You might be asked to draft your own LOR.
- Usually, if someone asks this, they just want to make sure that they cover all the basis and give you the strongest letter possible.
- But don't assume that they will edit it.



Vertebrate animals

- Must include the total number of subjects
- You can largely rip the rest of it off from your PIs successful R01s, tailoring to your specific projects
- Address:
  - 1) proposed use of the animals, and species, strains, ages, sex, and numbers to be used;
  - 2) justifications for the use of animals and for the appropriateness of the species and numbers proposed;
  - 3) adequacy of veterinary care;
  - 4) procedures for limiting discomfort, distress, pain and injury to that which is unavoidable in the conduct of scientifically sound research including the use of analgesic, anesthetic, and tranquilizing drugs and/or comfortable restraining devices; and
  - 5) methods of euthanasia and reason for selection if not consistent with the AVMA Guidelines on Euthanasia. For additional information, see http://grants.nih.gov/grants/olaw/VAChecklist.pdf.

Protections for human subjects & inclusion of Women, Minorities, and Children

- You can largely rip the rest of it off from your PIs successful R01s, tailoring to your specific projects
- For research that involves human subjects but does not involve one of the six categories of research that are exempt under 45 CFR Part 46, the committee will evaluate the justification for involvement of human subjects and the proposed protections from research risk relating to their participation according to the following five review criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, 4) importance of the knowledge to be gained, and 5) data and safety monitoring for clinical trials.
- When the proposed project involves clinical research, the committee will evaluate the proposed plans for inclusion of minorities and members of both genders, as well as the inclusion of children.

Resources:

This list is non-exhaustive, a google search will bring up many resources.

https://www.sciencedirect.com/book/9780124201873/a-practical-guide-to-writing-a-ruth-l-kirschstein-nrsa-grant

https://www.cc.nih.gov/training/students/appadvice.pdf

https://www.americanscientist.org/blog/the-long-view/the-science-of-scientific-writing

https://www.thepsf.org/documents/Research/Grants/Top-Ten-Grant-Writing-Mistakes.pdf

https://www.alexhunterlang.com/nsf-fellowship

https://elifesciences.org/inside-elife/b6bf37cb/webinar-report-how-to-plan-research-grants-that-further-your-career

https://alexisshotwell.com/writing-workshops-academic-activist/

https://kbroman.org/blog/2011/10/21/grant-writing/

http://www.grantcentral.com/workbooks/

https://www.pitt.edu/~gsiegle/Siegle-f31hints-BehaviorTherapist10_fordistrib.pdf

https://www.niaid.nih.gov/grants-contracts/calix-sample-f31-application-and-summary-statement

https://jef.works/blog/2017/10/19/NIH-F-series-grant-tips-and-example/

https://www.chemtoolman.com/nih-f31-fellowship-dos-donts/

https://postdocs.ucsf.edu/sites/g/files/tkssra2836/f/wysiwyg/NIH-Predoc-slides-5.24.18.pdf

https://www.biosciencewriters.com/Tips-for-Writing-an-Outstanding-NIH-Fellowship-Application.aspx

https://pdfs.semanticscholar.org/dda0/57dd2705b19ac8722c6bfd270feae4564540.pdf

http://grantscourse.columbia.edu/RubinJaime_Funding_for_Graduate_Students.pdf

https://journals.sagepub.com/doi/10.1177/0193945913485162

http://www.americanscientist.org/issues/pub/the-science-of-scientific-writing/1

https://pn.bmj.com/content/15/6/474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