

Beginning to Begin: Specific Aims

Chris Moore

College of Health and Rehabilitation Sciences: Sargent College



Objectives

- Your stress level with respect to grantwriting will decrease by 83%.
- You will identify the various people you need.
- You will have some understanding of the tasks involved in submitting a research grant application
 - Identifying your Research Questions
 - Scope
 - Expertise (you, your team)
 - Resources (your lab, your team resources, your institution)
 - Identifying an Agency and a Funding Mechanism
- You will have a general sense of what you need to find out from your institution
 - Requesting/transferring your eRA Commons User ID
 - Budget approval process and contacts
 - Submission process
 - IRB/IACUC process
 - Required training (e.g., Human Subjects, Animal Use, Research Ethics)
- You will know what makes a strong Specific Aims page
- You will know who your target audience is.

For whom are you writing?

Your reviewers are:

- Typically three assigned reviewers
- Recognized authorities in their fields
- Principal Investigators on projects comparable to or exceeding in scope those being reviewed
- Represent the national diversity with respect to:
 - geographic distribution
 - gender
 - Race
 - ethnicity
 - disability
- Scientists with a sense of community who understand the crucial role of identifying the most meritorious research applications.

Your Reviewers' Job

- The explicit objective of review is to:
“Fund the best science, by the best scientists...”
 - Looking for innovative, impactful proposals from talented, experienced scientists with good institutional support.
 - This is a competition.
 - Confirm that you are the right person in the right place asking the right questions.
- **Review does not**
 - Consider your financial or situational need.
 - Provide a manuscript-style review to suggest improvements.
 - Make sure that everyone gets a fair share of the available funding.

**You have your target.
You know your audience.
Now you can start.**

Your project must fit your funding target

- A two-year project (e.g., R03) must be appropriate in size and readiness
 - Ready to go. Lab space, target population & research team are all in place.
 - Demonstrably feasible for quick recruitment, acquisition, analysis and write-up
- A five-year project (e.g., R01) must be sufficiently complex, well-planned, and conceptually deep to warrant a large commitment.
- If you have targeted a TRAINING or CAREER DEVELOPMENT MECHANISM (e.g., F31, F32, K##):
 - In addition to the Research Plan itself, you must highlight the training potential afforded by your Sponsor, the Training Environment, and your own Background.

Overview

- Your Readers / Reviewers
- Review Objectives
- Getting a grip on your project's size and focus
- Innovating within the framework
(Normal Science vs Revolutionary Science;
à la Thomas Kuhn)
- Exploiting your unique talents
- What are Specific Aims?
- Strong Aims & Scientific Context
- Writing compelling Aims
- Common Challenges, Flaws and Errors
- The Scope of your Project

Getting Ready to Think About Starting to Approach the Concept of a Notion Regarding a Suggestion of your Idea

- Your Demonstrated Strengths
- Your Demonstrated Preparation
- Feasibility
- Where your idea fits in your scientific area
- Your Demonstrable Team
- Scope
- Guidance from your Program Officer

Choosing Your Topic

Building a Framework

- Stick with your strengths and your proven history. This is not the time to try new techniques.
- Select an approach for which you can provide published evidence that you and your team experienced and capable.
- Think creatively. Be innovative. Keep an eye on the Big Picture.
- Recognize your place in the overall framework of your discipline. Where are you best equipped to contribute to the overall advancement of the scientific enterprise in your area of expertise?
- There is no substitute for placing yourself solidly in the stream of ideas in your discipline.

Tackling the Specific Aims

- One page! No more. No less.
- Typically there are three aims.
It's just cultural.
But beware of any formula.
- Like an Abstract, but not.
- Like a Experimental Design, but not.
- Like a Literature Review, but not.
- Every element of the rest of the application should refer back, at least implicitly, to the Aims.
- Many readers will read only this page.

Aims must include:

- Your framework
- Your theoretical objectives
- Your experiments
 - Each experimental question
 - Experimental population
 - Key methods
 - Experimental design
 - Statistical models
- Consequences of the outcomes, including alternate outcomes.
- Perfect to send to colleagues and advisors for a quick check

Describing your Project in a Single Page

- Make your background framework explicit.
You know where this research fits in the greater scheme.
- Recognize your place in the overall framework of your discipline.
Where are you best equipped to contribute to the overall advancement of the scientific enterprise in your area of expertise?
- Play to your strengths and your proven history.
Highlight your own work that brings you to this point.
- Highlight innovative and creative aspects of this project.
- Formally state each experimental hypothesis.
- Formally state (or at least refer to) your experimental design (including modeling, statistical tests, controlled factors)
- Narrowly identify your sample population.
- Describe how the outcomes of these experiments will advance science within the framework you have constructed.
- Describe how these experiments will lead to improved human health or educational outcomes.

Strong Aims

- Are **memorable!**
 - Succinct and easy to read
 - Describe experiments with expected possible outcomes
 - Are programmatic and linked
 - Might
 - Challenge an existing paradigm
 - Address a critical barrier
 - Develop a new technology
 - Describe experiments that are novel and creative
 - Describe experimental objectives with a clear path to human health or societal benefit
- **Feasible**
 - For you and your team
 - In your environment (including targeted populations)
 - In the time allocated
 - Include formal statements of each experimental hypothesis, entailing a specific formal test of each hypothesis.
- Draw a clear line through
1. **what is known,**
 2. **to your contributions to that knowledge,**
 3. **to knowledge gaps and their consequences,**
 4. **to how this study will fill these gaps.**

Challenges in Constructing your Specific Aims

- Um... Be Specific! Aim!
 - Non-specific references to description (“looking at X”) or general effects leave you without an experiment.
- Building a rationale on something beyond a “paucity of extant literature”.
If you think your research is unique, you’d better look into that notion a little more deeply.
- There must be a theoretical framework.
If you don’t provide a framework, the reviewers will, and, **lo, it shall be “Fishing Expedition.”**
- It’s hard not to be **over-ambitious**.
Realistic and detailed projections of time needs will keep you in the **Feasible World**.
- **Domino Experiments**
(e.g., Aim 2 becomes meaningless if Aim 1 fails to go as planned)
- Failing to highlight the implications for **human health or education**

Common Problems with Specific Aims

- #1 = **Over-ambitious**
- Aims that are not Specific
 - Non-specific references to description (“looking at X”) or searching for an effect
- An incomplete understanding of the area
- Missing key citations
- Dogma (use of first person language can convey this unintentionally; “we believe...”)
- Hypothesis is not **falsifiable**.
- ~~You have included way too many words, including many that are superfluous, unnecessary, and fail to add actual content to the narrative you are building.~~
- **Preventable disasters:**
Typos, grammar erroneousess, form atting errors, citation errors¹⁴
- **Wrong target audience:**
 - Too High = **The Snow Job**
overly detailed and technically descriptive, without appropriate context
aka: A person who really works in this area would see how amazing it is.
 - Too Low = Trust Us
We’ll-Work-That-Out-When-We-Get-There. aka: Just Send Ca\$h
aka: you couldn’t possibly understand this
- **Unclear sample populations or experimental conditions**
 - vague, inappropriate, or unrealistic



MooreCA@bu.edu



College of Health & Rehabilitation Sciences: Sargent College

Grantwriting for Early Stage Investigators

Chris Moore

College of Health and Rehabilitation Sciences: Sargent College



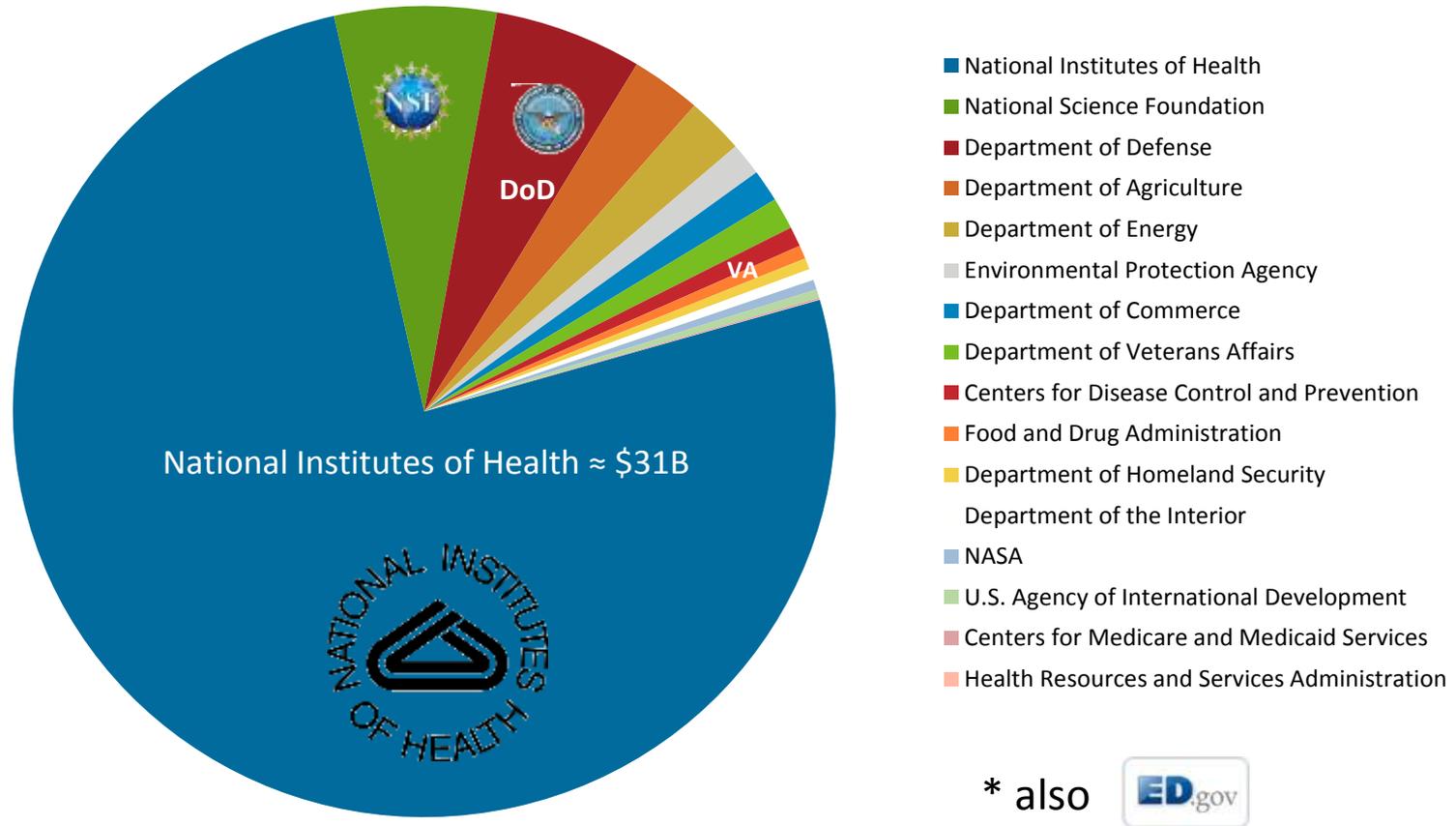
Objectives

- Your stress level with respect to grantwriting will decrease by 83%.
- You will identify the various people you need.
- You will have some understanding of the tasks involved in submitting a research grant application
 - Identifying your Research Questions
 - Scope
 - Expertise (you, your team)
 - Resources (your lab, your team resources, your institution)
 - Identifying an Agency and a Funding Mechanism
- You will have a general sense of what you need to find out from your institution
 - Requesting/transferring your eRA Commons User ID
 - Budget approval process and contacts
 - Submission process
 - IRB/IACUC process
 - Required training (e.g., Human Subjects, Animal Use, Research Ethics)
- You will know what makes a strong Specific Aims page
- You will know who your target audience is.

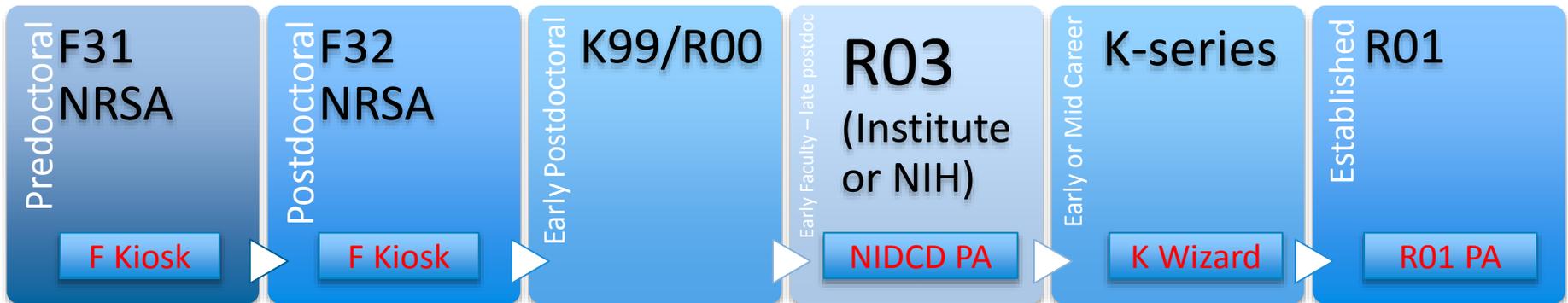
Overview

- Funding Agencies
- Funding Decisions
- Funding Mechanisms
- Your Readers / Reviewers
- Review Objectives
- Getting a grip on your project's size and focus
- Innovating within the framework (?)
(Normal Science versus
Revolutionary Science; a la Thomas Kuhn)
- Exploiting your unique talents
- What are Specific Aims?
- Strong Aims & Scientific Context
- Writing compelling Aims
- Common Challenges, Flaws and Errors
- The Scope of your Project
- Additional Resources

Where the Dollars are: Health Research Funding by Agency



Which funding mechanism fits you best?



Special Cases

R21

[Institute-specific
Research Grants Page](#)

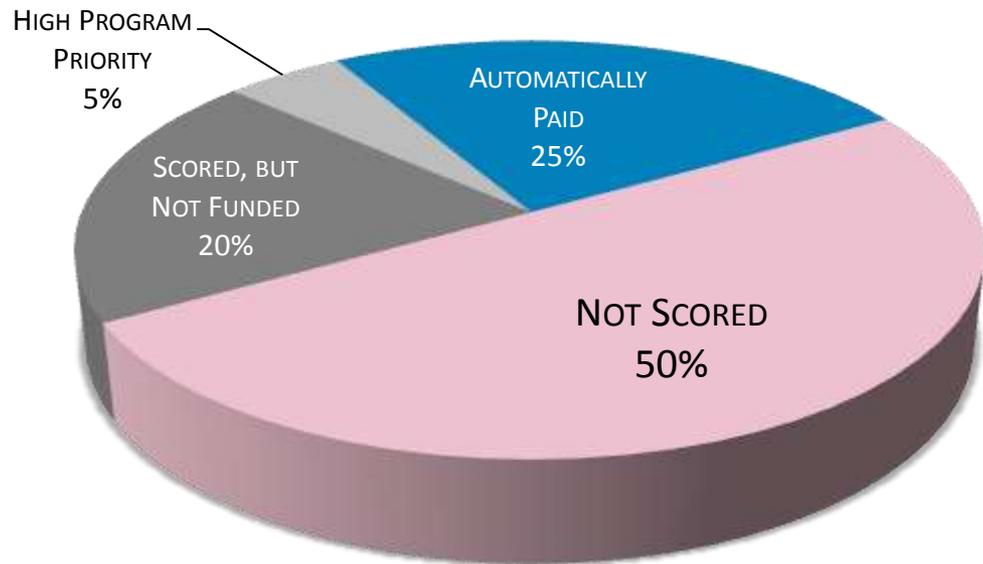
- e.g., High Risk – High Innovation or Translational to Patient Care

Supplements & Mechanisms for Under-Represented Minorities

Your piece of the pie

- Percentiles
- The Automatic Payline
- The Gray Zone
- High Program Priority
- “What NIH wants...”

EXAMPLE: FUNDING DECISIONS FOR ONE MECHANISM FOR RESEARCH APPLICATIONS



The Study Section / Review Panel

Check the membership of your likely study section.
There are many panels, but just for orientation, here are two examples:

Language and Communication (LCOM):

<http://public.csr.nih.gov/StudySections/IntegratedReviewGroups/BBBPIRG/LCOM/Pages/default.aspx>

Auditory System (AUD):

<http://public.csr.nih.gov/StudySections/IntegratedReviewGroups/IFCNIRG/AUD/Pages/default.aspx>

Project Scope

Keep a close eye on the time and budgetary commitments your project entails

How long will it take to identify, recruit, consent, screen, schedule, and run/treat each subject?

Are all specialized personnel needs met by the Key Personnel?

Are all ancillary arrangements in place:

- release time (letter of support from department chair)
- special clinical populations (letters of support from cooperating clinicians describing population numbers and characteristics at their facilities)
- access to specialized equipment (letters of support from cooperating labs)
- mentoring guidance (letters of support from on-site and off-site mentors)

Is all specialized equipment available or ready to order?

How long will it take to index, clean, and reduce the data?

How long will analysis of the data set require?

More Outline

- Self-Assessment – Knowing when you're ready
- Setting a funding goal
- Learning the grantwriting culture
- The grant submission process
- Online resources at NIH
- Why do you need a research grant?
- NIH Funding Mechanisms – Revisited
- People... People Who Need People...
- The Grantwriting Time Scale
- Forms
- Your Budget
- Review Criteria
- Significance – Strengths & Weaknesses
- PI/Team –Strengths & Weaknesses
- Innovation – S & W
- Research Design – S & W
- Outcomes – S & W
- Other Reviewed Elements
 - Use of Human Subjects or Animals
 - Budget
 - Biohazards /
Special Agents /
Stem Cells
- Examples of
Comments from
Critiques



Are you ready? Really... Are you ready?

- Self-assessment
 - Your publication record relative to your career stage
 - Your specialized training
- Your lab resources
 - Equipment / Space
 - Trained lab personnel
- Your team
 - Covers all necessary areas, including senior guidance
 - Experts
 - Communication and authority within the team
(especially where senior-level guidance is included)
- At your institution
 - Realistic Release Time (grant preparation and buyout)
 - Support personnel (e.g., IT, statistics, animal care, subject pools)
 - Clinical facilities and research relationships with them
 - Documented access to target populations
- Your idea
 - **Demonstrated feasibility**
 - High likelihood of success/impact
 - Clear experimental objectives

Best if used by ...

- Watch out for your own expiration dates
- Examples:
 - The F31 program (although most institutes don't provide predoctoral support)
 - Recipient must be a doctoral candidate
 - F32 can be written in advance of dissertation defense
 - NIDCD's R03 program (larger budget; expert review; better payline?)
 - Less than 7 years beyond terminal degree)
 - NIH Early Stage Investigator status
 - Less than 10 years since completion of terminal degree
 - K99/R00 Pathway to Independence
 - Less than 5 years of postdoctoral training

Keep your eye on the ball

- Identify your target
Agency (e.g., NIH),
Institute (e.g., NIDCD) and
Mechanism (e.g., R03)
- Read the Program Announcement **carefully**
- Contact your Program Officer
(email with request for a brief phone call)
- Download the application materials
 - Study the parts of the application so that you understand the task.
 - Pay attention to the things that take time, especially where you depend on others (e.g., Biographical Sketches; lab descriptions; letters of support)

Pay Attention to the Terms, Structure, and Organization

- Grant submissions entail a lot of specialized, technical knowledge. Don't dismiss these technical issues as trivial. **Resistance is futile.** You must become technically proficient in this process. It's the culture.
- FOA / PA / RFA / RFP
- F31, F32, K01, K02, K08, K18, K23, K99/R00, R03, R01, R15, R21
- NIH / VA / NSF / Ed / NIA / NIDCD
NICHD / NIMH / NIDRR / NIDCR

The Grant Submission Process - Logistics

- At your institution
 - Get your eRA Commons account established / transferred right away
 - Budget development & approval – signatures at department and college-levels
 - Submission through Research Office
- At NIH.Gov
 - Download the Application Guide and the Program Announcement
 - Identify your Program Officer and your target Review Panel
- On Grants.Gov
 - Be well-ahead of schedule.



Online Resources at NIH

- www.nih.gov
- www.nidcd.nih.gov
- www.nia.nih.gov
- www.nichd.nih.gov
- www.nimh.nih.gov
- <http://Report.nih.gov>
- <http://public.era.nih.gov/commons>
- www.training.nih.gov
- http://grants.nih.gov/training/F_files_nrsa.htm = F Kiosk
- <http://grants.nih.gov/training/careerdevelopmentawards.htm> = K Kiosk



Grantwriting 101: <http://videocast.nih.gov/summary.asp?Live=12277&bhcp=1>

Identify What the Grant Needs to Provide

- Salary Support / Teaching Release / Summer Salary
- Key Personnel Examples
 - Co-Investigators / Consultants
 - Graduate Research Assistants
 - Lab Manager
 - Programmer
 - Statistical Consultant
 - Research Assistants
- Equipment
- Subject Reimbursement
- Travel
- Other Supplies

People

- Your local, in-the-next-office, experienced grantwriting process mentor
- Your in-your-immediate-subdiscipline, experienced scientific mentor(s)
- Your Program Officer
 - All Training Activities (F or K): Training Officer at the Institute
 - Small Grant Program (R03): Small Grants Program Officer
 - Research Grants (R01): multiple Program Officers – see NIH website
- Your Budget expert

Budgeting Time in Grantwriting World

- Are you ready?
- Is your institution behind this effort?
(e.g., with release time, technical support)
- Do you have enough time?

Use The Application for Research Grant Heuristic - ARGH
(Grantwriting Time Budget Calculating Tool™)

$$T_{actual} = T_{estimated} \times 3 \text{ etu}$$

where **etu** = Elevated Time Unit
(e.g., seconds elevates to minutes; hours to days; months to years)

Anatomy of the SF424

- Introduction to a Resubmission (1 page)
- Specific Aims (1 page)
- Research Strategy (6 or 12 pages)
 - Significance
 - Innovation
 - Approach
 - Timeline
- Protection of Human Subjects
- Inclusion of Women and Minorities
- Inclusion of Children
- Vertebrate Animals
- Letters of Support
- Appendix (limited use)
- Budget (modular)
 - Budget justification
- Biographical Sketches for all Key Personnel (4 pages)
- References Cited

Research Strategy

- The Narrative
- These 6-to-12 pages are where you do all of your real creative, scientific work.
- Fully develop the Background
- Describe your Preliminary Results
- Describe your Experimental Design
- Lay out the Sample, including all narrowly defined inclusion/exclusion criteria
- List all standardized tests
- Describe all non-standardized assessments
- As needed, describe formally structured involvement of senior personnel and team members.
- Describe statistical treatment and modeling
- Carefully consider pitfalls and remedies
- Consider alternate outcomes and their interpretation
- Use synthetic data to show full treatment and interpretation.
- Confirm feasibility by referring to published results and/or showing real data.
- Describe the consequences of these results.
- Include a detailed timeline

Budget

- Not a trivial task; not for newbies. You need help and advice on designing your budget.
- Usually, about 80% or more of your budget is PERSONNEL.
- Some specialized equipment is expected, but most research grants are not the way that you build a lab from the ground up.
- Subject costs
- Sub-contracts / Consortium costs (when other institutions are involved)
- Other costs include:
 - Supplies
 - Computers
 - Travel
 - Publication Costs
 - Indirect Costs

What Reviewers are Looking For...

The CORE Criteria

- Research Grants



Significance



Investigator



Innovation



Approach



Environment

- Training Grants



Applicant



Sponsor/Team



Research Plan



Training Potential



Environment

Significance – Strengths

- The project addresses an important problem or a critical barrier to progress in the field.
- If the aims of the project are achieved, scientific knowledge, technical capability, and/or clinical practice will be advanced.
- Completion of the aims will change the concepts, methods, technologies, treatments, services, or preventative interventions that drive the field.



Significance – Weaknesses

- Lacking or weak theoretical framework
- Aims are not hypothesis-driven
 - methods-, population-, or technology driven
- Weak or unclear motivation (“a lack of information” is not necessarily motivating)
- Poor integration of existing literature (especially when the reviewers’ contributions are ignored... ouch!)
- Weak connection to human health



PI / Candidate / Research Team - Strengths

- PI's, collaborators', and other researchers' areas of expertise are well suited to the project.
- If Early Stage Investigators or New Investigators, does s/he have appropriate experience and training?
- The PI's record of accomplishment is appropriate for career stage and has advanced the field.
- If the project is collaborative or multi-PD/PI, the investigators have complementary and integrated expertise;
 - leadership approach, governance and organizational structure appropriate for the project.



PI / Candidate / Research Team - Weaknesses

- Weak publication record / trajectory *relative to career stage*
 - Non-productive post-doc training
 - Unpublished dissertation research
 - Unproductive prior grant support
(perception is that supported work won't be published)
- PI lacks training in methods or analysis, and lacks collaborator to offset this weakness
- Application lacks a formal plan for collaborators to interact
- Team lacks expertise (supported by publication) in essential area
- Mentor who is too junior, overcommitted, or unfunded



Common Strengths 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?



Common Weaknesses Innovation

- Techniques are not current or appropriate
- Tilted too heavily to description
- Too incremental
- **Just not interesting**
 - “Among the infinite questions that *could* be asked, is this the one that most deserves to be addressed?”
 - Does it advance an important scientific area?



Research Design – Strengths

- The overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims.
- Potential problems, alternative strategies, and benchmarks for success are presented.
- Necessarily risky aspects of the experiments are anticipated and managed.
- For clinical research, 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, are justified by the scientific goals and research strategy.



Research Design – Weaknesses

- Overambitious (#1) – betrays naiveté & poor planning (not “drive” or bang-for-the-buck)
- Feasibility not demonstrated
 - Feasibility of sample size, population, techniques
 - Please... “Pilot data”, which may be adequate to demonstrate feasibility should never be discussed as an underpowered experiment that just needs to be supported statistically.
- Justified need for the approach proposed
- Sample size not supported
 - By power analysis using real support values
 - By preliminary data (R03s have a lower standard here)
 - Using reasonable effect sizes



Outcomes – Strengths

- Preliminary or hypothetical data are presented as a way of illustrating the targeted data set.
- The experimental design (including a well-motivated power analysis) is appropriate and economical with respect to the specific aims.
- The alternative potential outcomes are thoroughly considered and interpreted.



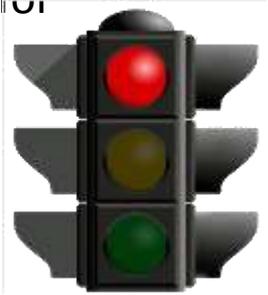
Outcomes – Weaknesses

- Failure to present possible results and interpretation
- **Failure to consider possible pitfalls and remedies**
- Failure to describe consequences, scientific impact, and potential impact on human health.
- Potential results are not described in terms of the potential scientific advances and impact.



Reviewer Comments – Not Enthusiastic

- “The first two aims of the proposed research have already been completed.
- “The proposed research appears very unlikely to be completed in the proposed time. Too many experiments are proposed, and there is no evidence that the applicant can generate this level of productivity.”
- “The applicant’s weak publication record and the lack of a dissemination plan suggest that it is unlikely that the proposed research will be published.”
- “The proposed research is not substantially different from work by Sesame, Bialy, and Garlic (*Bagels Today*, 2010), which provided an unequivocal result.”
- “The application lacks any demonstration of feasibility; the clinical sources for subjects are undocumented; the applicant has no demonstrated expertise in the proposed methods; institutional support is weak, given the department’s failure to provide space or release time.”



Reviewer Comments – Enthusiastic

- “The applicant has a strong publication record, including frequent (about three publications per year) first-author publications in high-impact journals, including *Nature*, *NEJM*, and *Cell*.”
- “The composition of the research team is very strong, including highly productive researchers (i.e., each leads his/her own funded laboratory) in complementary research areas (e.g., perceptual psychology, developmental biology, pediatric audiology). All areas of expertise required by the proposed research are included.”
- “The likely success of this research is considerably enhanced by the logistics of the mentoring plan and the excellent alignment of the mentor’s expertise with the proposed research.”



Check out some funded projects

RePORTER

<http://projectreporter.nih.gov>



Search Fields:

- Project Details - R03 or F32, for example
- Use Text Search to search your discipline



MooreCA@bu.edu



College of Health & Rehabilitation Sciences: Sargent College