Grant Writing Tutorial

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Annual Meeting
American Society of Biomechanics
Providence, RI
August 18–21, 2010

Overview

- First Part by Dr Buchanan: writing for the NIH with subtopics in understanding the grant application review process, writing an unsuccessful proposal, mock proposal review, new guidelines
- Second Part by Dr Stergiou: tips for successful proposals to any funding agencies
- Q & A session

Part 1 (Buchanan): Overview

- Understanding the grant application review process
- NIH funding mechanisms relevant to us in biomechanics
- How to write a bad proposal
- Mock proposal review

Understanding the NIH Grant Application Review Process

- How NIH applications are scored, ranked, and funded
- What goes on at an NIH study section meeting
- Ethics, etiquette, and politics

Review Formats

- full study section
  - subset reviews each proposal
- small panel
  - group meeting/conference call
  - everyone reviews the proposal(s)
- individual written reviews
  - no group dynamics
  - usually only one proposal

Reviewers

- reviewers are not blinded to the applicants
  - because they must assess their qualifications
- reviewers leave the room during the discussion if they
  - work at the applicant's institution
  - are otherwise close to the applicant

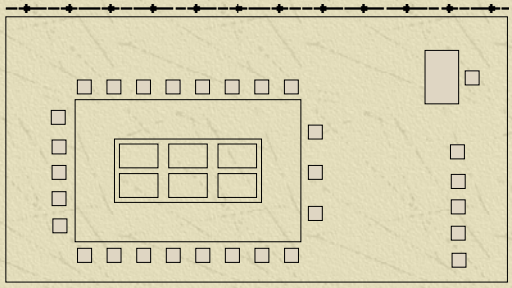
NIH Study Section Meeting

- about 25 reviewers
  - university, government, industry scientists
  - "regular" and "ad hoc"
- one regular member is chair
- Scientific Review Administrator (SRA) is NIH's overseer
- 40-140 proposals reviewed in a session

NIH Study Section Meeting

- each proposal is assigned to
  - a primary reviewer
  - a secondary & usually a tertiary reviewer
  - sometimes 2-3 "readers" (do not write a full review)
- each reviewer has about 10 reviews to write and several proposals to read
- everyone is free to discuss/comment
- everyone scores every proposal

NIH study section meeting



NIH study section meeting

- "streamlining" or triage
  - at start reviewers provide list of proposals they reviewed that were in bottom half
  - if assigned reviewers agree and no one objects, proposal not scored or discussed
  - anyone can object, no argument necessary
- usually < half streamlined
- usually 20 - 30 min. per discussed proposal

NIH study section meeting

- primary reviewer presents the proposal
  - description
  - positive and negative aspects, init. score
- secondary & tertiary reviews follow
  - detail depends on extent of agreement
- readers comment, general discussion
- 1º, 2º, 3º reviewers suggest scores
- everyone writes down their own score
- budget & ethics are discussed after scoring

NIH study section meeting

- Scores are 1 (best) to 9 (worst)
  - anything ≥ 5 (or in bottom half) should be streamlined
- mean score of all study section members x 10 = reported score (i.e., 10-90)
- The relationship between priority score and percentile rank varies by study section.

NIH study section meeting

Calculating an R01's percentile score:

- all the applications for the current study section meeting are pooled with those from the previous 2 meetings of the same study section
- the scores are rank-ordered and the application's percentile is calculated

Ethics, Etiquette, and Politics

- The SRA and chair are ethics watchdogs
  - no conflicts of interest, real or perceived
  - no discussions of application between reviewer and applicant, before or afterward
  - all discussions of applications between reviewers must occur in session
- the mood of the room is professional
- other NIH administrators usually present

NIH Funding Decisions

- funding is based on 2 levels of review
  - study section - 90% of the decision
  - the institute's advisory council
- the "council" = intramural and extramural scientists and administrators
  - assess quality of reviews
  - decide on grant's budget
  - factor in legislative mandates
  - cannot alter the scientific evaluation or score

NIH Funding Mechanisms

- NRSA awards (F31, F32)—pre-doc and post-doc grants
- K awards (K01-K99)—career development grants
- R03—small, starter grants. Pilot & feasibility studies.
- R15—AREA grants (Academic Research Enhancement Award) for institutes without strong NIH histories. No preliminary data required.
- R21—exploratory/developmental grants, no preliminary data required.
- R01—big boy grants
- P awards (e.g., P01)—program project grants for large teams (really big boy grants)

A 10-step Plan for Losers

Advice for Writing a Bad Grant Proposal

1) Don't Include Hypotheses!

- In reality, the secret to "doing research" is to go into the lab, measure a bunch of things, and see what looks good.
- Just write in your proposal that if you get the grant you will try to do things using plan *A*. If that doesn't work, you'll think of a plan *B*, etc.…until you get things working. This is the classical "shotgun" approach and it is especially popular among engineers.
- In fact, this is what separates engineers from scientists (who are confined by the so-called "scientific method").

2) Be Ambitious!

- A good proposal is one that demonstrates to the reviewers that you have lots of ideas, so write them all down.
- Don't worry if you are proposing enough work for ten or fifteen years—the reviewers will tell you which ideas they want you to pursue.

3) Cool Tools Rule!

- If you have developed a model or an engineering method that nobody else has, write a proposal that uses the model in as many ways as possible.
- These uses do not have to be related to a common problem or even to each other—reviewers will know good science when then see it!
- Show them how cool your method is and do not worry about trendy phrases like "biological relevancy."

4) For Clinicians: Don't Worry About Engineers!

- Submit your proposal to the NI*H*, not the NSF. There are no engineers at NIH.
- Only use very simple engineering whenever necessary—about the level of a freshman physics course—because addressing clinical problems is key.
- Do not reference state-of-the-art engineering approaches or else the reviewers will not be able to follow you. Besides, what are the chances that they would ask someone like Scott Delp to review your proposal?

5) Statistics Are for Anal-retentive People!

- When you write about data analysis, just say something like "I will do statistics on the data." The reviewers will understand what you mean.
- They all know that you will feed your numbers into a computer and look for the best "p" values, so don't mess with the details.

6) Remember: Hypotheses Are Simply Your Good Ideas!

- If you feel compelled to formulate hypotheses (despite #1 above), make sure that they are grand and glorious.
- They should not be specific enough to be testable.
- Furthermore, once they are described in the opening section, you should never refer to them again.
- Your goal (beyond getting funded) is to do science, *not* to test hypotheses.

7) Use Creative Writing!

- The introduction of fictional characters into your proposal who explain things to the reviewer is highly effective.
- This adds the needed human element and helps to avoid all those passive sentences.

8) "Preliminary Work" Is Not Cost Effective!

- The granting agency wants you to do some of the work before they give you the money. Don't let them trick you!
  - *They are just trying to save costs.*
- If you do substantial previous work, they will fund you for less time.
- Economically, it if far better to have a poorly developed "previous results" section then to solve all of the hard problems without being paid for it.
- Just stress in your proposal that you are a professional and you will be able to solve any problem that arises.

9) Be As Technical As Possible!

- Try to impress the reviewers with your knowledge of math or engineering.
  - For example, if you are describing the 3D geometry of the surface of the knee, refer to it as "a manifold in *n*-space."
  - Another great strategy is not to assume your coordinate systems are orthogonal.
- Remember, if the reviewers have trouble understanding your proposal and are left scratching their heads, they can only conclude that you are smarter than they are.

10) Researchers Are Not Bean Counters!

- The "budget sheets" are boring parts of every proposal where you are asked how much money you want. Enter big numbers here.
  - Don't mess with a lot of prose justifying why you need a 16-processor supercomputer. We all know that you need it because it will be cool and those who get grants get cool things!
  - Never mind that you won't use it for much beyond word processing. Hey, you are going to need something to write that next proposal on a few years from now!

"The Six Million Dollar Corpse"

A Mock Grant Proposal

Abstract (Part 1 of 3)

Crash dummies have been employed for simulating traumatic injuries in humans since the 1920s [1]. Recent advances in crash dummy technology have given us dummies with realistic constitutive properties for skin [2,3], bones [4,5,6] and even internal organs like liver [7], stomach [8] and brain tissues [9,10]. However, to date no crash dummies have included any structures that resemble the human neuromuscular system. This is a significant problem because muscles are the key structures for stabilizing the joints [12-20]. …

Abstract (Part 2 of 3)

The goal of this project is to design a Muscle Activated Crashdummy (MAC) that, in addition to the constitutive properties of passive tissues found in other models [2-10], will have realistic muscles and reflexes. The key to MAC's uniqueness will be his artificial muscles made from polyacrylonitrile fibers [21]. These fibers will be used because they exhibit Hill-type force-velocity relationships [22] and have similar passive constitutive properties to normal muscles [cf 23 and 24]. To make MAC realistic, sixteen muscles that span the neck, spine, shoulders, elbows, wrists, hips, knees, and ankles will be included. …

Abstract (Part 3 of 3)

In addition, MAC will have a nervous system that will provide realistic reflexive feedback to the muscles so that they can be used to stabilize the joints. Data for the basic constitutive properties of MAC will be taken from previous crash dummy studies [25-29]. Reflexive muscle activations will be recorded from EMGs during simulated driving accidents in instrumented stuntmen and stuntwomen. MAC will be compared to data from a generic crashdummy: the Deafferanted Unmuscularated Mannequin Body (DUMB). In a series of crash tests we believe it will become apparent that MAC is superior to DUMB in modeling traumatic injuries.

Review Outline for NIH Grant

- 1. Significance
- 2. Investigators
- 3. Innovation
- 4. Approach
- 5. Environment
- **Overall Impact**

1. Significance

- People get killed or seriously injured in car crashes every year. These injuries constitute a major component of national health care costs
- Crash dummies are widely used for studying traumatic injuries. But current ones cannot simulate the neuromuscular responses.
- Score: 3

2. Innovation

- Perceives a need in the field and attempts to fill it in a unique way. The lack of soft tissue responses in current crash dummies is a serious shortcoming.
- In principle, adding such responses could represent an important innovation.
- The use of polyacrylonitrile fibers in novel and interesting and novel means of modeling active as well as passive tissue properties.
- While novel, the feasibility of the project is low (see approach)
- Score: 4

3. Investigators

- Written by a reputable investigator who received his PhD in Applied Mechanics from Northwestern University in 1986. He is currently the Laird Professor of Mechanical Engineering and Director of the Delaware Rehabilitation Institute at the University of Delaware.
- Although he has a strong background in biomechanics, he has no publications in this area.
- Needs additional collaborators: statistics, chemical engineering
- Score: 5

4. Approach (1 of 3)

- Strengths:
  - Based on solid principles of biomechanics and neuromuscular physiology.
  - Attempts to validate model with real data.

4. Approach (2 of 3)

- Weaknesses:
  - Cute language (MAC and DUMB) is strained and doesn't help. [This won't be articulated in the review.]
  - Hypotheses are not clearly articulated and are not testable—no possible statistics.
  - Lacks preliminary data.
  - It would be outrageously expensive and so technically difficult that the likelihood of success is low. It would take forever to get so many muscles to work properly. Overly ambitious.

4. Approach (3 of 3)

- More Weaknesses:
  - The approach is naive. Most traumatic injuries occur so quickly that muscles do not have time to be activated.
  - Polyacrylonitrile fibers resemble real muscle, but are about 100x slower, making them useless for this study.
  - Instrumenting stuntmen (and stuntwomen) in auto accidents? This would not receive human review board approval.
- Score: 8

5. Environment

- As stated, the project would be strengthened by the addition of a Chemical Engineer knowledgeable in polyacrylonitrile fibers.
- It is unclear whether or not the investigators have the facilities to perform crash tests on conventional and polyacrylonitrile-equipped dummies
- Score: 5

Overall Impact

- This is a surprising naïve proposal from a highly regarded expert in biomechanics.
- It will have no impact in the field due to is low likelihood of success.
- This proposal would be recommended to be *streamlined* (overall score = 7).

Part 2 (Stergiou): Overview

- Why is grant writing important?
- Tips for successful proposals to any funding agencies
  - The seven-steps for writing a good proposal
  - Tips for success (getting started, funding the right agency, evaluating your ideas, etc.)

Why is Grant Writing Important

- At least five benefits are listed below
  - Your research ideas are peer-reviewed
  - Provides funding for research personnel
  - It is THE measure of success in research
  - Institutions require it for continuation
  - Permits larger research projects

Why is Grant Writing Important

- Extrinsic Motivation: rewards originate outside the individual (money, prestige, awards, recognition, perks)
- Intrinsic Motivation: rewards originate with the individual (satisfaction, self-worth, feeling of competence)
- FACULTY ARE MOTIVATED MORE BY INTRINSIC THAT EXTRINSIC FACTORS

Tips for successful proposals to any funding agencies

- There are many funding agencies
- Federal, State, Private, etc.
- The following tips have been compiled from various sources and have been applied successfully

How to write your grant proposal: Seven Steps

- Step #1: Your Notebook
  - get a BIG Notebook with dividers where you include the following:
  - application forms and guidelines
  - the agency's mission
  - contact information
  - anything you can find about the reviewers
  - previously funded applications from this agency if you can locate any
  - timeline to check your progress

Seven Steps

- Step #2: Getting you and your science ready for review
  - Write one page with your aims (hypotheses or questions) and the significance of your study with respect to the mission of the agency
  - E-mail this page to the agency to receive feedback
  - E-mail this page to few trusted colleagues that can give honest feedback
  - Tighten your aims based on feedback received

Seven Steps

- Step #3: Look at the scientific mandates of the work you propose
  - the SCIENCE has to be startling, clear, and compelling
  - Obtain formal professional biostatistical help, giving the biostatistician the research aims. Ask for a power analysis, and a synopsis of the biostatistical modelling/analysis which will be used. Make sure you understand the concepts well, so that it is easier to formulate a research plan.

Seven Steps

- Step #3: Look at the scientific mandates of the work you propose - continued
  - Read and reread the world's literature paying special attention to studies similar to yours
  - If possible find some studies that have a similar statistical design with yours and read them carefully

Seven Steps

- Step #4: Making a Grant Proposal
  - Make a very detailed (how many human subjects over what period of time, exclusion, inclusion criteria, what locations, which clinician, etc.) outline of your research plan
  - Give the aims, the power analysis, and the detailed outline to senior funded researcher at your institution who is NOT POLITICALLY CONNECTED to you in any way. Ask for a harsh criticism, and ask for any suggestions. Give the senior researcher a full three weeks to do it.

Seven Steps

- Step #4: Making a Grant Proposal - continued
  - In the mean time, get the IRB forms together on your desk, and line up letters of support, and start writing the entire grant, following the directions in your notebook very carefully.
  - As you begin to write, keep in mind the purpose of the published announcement and whatever evaluation criteria are available.

Seven Steps

- Step #4: Making a Grant Proposal - continued
  - NOTE: If it is possible for you to take a writing class at your university….just a part time one…..it would help! Especially the kind where you learn to convey vision, tension, conflict and solutions succinctly, and rapidly. If they offer a beginning screenwriting class, that would be ok, short stories, poetry, whatever would help you learn to communicate your vision to others.

Seven Steps

- Step #5: An Application Emerges
  - When the critiqued outline is available, back from the senior researcher (don't forget a thank you note), make a grant out of it. Complete a draft of the entire proposal, including the budget. You should allow eight full time weeks for this transition. Now you have a draft. You can ask the scientist who helped you to take another look and your colleagues, too. At the end of this time, your proposal should look like a grant. Follow the instructions in your notebook carefully and adhere to page limits. PUT IT AWAY.

Seven Steps

- Step #5: An Application Emerges - continued
  - After at least a five day break, look at the grant again, and tune and tweak. Get your institutional and departmental signoffs.
  - Chip away at your IRB submission, so that it is ready to turn in the week before your peer review (or sooner). You do NOT have to have IRB approval before you send in the grant, but they will not release the funds to you until you have this.

Seven Steps

- Step #6: Get it out
  - Compose the cover letter. If possible get feedback from your program staff on this letter. 10 days before the due date submit it - 5 days later, make sure it is there. Put it in a drawer for a while, but keep attending to the world literature
  - After review, go over your comments with program staff, who will also be able to give you guidance re: likelihood of funding at this point, or after resubmission. If you have to do rewrites, wait until you have digested the summary statement. Ask the senior researcher to review the summary statement with you as well.

Seven Steps

- Step #7: REST, don't quit, REST, don't quit!
- It is allowed to fall, it is required to stand up!

Tips for getting started

- Make sure you have the support of your chairman or your director
- Make sure you know what your development office can do for you and gain their support (use chocolate)
- Build your facilities and equipment using foundation and other internal grants
- Develop a focused line of research (Strong Inference by Platt)

Tips for getting started

- Graduate student research projects should fall within the focus of your research
- Every study should have a high potential for publication (be a finisher)
- Develop Relationships-Collaborations (Clinicians, Biostatistics, Engineering, etc.)

Factors to consider when applying for a grant

- The scientific quality of a project determines whether it is funded.
- Reviewers will assess whether you and your institution have the expertise to get the job done (Brains)
- Reviewers will assess whether you have the resources to get the job done (Bricks)
- Does your institution allow you enough time to accomplish the research?

Factors to consider when applying for a grant

- Are you, the PI, and your colleagues qualified to do the work? PAVE YOUR WAY WITH PUBLICATIONS.
- The presentation of your application can make or break your application (typos, grammar, inconsistencies, etc.).
- Bring in collaborators to fill gaps in your expertise and resources, especially someone who is well known.

More Tips – The Bottom Line

- For all agencies, good grantsmanship is knowing HOW to identify the "hot buttons" that need to be punched, and then knowing how to punch them!
- You need to make yourself FIRST in whatever category you choose!

More Tips – Your idea is key

- Steps to develop a novel idea
  - Identify the niche area ("your t-shirt")
  - Collect and critically analyze background information related to the problem
  - Develop a preliminary idea (don't force it)
  - Assess the idea's potential for success and modify it if necessary (seek criticism from trusted colleagues – watch out our for hawks)
  - Refine the idea to maximize its potential for IMPACT on the field

More Tips – Assess Yourself

- Before you move forward with this novel idea assess yourself
  - Do you have the expertise
  - Do you have the resources
  - Do you have the personnel
  - Do you have the preliminary data to be competitive

More Tips – Assess the Competition

- Before you move forward with this novel idea assess the competition
  - Literature
  - Databases of existing grants

More Tips – Assess potential for funding

- Before you move forward with this novel idea assess potential for funding
  - Find the agency that fits your idea (your proposal will help the agency to achieve its goals)
  - Mission Statements – Priority Areas
  - Contact the program officer and listen carefully

More Tips – Characteristics of a successful grantsperson

- Makes a good first impression
- Is well –prepared
- Is credible
- Delivers a clear message
- Provides supporting documentation
- Has appropriate endorsements
- Has something special to offer
- Is persistent

Acknowledgements

- Dr R. Bruce Martin, who gave a similar tutorial with TSB for the ASB 11 years ago.
- Dr Carol Nicholson, who gave me (NS) the seven steps
- Dr Steven Messier, who gave me (NS) a similar tutorial many years ago
- everyone whose proposals we've reviewed
- everyone who reviewed and critiqued our proposals