A Novel Approach to Writing Effective NIH Research and K Proposals: Writing for Patterns Reviewers Expect to See

Rick McGee, PhD, Professor of Medical Education
Associate Dean for Professional Development
CNCDP-K12 Workshop
June 17, 2026

NORTHWESTERN UNIVERSITY
FEINBERG
SCHOOL OF MEDICINE

Who am I?

BS and PhD in Biochemistry – lipid biochemist

2 year postdoc at NIH in neurobiology

10 yrs at Georgetown (Pharmacology) – cellular neurobiology

4 yrs at Medical College of Ohio – Pharmacology and Assoc. Dean for Student Affairs – closed lab

12 yrs at Mayo Clinic – Leading PhD and MD/PhD programs, Improving diversity in all training, helped create MS in Clinical Investigation, adding systematic training to mentoring, started evolution into social scientist

3.5 yrs at NIH – Director of Student Affairs (PhD trainees at NIH)

17 yrs at Northwestern – Faculty coach, also lead social science research team studying how scientists develop, creating/ testing coaching approaches to complement mentoring

Currently PI on NIGMS MIRA, Co-I on 2 U01 awards on Grant Writing Coaching Groups and Culturally Aware Mentoring

The big picture – What are reviewers (+ POs, others) trying to decide when they review a K?

Why should we invest in you vs. other candidates?

Is there evidence from your past efforts that predict you will grow into an independently-funded researcher?

Is the research program you have begun, and would expand with the K, likely to have a significant impact on the field?

Does your research program meet the IC priorities? (new…)
https://www.nih.gov/about-nih/nih-director/statements/advancing-nihs-mission-through-unified-strategy - each IC too

Are all of the elements of your research environment (people, resources, support, etc.) in place to enable you to thrive, not just get by?

Your job is to create a clear and compelling story that makes it crystal clear the answers to all of these is yes.

How did my approach to writing NIH style grants come to be?

Began around 2000 – during creation of Masters of Science in Clinical Investigation at Mayo Clinic

Created new course on Grant Writing – opened the question: "Can you teach grant writing or is it all about mentors?"

Began experimenting with teaching/learning and small groups

Forced me to completely re-think how grant writing skills are taught/learned/acquired

First used in formal groups with postbac 'students' – amazed by role it played in teaching research design AND writing

Came to Northwestern in 2007 in current role – huge evolution in design and understanding since then – more later…

Expanded to national applications through AAMC in 2012 and NRMN in 2014

Why is grant writing so hard to master?

Think about how much has to be mastered first becoming a scientist…then…

Proposals require complex integration of existing knowledge, research questions and design, and unique form of writing

Writing for the future not just about the past like papers

In the past this has seldom been approached as a concrete skill to be purposefully taught – aside from workshops

Largely left to mentors and self-learning

Informal mentoring as a process is very idiosyncratic with high degree of variability in skills taught

Often tacit (or explicit) belief among some scientists that being able to figure it out by yourself is one of the determinants of 'belonging' in the Community – no evidence this belief leads to the best scientists or science

Research, writing and review are "socially constructed"

What does this mean? To become skilled in each facet it helps to understand the norms and expectation, and ideally where they came from

People who have become successful understand those norms, often without realizing they exist or how they learned them

You start by learning the norms of science and doing research – for MDs starts much later than PhDs

Think of learning grant writing as a next step – and there is NO WAY you can inherently know how to do it!!

Socially constructed means it is subject to well established social science theories, models and constructs

Communities of Practice

C of P (Lave & Wenger): groups who share a passion or goal for something they do, and learn how to do it better as they interact regularly

- Shared interest (domain)
- Competence – techniques, beliefs, talking and carrying oneself like a scientist
- Interaction and learning from each other
- Shared practices unique to each group – methods, tools, shared history, ways of doing things

Membership

- Legitimacy or marginalization of newcomers determined by perceived competence with practices
- Different rules may apply to different “types” of group members
- Practices draw on & reflect the power structures of group, as well as wider society, including those based in race, ethnicity, class, and gender

Examples & Implications of C of P for Scientists

Examples of C of P's in science

- Biomedical science as a whole or an individual discipline
- PhD programs and research groups
- Medical and discipline specialties

Challenges for newcomers

- Practices & rules often invisible (work habits, social expectations)
- Not consistent between research groups
- Seldom malicious or even conscious – but unconscious bias and untested assumptions can be played out
- Newcomers seen as 'different' have greater risk of marginalization
- Huge variation in the amount and type of experiences

Strategies to lessen marginalization

- Openness to what new members bring
- Provide key insider knowledge and guidance (mentoring/coaching)
- Make the invisible visible – like we are doing today
- Shift into a teaching & learning mode to complement mentoring

Reviewers behave as members of a C of P!!

Writing proposals and review are perfect examples of an operational community of practice

- Members have highly conserved and reinforced expectations of what makes a member legitimate – reinforced through powerful social experiences – a.k.a. study sections
- Potential new members are consciously and unconsciously scrutinized based on resemblance to members – 'pedigrees'
- Writing style highly conserved over time – e.g. Specific Aims page
- Knowing this reveals importance of writing what/how is expected

Knowing what they expect is hard to learn – mentors reveal or 'teach it' to highly varying degrees – that is why we are here!

Starting Tenets

1. Writing research and training proposals is not time away from science, it is integral to doing good science
2. The value of formal writing is huge for analytically and strategically deciding how to spend your time – even if it is not funded!!!
3. Grant writing is a complex skill that is best learned through conscious application of high-level leaching and learning principles
4. **With few exceptions, high quality writing will <u>not</u> cover up weak or inadequately developed science – at the end of the day it is the science that gets funded**
5. **Feedback on writing opens a window to the science**

When and what do you start writing?

When you know what you are going to write about…or at least have a good starting point

What are your research questions? Write them down.

What are your hypotheses? Write them down.

What impact will answering your questions have on the field? Write it down.

Talk through these with colleagues/mentors/coaches

Outline your Approach in terms of achievable aims and outline of an approach

Get good start on all of these but don't get mired down

Then you can start on a Specific Aims Page – your miniature proposal – we will come back to this…

Feedback on your thinking is essential at all steps!!! – writing is a window into your thinking for yourself and mentors

Getting started on a K is a little different…

It needs to start with "What do you want to be when you grow up" – i.e. after the K, starting your own research program

The career development plan and how you will be different after the K is at least as important as the science – they must synergize

What expertise and skills do you have now? What new skills will you need to master to launch your research program after the K?

Create an outline of your career development plan at the same time as the research outline.

Yes, I know it is asking a lot!

What do you have to achieve in a K proposal?

Demonstrate the research you are proposing is important, feasible, a logical next step, and hopefully innovative/novel

Show that you really understand the field, both the broad topic and the precise niche you are in – including best techniques

Show that you are actually working in the field

Demonstrate your prior research accomplishments are excellent and appropriate for your career stage

Show a pathway for a successful independent R award

Write in a way that is crystal clear with every word serving a purpose – and for multiple types of reviewers

Convince the reviewers that you are a future legitimate member of the elite NIH-funded research community

It all starts by understanding review processes and knowing your reviewers

In science we write for reviewers. To be a successful writer you have to start from an understanding of:

- What reviewers are used to seeing
- What they want to see
- The criteria they are using to judge what they read
- Their likely approaches to their task
- Knowing and writing to these shows you are legitimate

Your task is to turn the reviewer into your advocate:

- Make the work of the reviewer as simple as possible
- Convince them your work is VERY important
- Convince them you are worth investing in as a future independent researcher

Writing for different types of reviewers

The expert, someone who knows as much, or more, about the topic as you do

The sophisticated non-expert

The skilled scientist who knows almost nothing about your specific topic

The technical expert – e.g. biostatistician or epidemiologist

A non-scientist who may still have a lot of input into review decisions and outcomes

Scientists immersed in training programs

K study sections are different from research ones – more breadth, less depth – this may change…

KNOW YOUR REVIEWERS!!! You are writing for THEM.

NIH Information and Videos on Grant Review

Link to NIH Review Home Page

http://grants.nih.gov/grants/peer_review_process.htm

Videos worth spending 20 minutes viewing!!

https://public.csr.nih.gov/NewsAndPolicy/PeerReviewVideos

Top Reviewer Q&A

https://public.csr.nih.gov/FAQs/ReviewersFAQs

Review criteria for R grants (previous)

Overall Impact – the score that matters (1-9)

Core Review Criteria for Research Proposals (1-9)

- Significance – may be global or within a field
- Investigator(s)
- Innovation
- Approach
- Environment

You are actually writing to review criteria

Review criteria very different for K awards

Significance

Significance. Does the project address an important problem or a critical barrier to progress in the field? If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved? How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?

Investigator(s)

Investigator(s). Are the PD/PIs, collaborators, and other researchers well suited to the project? If Early Stage Investigators or New Investigators, do they have appropriate experience and training? If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)? If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?

Innovation

Innovation. Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?

Approach

Approach. Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project? Are potential problems, alternative strategies, and benchmarks for success presented? If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed? If the project involves clinical research, are the plans for 1) protection of human subjects from research risks, and 2) inclusion of minorities and members of both sexes/genders, as well as the inclusion of children, justified in terms of the scientific goals and research strategy proposed?

Environment

Environment. Will the scientific environment in which the work will be done contribute to the probability of success? Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed? Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?

Major Revisions began January 25, 2025!!!

- Factor 1: Importance of the Research (*Significance, Innovation*) scored 1-9

- Factor 2: Rigor and Feasibility (*Approach*), scored 1-9

- Factor 3: Expertise and resources *(Investigator, Environment)* to be evaluated as either sufficient for the proposed research or not (in which case reviewers must provide an explanation)

All 3 would be considered in overall Impact score but designed to put less weight and minimize undue influence of general scientific reputation

Review criteria for K – have not changed yet…

Overall Impact/Merit – the score that matters

- Candidate
- Career Development Plan/Career Goals and Objectives
- Research Plan (Specific Aims, Significance, *Innovation*, Approach)
- Mentor(s), Co-Mentor(s), Consultant(s), Collaborators
- Environment & Institutional Commitment to the Candidate

ALL sections of the application must be strong – any one that is weak will drag down the rest

No indication yet that K scoring is changing

K Scored Review Criteria

Candidate (Biosketch and Prior Research)

Does the candidate have the potential to develop as an independent and productive researcher?

Are the candidate's prior training and research experience appropriate for this award?

Is the candidate's academic, clinical (if relevant), and research record of high quality?

Is there evidence of the candidate's commitment to meeting the program objectives to become an independent investigator?

Do the letters of reference address the above review criteria, and do they provide evidence that the candidate has a high potential for becoming an independent investigator?

Telling YOUR story…

You are providing the reviewer DATA about you – the path by which you got to where you are and your accomplishments

Get beyond a listing to the logic and contributions – ideally showing increasing independence and creativity

Each step should have purposeful plan or at least explanation

Solving difficult technical problems important to bring out

Whenever possible give evidence of how others have recognized or especially built from your work – impact

If you have had any bumps or delays, explain them, don't make a reader guess – life happens! – how you adapted

Can be difficult to write about youself – balance between giving data and bragging/name dropping/over-blown

K Scored Review Criteria

Career Development Plan/Career Goals and Objectives

What is the likelihood that the plan will contribute substantially to the scientific development of the candidate and lead to scientific independence?

Are the candidate's prior training and research experience appropriate for this award?

Are the content, scope, phasing, and duration of the career development plan appropriate when considered in the context of prior training/research experience and the stated training and research objectives for achieving research independence?

Are there adequate plans for monitoring and evaluating the candidate’s research and career development progress?

Why should we invest in 5 years of your life?

Start with the destination – the really important research program you will be leading AFTER the K

The skills you have now and the new ones you need to add – MUST be real and meaningful, not just more experience

Make clear how the research during the K will lead to an R01 or similar submitted ideally year 4 – may have branches

Good to have smaller research grant submissions too – build evidence you can lead a team before the $2 million ‘ask’

Each of the mentors contributes to your change

OK to begin collaborations too – diversification – but don’t get over-extended or diluted

K Scored Review Criteria

Research Plan (recently expanded)

Are the proposed research questions, design, and methodology of significant scientific and technical merit?

Is the prior research that serves as the key support for the proposed project rigorous?

Has the candidate included plans to address weaknesses in the rigor of prior research that serves as the key support for the proposed project?

Has the candidate presented strategies to ensure a robust and unbiased approach, as appropriate for the work proposed?

Scored Review Criteria - continued

Research Plan (recently expanded)

Has the candidate presented adequate plans to address relevant biological variables, such as sex, for studies in vertebrate animals or human subjects?

Is the research plan relevant to the candidate's research career objectives?

Is the research plan appropriate to the candidate's stage of research development and as a vehicle for developing the research skills described in the career development plan?

If proposed, will the clinical trial experience contribute to the proposed research project? (for K23 most likely)

Research must align with career development

The research needs to be designed to assist and reinforce your career development plan

Research must show a pathway to future independent grants and program by the end

It is ok to have collaborators in the future, but YOU have to be the one driving the research questions

In particular, the research must differentiate you from mentors

Research Plan

Follows the same format as R proposals

Scope must be limited to what is feasible with a lot of your time and usually not many research $$$ unless you have other non-K funds for research

Research is as much a substrate for accomplishing career development aims as a contribution to the field

Ideally has 'branch points', not make-or-break findings – no matter what you find there IS a next step

Must set the stage for the R01/research program AFTER K

Having more than 1 research theme can work, but caution

If you get the K, don't feel too constrained that you have to follow it to the letter, can't collaborate on new things too

K Scored Review Criteria

Mentor(s), Co-Mentor(s), Consultant(s), Collaborator(s)

Are the qualifications of the mentor(s) in the area of the proposed research appropriate?

Do(es) the mentor(s) adequately address the candidate's potential and his/her strengths and areas needing improvement?

Is there adequate description of the quality and extent of the mentor's proposed role in providing guidance and advice to the candidate?

Is the mentor's description of the elements of the research career development activities, including formal course work adequate?

Is there evidence of the mentor's, consultant's and/or collaborator's previous experience in fostering the development of independent investigators?

Is there evidence of the mentor's current research productivity and peer-reviewed support?

Scored Review Criteria

Mentor(s), Co-Mentor(s), Consultant(s), Collaborator(s) (cont.)

Is active/pending support for the proposed research project appropriate and adequate?

Are there adequate plans for monitoring and evaluating the career development awardee's progress toward independence?

If the applicant is proposing to gain experience in a clinical trial as part of his or her research career development, is there evidence of the appropriate expertise, experience, and ability on the part of the mentor(s) to guide the applicant during participation in the clinical trial?

Your mentoring cloud…

Can vary a lot between applications

Be cautious if you have worked with someone a long time

Essential that your research differentiates you from them

Fine to use the full range from primary mentor to collaborators – don't be afraid to be equal with some

Becoming more common and encouraged to have some (and spend some time) away from primary training site

For each person think 4 elements very compactly:

1) Who are they?
2) What are they good at?
3) What you will get form them?
4) How will you get it?

K Scored Review Criteria

Environment & Institutional Commitment to the Candidate

Is there clear commitment of the sponsoring institution to ensure that the required minimum of the candidate's effort will be devoted directly to the research described in the application, with the remaining percent effort being devoted to an appropriate balance of research, teaching, administrative, and clinical responsibilities?

Is the institutional commitment to the career development of the candidate appropriately strong?

Are the research facilities, resources and training opportunities, including faculty capable of productive collaboration with the candidate, adequate and appropriate?

Is the environment for scientific and professional development of the candidate of high quality?

Is there assurance that the institution intends the candidate to be an integral part of its research program as an independent investigator?

Institutional Commitment

For K08, K23 or K01 staying at the same site, has to be clear they are committed to your irrespective of the K!

The more specific and detailed the better - $$, space, access to research resources, cores, etc.

The overall writing style should ‘tell a story’

Think of it as guiding or controlling the thinking of the reviewer – cognitive control

This includes consciously considering what a reviewer might be thinking and writing to it

- Particularly critical if there is controversy in the field and/or what you are proposing might challenge current thinking!

Don’t forget to write toward different levels of reviewers

MUST employ rigorous technical writing standards

- Paragraphs really do need meaningful topic sentences
- Each sentence must be logically connected
- The last sentence of a paragraph must sum it up and/or make clear to the reader where they are headed in the NEXT paragraph – see videos on sentences and paragraphs

http://www.northwestern.edu/climb/

Grant Sections – what to accomplish in each

Specific Aims – 1 page

- One page synopsis of the proposed research
- Starts from setting the context – a funnel with steep sides
- What is the problem or need?
- Why is it important/significant?
- What is known – from other's work to your own?
- What new information do you hope to uncover?
- What is specific question(s) are you asking and/or the hypothesis you are testing?

Bulleted list of Specific aims – what you plan to do – usually with a sentence or two of detail

Impact Statement – includes a nod to career development impact too

Crystal clear to the reader why what you are proposing is important and what you will do

Make or break for reviewer enthusiasm even with a K!

Research Strategy – 3 Sections – 4-6 pages

Significance = importance

- Previously “Background and Significance”
- Much less emphasis on Background, but builds the context behind the question and proposed research
- Establishes the logic path to what you propose to do – easy to forget to make logic clear – you know it and fill in blanks
- Convinces the reviewer you know the field and what is important to pursue vs. less important
- Expands what is provided briefly in Aims page
- Preliminary Data might come in here or mentioned here to be expanded in Approach
- Likely 1-1.5 pages for K
- Work MUST be significant even if not highly innovative!

Research Strategy – Innovation

Innovation = novelty

Mixed opinions on role of Innovation in Ks – not a scored criterion, innovation is always good, but high risk is not good for a K

Innovation very seldom drives funding even for an R01!

The logic may be innovative or the methodological approach – may bring new observation in one field to another

New technologies open up possibilities for innovation

In theory, innovation should give permission for higher risk science but still not always ok with reviewers

Innovative work still must be logical and reasonably feasible!

Sometimes hard to distinguish from Significance

No longer separately scored starting in 2025

Research Strategy – Approach

This is the section where you say exactly what you plan to do to achieve each Aim and test each hypothesis – organized by each Specific Aim

You often have a section on methods that apply to the entire project but also in each Aim – but not repeated

Aims should relate to each other but not be dependent on a specific outcome for a previous aim

Scores on Approach and Significance most closely align with Impact score for R proposals!!

Not aware of any data on which criteria align best with overall score for K awards – they all matter!

Candidate & Career Development

Page Limits – be sure to follow!

https://grants.nih.gov/grants-process/write-application/how-to-apply-application-guide/page-limits

Separate document from Research Strategy uploaded – together they can't be more than 12 pages

Candidate Information

Goals for Career Development

Ranges from 4-6 pages total – example below is for 6 pages total

Candidate Background – 1-1.5 pages (1 example – can vary)

Another story but the nature of the story can be highly variable

This is about you not the science you want to do (until the end)

It is the story line that ties together the bits of the biosketch – the how and why that ties the pieces together

Unique experiences and how they have shaped you as a scientist (and person)

It MUST bring out your accomplishments – no time to be understated but don't go over the top!!

Bring out the 'innovation' of you like 'innovation' of the science

Emphasize research ideas/approaches/opportunities you created

Ends with a short reiteration of your skills leading to the final skills you need for your future research – the K

Career Goals and Objectives – 0.5 pages

Ok to start with the obvious – independent investigator – but move on quickly to your research vision/program

The type of research problems and questions that the field needs answered over the next 10-15 years

If there are types of research you will be uniquely prepared to address AFTER the K, bring them out

Career Development Plan – 4 pages

Start with a big picture paragraph

Often works to have 3-4 Career Development Goals

They need to led to substantive change from who you are now and required for the research you will do AFTER the K

Go on to break each down to HOW you will achieve them

Big section on mentoring team – rationale for each, how you will work with each, what you will gain from them

Typically a table that captures a timeline of what you will do each year, including courses, and often how they align with research aims over the same period of time

Back to teaching and learning…Online Tools for Grant Writing

Developed by communications expert who worked with us for 18 months – Karl Keller

Animated PowerPoint presentations with audio – each 15 minutes or less

Vivid display of the patterns that reviewers see and expect to see in grant judged as high quality and fundable

Classic cultural capital which funded PIs have acquired but often can't articulate what they are doing or why

http://www.northwestern.edu/climb/resources/written-communication/index.html

WRITTEN COMMUNICATION

Being a scientist means more than just doing exceptional research. A good scientist is also a good writer. In fact, you won't truly be successful as a scientist until you learn to write well. You have to publish papers and apply for grants to fund your work. In fact, your career depends on the ability to write well.

The resources below are designed to help you improve your writing skills. The advice provided here is not only actionable and practical, it's science-based. The advice is designed to "de-mystify" the writing process. These resources focus on skills you can quickly master, no matter how you view yourself as a writer, and no matter how complex and subtle the science is.

The links below lead to PowerPoint or video files used for our workshops for second year CLIMB students when we focus on written communication skills.

View a PowerPoint or video file:

- Key Science Writing Skills
  - 5 Principles for Writing Readable Sentences
  - Creating Coherent Paragraphs: Topic Sentences, Echo Words, Transitions
- NIH Grant and Dissertation Proposals
  - Aims Pages, Part 1: Rhetorical Patterns
  - Aims Pages, Part 2: Specific Aims
  - Understanding NIH Review Criteria
  - NIH Grants: Analyzing the "Big Structure" of a Funded Proposal
  - NIH Grants: Exlporing the "Significance" and "Innovation" Sections
  - NiH Grants: Analyzing the "Approach" Section
- NSF Grant Proposals

QUICK LINKS

- Contact Us

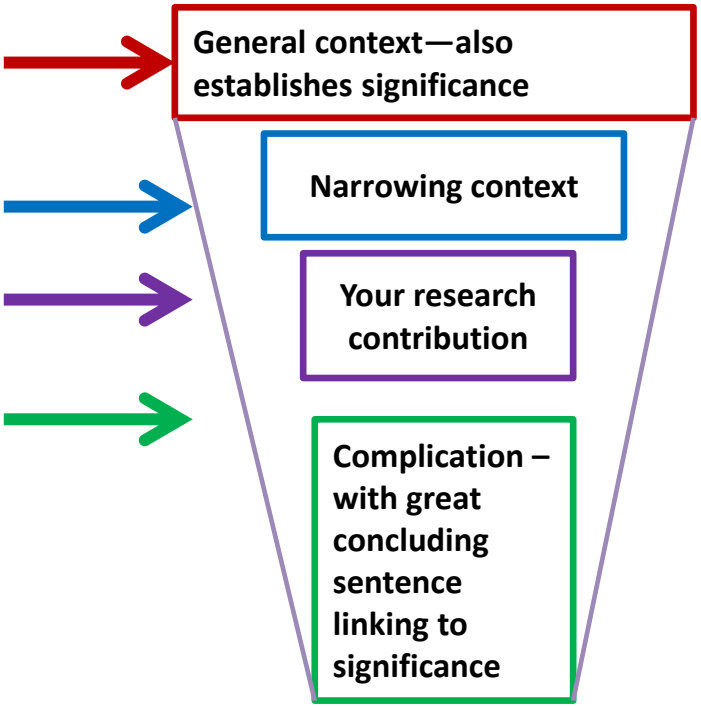
NORTHWESTERN BIOSCIENCE PROGRAMS

- Biomedical Engineering (BME)
- Chemical and Biological Engineering (ChBE)
- Driskill Graduate Program in the Life Sciences (DGP)
- Interdepartmental Biological Sciences (IBiS)
- Northwestern University Interdepartmental Neuroscience (NUIN)

Opening paragraph funnels to a complication

Specific Aims

Eukaryotic innate immune systems act as effective barriers to infection by microorganisms. Understanding the mechanisms that bacterial pathogens employ to circumvent innate immune systems will improve our ability to control disease. Plants and animals use specific pattern recognition receptors (PRRs) to recognize conserved molecules of microorganisms (known as PAMPs). Plants have numerous PRRs that can recognize specific virulence proteins specifically present in pathogens (known as Avr proteins). Many Gram-negative bacteria use type III protein secretion systems to inject effector proteins into host eukaryotic cells. We have shown that a primary role for many *Pseudomonas syringae* type III effectors is to suppress innate immunity. However, the enzymatic activities and the mechanisms that type III effectors use to suppress innate immunity are not well understood. Identifying the enzymatic activities of type III effectors and their substrates is essential to identify important components of innate immunity and to improve strategies to control bacterial diseases.



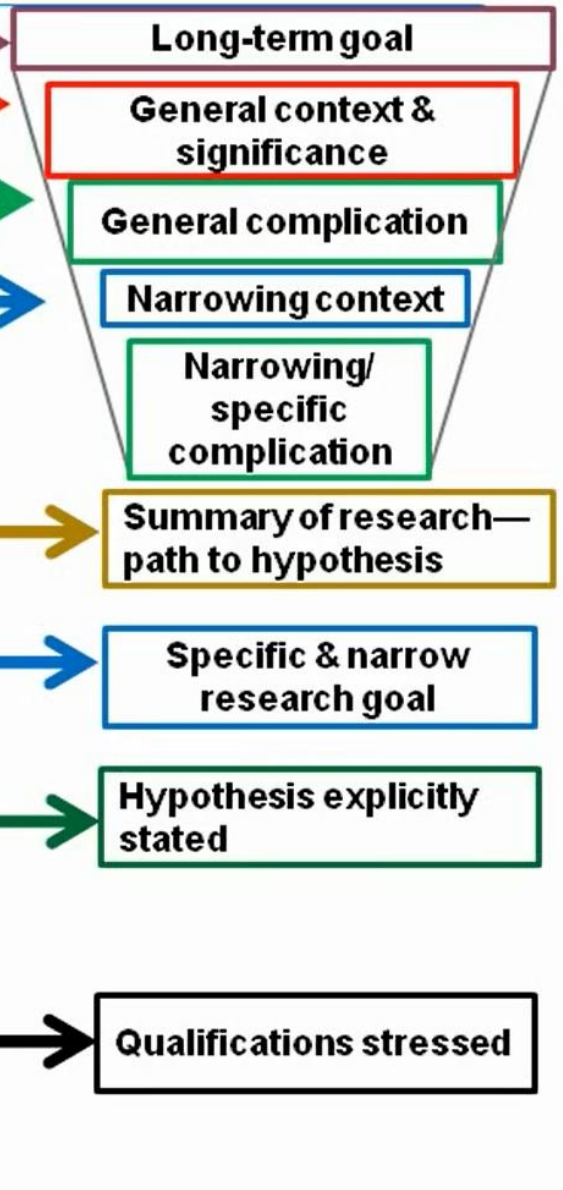
The next paragraph takes up other components, with qualifications addressed after aims

Specific Aims The long term goal of this research project is to identify the optimal dose and schedule of administration of drugs active against influenza viruses that will prevent and/or cure people with influenza without causing the emergence of resistant viruses. The adamantanes and neuraminidase inhibitors have been used for the prevention and/or treatment of influenza. However, they often fail because treatment with these drugs leads to the emergence of resistant viruses in the treated population.

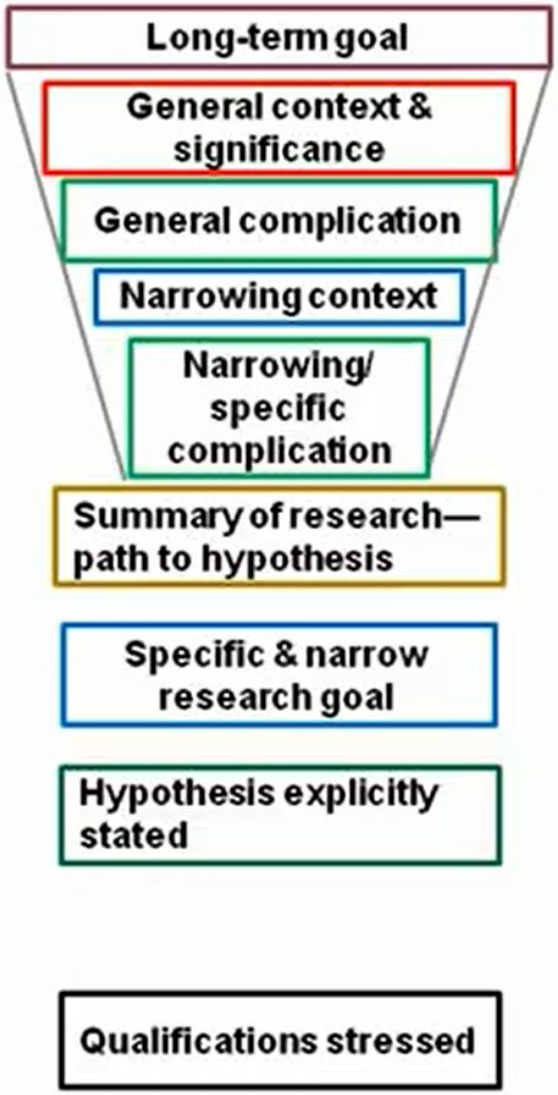
Adamantanes have historically been used in the treatment and prevention of influenza A virus infections (1). Recently, viruses that are resistant to these inexpensive drugs have emerged, rendering them less useful for the therapy of influenza (2, 3). Neuraminidase inhibitors represent a new class of agents for use against type A and type B influenza virus infections (1). While shown to be effective, there have been instances of emergence of resistance or reduced sensitivity during therapy with neuraminidase inhibitors (4-6). This has been seen especially in children where high clearances for these agents in general and oseltamivir in specific are the norm (5).

The hollow fiber infection model (HFIM) system has been used to determine the optimal dose and schedule of administration of antibacterial, antifungal and antiviral compounds for use in the treatment of individuals infected with bacteria, fungi, and viruses (7-16). We propose to use the HFIM system to study the effects of amantadine and the neuraminidase inhibitor, oseltamivir carboxylate, on the replication of influenza viruses and to identify the pharmacodynamically-linked variables for these antiviral drugs, alone and in combination, with respect to inhibition of virus replication. We also propose to identify whether a different pharmacodynamically-linked variable is present for suppression of emergence of resistance. We hypothesize that the HFIM system can be used to provide information on resistance selection in humans and that the HFIM system can be used to determine the dose and administration schedule of antiviral compounds and combinations of antiviral compounds that will inhibit the replication of influenza viruses while preventing the emergence of resistance.

Our research strategy involves a multifaceted, translational collaboration designed to optimize the move from research discovery to clinical application. The collaborators in this activity include a nonprofit research institute (Ordway Research Institute. Albany, NY), a non-profit genomics research institute (Translational Genomics Research Institute, Flagstaff, AZ), and a private biotech company (Adamas Pharmaceuticals, Inc, Emeryville, CA). This strategy has proven successful in other activities including a current and ongoing research project involving the above partners



So, let's look at the two rhetorical patterns, side by side—similar components different sequence



Your challenge is to identify these components for your research, arrange them logically; this template can help

General context & significance	What is "big picture" for research? Why is it important?
Narrowing context	What is known and accepted in your research area?
Your research contribution	Has your previous work contributed? How?
Complication	What is the problem, roadblock, the unknown?
Long-term goal	What final "big result" will research will help achieve?
Specific goal of this research	What is "specific narrow goal" of this research?
Summary of research—path to hypothesis	How does previous research lead to hypothesis?
Hypothesis	What do you believe to be the answer to the complication?
Qualifications stressed	What makes you the right person to undertake this research?

The writing design and rhetorical patterns carry through to Significance and Innovation

Think of Significance as taking the key sentences or paragraphs of the Aims page and expanding the details

The rhetorical patterns are the same, just more detail – and full references!

Following the exact same pattern really helps the reader

Be cautious about adding sections not touched on at all in the Aims page – a reader may not expect them

Innovation can be very succinct, bullet points even, hopefully already evident so you are just reminding the reader

Innovation is seldom score-driving unless too low

Teaching and learning proposal writing

All learning starts with ‘teaching’ new information/patterns/ skills that you could not be expected to know

Practice/apply – no substitute! This is where short workshops fall short – practice is best with something that matters

Feedback from experts – where peer groups alone are limited

Repeat, repeat, repeat, repeat – get the message?

Must start with small bits to learn from to avoid wasted time and ‘inaccurate’ learning

Providing feedback under expert guidance VERY fast way to practice and learn

McGee's Axiom

The probability of a proposal from an early-stage investigator (PhD student, postdoc, early faculty) being funded is directly (perhaps exponentially) proportional to the amount and quality of feedback received while writing

Feedback is essential at all stages of proposal development and is best provided on small portions of writing, NOT waiting for a full draft

Feedback – make or break for success

Simply not possible to do it on your own

But quality and timely feedback can be really hard to get

You have to do your part – starting FAR in advance

Think about how you will get feedback, from whom, in what ways, even BEFORE you start writing

I am going to propose you focus on oral feedback as much as traditional written feedback, especially at the start

Verbal feedback as an option vs. written

Both can be very helpful – not either/or

Written feedback strengths

- Written alternatives/explanations to work from
- Can be thoughtful response considering alternatives
- Can be created in open time – e.g. while flying

Witten feedback limitations

- Hard to get detail and focus
- Typing is a very slow process – limited details
- “Looks fine to me” – limited critical attention
- Hard to get someone to focus on large pieces of writing

Verbal feedback…

Verbal feedback (dialogue) strengths:

- Much more rapid and replicates initial response of the reader – first impressions matter
- Can reveal thinking leading up to reactions – logic path
- Able to think out loud and consider multiple options
- Engages the writer and reader in dialogue – multiple rapid iterations toward revision

Verbal feedback limitations:

- Thinking out loud can be interpreted as ‘final’ not fluid
- Not everyone comfortable with spontaneous reactions – prefer to mull over before declaring
- Need way to capture conversation or can slow down the process

What can verbal feedback look like?

"In the 30 minutes of our next meeting, I would like to have you read my Specific Aims page, paragraph by paragraph, and tell me what you are taking away from the paragraph, what you are wondering, what is making sense, what is not, what you still want to know. That way I can understand what my writing will read like for a reviewer, and you don't have to waste you time typing."

"We can talk through ways to fill in what is missing, get rid of what is not needed, move toward a compelling rationale for what I plan to do"

"So I don't have to try to type notes as fast as we talk, I will just record our conversation using my phone so I have all of it when I go back to revise toward the next draft."

Group/peer feedback vs. single expert

Both have great strengths done right!

- Group is stronger teaching/learning paradigm – observe multiple iterations and logic of expert
- Able to practice on others – much easier than self!
- Rapidly reveals what the 'expert' forgets to tell the reader
- Expert (coach) can 'teach' many people at once!
- Can be incredibly time efficient – reveals reactions of multiple brains at the same time – and revise in real time
- Attention and feedback visible – group keeps all on task

DON'T think of it as CRITIQUE – it is all about 'cognitive display' – "When I read this paragraph this is what my brain is doing."

This is my day job, so I believe in it, but not easy to set up

Critical elements of peer feedback

Well-intended but still novices – coach/mentor buffers/guides

You are not writing for reviewers TOO far outside your field so those outside can't expect it to be understandable by them

Value what peers provide – they often are more insightful than you might expect – less 'biased' to new ideas than mentors and 'experts'

<u>Not about critique or strong opinions about one 'right way'</u>

Take-Home Messages

Writing proposals is an invaluable element of high-quality research

Writing research grants is a teachable, learnable skill

- Often not approached as such because of the focus of research training on informal mentoring
- Effective grant writers (i.e. mentors) often can't explain or deconstruct why they write the way they do and why it works

The ability to write and sound like what reviewers expect is a central ingredient of being judged as a legitimate member of the research community – strong social underpinnings

It is extremely difficult to become a skilled writer by yourself – look to colleagues and groups as invaluable resources

More Take-Home Messages

Get feedback early and often on small pieces of writing

Recognize you will get different perspectives from different kinds of readers

See if you can get people to ‘think out loud’ as they read – reveal what they are thinking as they read

Feedback on a full proposal is great but requires a lot of time – be sure to have the right people do it

Don’t let writing proposals hold you back!

Good Luck!!!

Enjoy the journey on the road to acquiring Pathological Grant Seeking Behavior!

Rick McGee – r-mcgee@northwestern.edu