08: Proposals (part II)

March 16, 2012
Announcements

- Volunteer RFE presenters for Fri Mar/30?
- Proposal due in 2 weeks, also Fri Mar/30 (2pm). No extensions unless you have a REALLY GOOD reason.
Background reports

- Average = 90/100

- Overall impressions/comments
  - I was looking for clarity and connectivity, even if I was not familiar with your research topic. So, I looked for a strong connection between your questions and the background information you provided. For example, if you say that you want to know how to manufacture something, then you should be discussing the important *details* of existing manufacturing processes.
  - If I was more familiar with your topic, I made more/pickier comments but I don’t think this affected how I assigned points.
  - Think about turning your report into a perspective paper in a leading journal in your field (sometimes called a “minireview”).

- Picky things
  - Be very careful about spacing, font consistency, typos
  - Avoid vague adjectives – realize the power of a few extra words
  - Use descriptive figure captions
  - If you copy/modify a figure from a publication, reference it in the caption
  - Don’t say “my research group”
Today: proposals (part II)

- Review our proposal exercise abstracts/aims
- Attributes of agency review processes
- Discuss the proposal assignment
- Advice for preparing each part of a typical proposal
- Other guidelines for readability and clarity
- If time permits, talk about the differences between writing proposals and papers

New references on ctools:
- Advice on the process of writing a research paper.
Example: pneumatically actuated grippers

Group exercise –due next Friday March 16

- Write a 1 or 2-paragraph summary of a proposal based on the Ilievski paper, focusing on what you’d like to do next (anything)
  - The summary should follow the modified Nature format discussed during class (see reading on ctools)
  - The summary should identify both the intellectual merit and broader impact of your proposed work

- In addition to the summary, identify 3 or 4 specific aims of your proposed research. Each aim should be described in 1-2 sentences. You should also think of how you will measure your progress toward each aim (i.e., qualify/characterize results). You don’t need to write about this though.

- For class on March 16:
  - Bring 10 copies of your team’s summary (for a peer review exercise)
  - Be ready to explain and defend your aims in front of the class
Our review activity

- We form one review panel, with teams sitting together
- Everyone reads and scores 2 proposals (not theirs)
  - 5: excellent
  - 4: very good
  - 3: good
  - 2: fair
  - 1: poor
  - “multiple ratings” allowed, like 4.5 = E/VG
- Make notes on strengths and weaknesses for discussion
- We collect and tabulate the scores
  - Write the proposal code (A,B,C,D) and score on the paper
- We compare and contrast the proposals with the two highest scores
- We decide which proposal is recommended for funding
NSF review criteria

Criterion 1: What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Criterion 2: What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

NSF proposal review process

- Program director receives proposals and sorts the proposals by theme within his/her program.
- Program director recruits panels (approx. 10 people for 20 proposals) and assigns proposals to the reviewers, avoiding obvious conflicts of interest.
- Reviewers read proposals (4-6 each) before the panel meeting and enter comments/scores online.
- Panel convenes at NSF HQ (Arlington, VA) for a 1-day meeting.
- Typically about half of the proposals are eliminated within the first hour.
- Scores are revised according to panel discussion; summaries are written.
- Program director makes final funding decisions, based on budget and other criteria (geographic/demographic).
NSF proposal review process

Merit Review Process

Click the square buttons to find out more information about the review process.

**Phase I**
- Proposal opportunity announced
- Proposal preparation and submission (90 days)

**Phase II**
- Proposal reviewers selected
- Peer review
- Program officer recommendation
- Division director review

**Phase III**
- Award processing review (30 days)
- Award finalized

The review process in general

- Differs widely by agency/organization
- Reviewers are always pressed for time
- Most/all of the time, there is a surplus of high-quality (fundable) proposals
- The program director may have a lot of discretion
- Bias is, unfortunately, part of the process – this only makes it more important to be known among the “community”
- Find out as much as you can about how the review process really works, and what the program is really looking for
- This applies to fellowships too
...short-comings of 605 proposals rejected by the National Institutes of Health is worth pondering. The list is derived from an article by Dr. Ernest M. Allen (Chief of the Division of Research Grants, National Institutes of Health) that appeared in Science, Vol. 132 (November 25, 1960), pp. 1532-34. (The percentages given total more than 100 because more than one item may have been cited for a particular proposal.)

**Problem (58 percent)**
1. The problem is not of sufficient importance or is unlikely to produce any new or useful information. (33.1)
2. The proposed research is based on a hypothesis that rests on insufficient evidence, is doubtful, or is unsound. (8.9)
3. The problem is more complex than the investigator appears to realize. (8.1)
4....

**Approach (73 percent)**
1. The proposed tests, or methods, or scientific procedures are unsuited to the stated objective. (34.7)
2. The description of the approach is too nebulous, diffuse, and lacking in clarity to permit adequate evaluation. (28.8)
3. The overall design of the study has not been carefully thought out. (14.7)
4....

**Investigator (55 percent)**
1. The investigator does not have adequate experience or training for this research. (32.6)
2. The investigator appears to be unfamiliar with recent pertinent literature or methods. (13.7)
3. The investigator's previously published work in this field does not inspire confidence. (12.6)
4....

**Other (16 percent)**
1. The requirements for equipment or personnel are unrealistic. (10.1)
2....
From the other side

**MERIT IN THE MIDDLE?**

Plotting the median number of grant-linked publications (2007 to mid-2010) and median average journal impact factors against total US National Institutes of Health funding to investigators in 2006 shows the highest performance at medium funding levels.

Measures of productivity peaked at $750,000, then dropped off.

Number of researchers at funding level (in hundreds)
PhD Research Process | Winter 2012

Research proposal assignment

Due on ctools at 2p Friday, March 30. Bring paper copy to class also.

a. Guided by your background report, identify the following (you don’t need to submit this as a separate part of your assignment, and it doesn’t count toward the page total):
   1. The key question/topic your research will seek to address. You should be able to express this in one sentence, a.k.a. your “mission statement”.
   2. The steps you expect to take (i.e., the research activities) in order to answer your question. These will be refined into the specific aims of your proposal.
   3. The most relevant background info to motivate your key question, and to justify your choice of aims.

b. Based on the analysis from (a) write a proposal with the following sections:
   1. Summary (1-2 paragraphs) according to the modified Nature “first paragraph” format discussed in class. It should include your 1-sentence mission statement in bold text.
   2. Background. This is selected text, possibly written more compactly, from your report.
   3. Rationale and novelty, i.e., why your work fills an important need in light of the current status of your field, and why your approach is unique. This is VERY important.
   4. Description of proposed research, including at least 3 major tasks or aims. Each aim should be summarized in one sentence, followed by a more detailed description, and should have a measurable outcome. Each aim should stand reasonably well on its own, although later tasks may build upon previous findings.
   5. Expected outcomes, assuming your research is successful (BOTH scientific and practical).
   6. A timeline, indicating the start/end and duration of each of your research aims. The timeline resolution need not be finer than 3 months.
   7. Description of your qualifications (1 paragraph), i.e., why you are (or will be) qualified to do the proposed work.

c. The proposal must be 4-5 pages, with 1” margins (left/right/top/bottom), single-spaced, 11- or 12-point font. Sections should be divided with headings. The page limit excludes figures (plan for 0.5-1 page total area, more is OK) and references. Use the Nature reference format.
The modified *Nature* format

**General and specific background (WHY)**

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

**Your mission statement (WHAT NOW)**

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarising the main result (with the words “here we show” or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

**Summary of aims/methods (HOW)**

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (The above example is 190 words without the final section, and 250 words with it).

**Expected outcomes: both intellectual merit and broader impact should be clear (WHAT LATER)**

During cell division, mitotic spindles are assembled by microtubule-based motor proteins\(^2\text{,}^2\). The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family\(^3\text{,}^5\). Hypotheses for bipolar spindle formation include the 'push–pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules\(^2\text{,}^4\text{,}^5\). However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at \(~20\text{ nm s}^{-1}\) towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at \(~40\text{ nm s}^{-1}\), comparable to spindle pole separation rates *in vivo*\(^6\). Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

http://www.nature.com/nature/authors/gta/Letter_bold_para.doc
The summary must be convincing!

Working through a tall stack of proposals on voluntarily-donated time, a committee member rarely has time to comb proposals for hidden answers. So, say what you have to say immediately, crisply, and forcefully. The opening paragraph, or the first page at most, is your chance to grab the reviewers' attention. Use it. This is the moment to overstate, rather than understate, your point or question. You can add the conditions and caveats later.

- See my NSF project summary
The background

- First, state the general importance of your research topic
- Then, highlight key findings that relate to your proposed work
  - Important findings that motivate your study
  - Important background information (including fundamentals)
  - This can include your own preliminary work (sometimes that’s a separate section)

- Don’t criticize past work (= makes reviewers angry), rather state *opportunities* for improvement

- This section is a difficult balance of breadth and depth
The rationale and novelty

- What is the main idea of the proposal?
- Why is it important? (why is it needed?)
- Why is it unique?
- What is the GAP?
Dividing the big idea: objectives/aims
Planning: series and parallel

- What happens if a wire breaks?
  → Risks and countermeasures

http://www.guitarnuts.com/wiring/serpar.php
Think long-term

By the time you write your proposal, obtain funding, do the research, and write it up, you might wish you were working on something else. So if your instinct leads you to a problem far from the course that the pack is running, follow it—not the pack: nothing is more valuable than a really fresh beginning.
A good idea is necessary but not sufficient for a successful proposal. Especially, the reviewers will want to know what you will do if something goes wrong. Your idea and approach must be robust to their concerns.
Overall: the hourglass design
The ladder of abstraction [Hakayawa]

1. The cow known to science ultimately consists of atoms, electrons, etc., according to present-day scientific inference. Characteristics (represented by circles) are infinite at this level and ever-changing. This is the process level.

2. The cow we perceive is not the word, but the object of experience, that which our nervous system abstracts (selects) from the totality that constitutes the process-cow. Many of the characteristics of the process-cow are left out.

3. Bessie (cow₁) is the name we give to the object of perception of level 2. The name is not the object; it merely stands for the object and omits reference to many of the characteristics of the object.

4. The word “cow” stands for the characteristics we have abstracted as common to cow₁, cow₂, cow₃ . . . cowₙ. Characteristics peculiar to specific cows are left out.

5. When Bessie is referred to as “livestock,” only those characteristics she has in common with pigs, chickens, goats, etc., are referred to.

6. When Bessie is included among “farm assets,” reference is made only to what she has in common with all other salable items on the farm.

7. When Bessie is referred to as an “asset,” still more of her characteristics are left out.

8. The word “wealth” is at an extremely high level of abstraction, omitting almost all reference to the characteristics of Bessie.

<table>
<thead>
<tr>
<th>Level Four</th>
<th>economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Three</td>
<td>farm assets</td>
</tr>
<tr>
<td>Level Two</td>
<td>cattle</td>
</tr>
<tr>
<td>Level One</td>
<td>Bessie, the cow</td>
</tr>
</tbody>
</table>
ACTION WORDS

A resume should sound alive and vigorous. Using action verbs helps achieve that feeling. “I changed the filing system” lacks punch and doesn’t really indicate if the system was improved. “I reorganized and simplified the filing system” sounds much better and provides more accurate information.

Review the sentences below to get a feel for action words. Then quickly scan the words in the following list and check any you think you might want to use in your resume. Don’t try to force them in; use them when they feel right.

Conducted long-range master planning for the Portland water supply system.

Monitored enemy radio transmissions, analyzed information, and identified enemy strategic and tactical capabilities.

Planned, staffed, and organized the intramural sports program for this 1,200-student college.

Produced daily reports for each trial and made sure documents and evidence were handled properly.

Presented seminars to entry-level secretaries and worked to increase the professionalism of secretaries in the county system.

Improved the coordination, imagination, and pantomime techniques of adults through mime and dance training.

Allocated and dispensed federal moneys to nine counties as board member of the CETA Advisory Board.
However, don’t be too dreamy (foofy)

- **Foofy** -- Vague, evasive, betraying lack of mastery and confidence; exaggerated claim without evidence
- **Foofy example**: “Nanotechnology promises enormous economic benefits.”
- **Less foofy**: “Smith, writing in the Wall Street Journal, estimates that nanotechnology will have a $100 billion impact on the world economy in five years [ref].”

- Some of you made really dramatic impact statements in your background report, but these statements were not supported by rationale. Be specific, and be quantitative where possible.
- It’s most important to know the expected contribution of your work, and then you can make a jump to the overall impact of the field and longer-term efforts.
Another angle: have a clear context and clear objectives

WHY    WHAT    HOW/WHO

- **Context**
  - Defined broadly with clear motivation (e.g., quantification if possible)
  - Connect the big issue to your specific focus
  - It should be clear why your work (if successful) is unique and will make a difference

- **Objectives/tasks should be**
  - Specific (= what will be done)
  - Measurable (= how you will measure the outcome)
  - Practical (= can be done)
  - Logical (= makes sense, on its own and in combination with other tasks)
Know your audience

- Who will review the proposal?
- What are their selection criteria? (even if your idea is great...)
  - Person/expertise vs. what the research is about
  - Relevance to their interests
  - Fundamental understanding vs. practical applications
  - Education/outreach?
  - ...

- Talk to someone who knows the agency/program/topic
  - Faculty talk to program managers
  - Students talk to others who applied for the fellowship before

- Envision the match
  - They may have a problem looking for a solution
  - You may have a solution looking for a problem
Formatting influences reviewer comfort

- Font size and margins; spacing between paragraphs
- Clarity of figures
- Often, less is more! The decision is based on the important things, and you want the reviewer to find those quickly.
Procrastination is the enemy of good proposals

- Success not proportional to how much time you spend!
- but success is proportional to how clear your ideas are
- and, clarifying your ideas takes time
- So, it’s important to be efficient, and it’s obvious when you read a proposal that has been rushed
- My experience agrees with this, both as writer and reviewer
George Whitesides on writing a paper

- [http://pubs.acs.org/page/publish-research/episode-1.html](http://pubs.acs.org/page/publish-research/episode-1.html)
Writing a proposal vs. writing a paper

- When do you start planning to write paper?
- Envisioning the “paper” can be a tool for planning research, as soon as you can see the light.
- Study example papers that you really like.
- Background and results content from proposals often gets used in papers, and vice-versa.
- Establish an efficient process for outlining, drafting, and revising (get everyone’s opinion, but not too often).
- Always try to take your work to its full potential.
- It’s important to understand the journal review process.
- Don’t be discouraged by rejection (it is not a failute); negative comments can be very useful to understand how others interpret your work and how you can improve communication.
- Lots more stuff: see ctools resources for today (zip file).
Ashby’s approach

Figure 1. The Design Process. Designing a paper is like designing anything else: there are five essential steps.
Ashby’s visual outline

A3 or A4 sheet, landscape mode

Good ideas for the text

Boxes with main headings

Things that are still needed

Links between sections of text

Figure 3. A model for a concept sheet.
Your advisor will probably be critical, but this is part of the process

**Comic: PhD Comics**

**Panel 1:**
WHAT IS WRONG WITH MY WRITING?
WELL, FOR STARTERS, YOU USE TOO MANY SENTENCES.

**Panel 2:**
ALSO, YOUR CHOICE OF WORDS IS OFTEN INCORRECT.
AND YOUR PUNCTUATION MARKS ARE STRANGELY PLACED.

**Panel 3:**
REALLY, THE TROUBLE BEGAN WHEN YOU FIRST PRESSED A KEY ON YOUR KEYBOARD.

**Panel 4:**
ANYTHING ELSE?
YOUR FIGURES ARE UGLY.
You can write a good paper about almost anything.
Homework

- Draft aims of your proposal. Bring 3 copies for peer review in class next week.
Extra slides
Graduate fellowships = freedom!

- You’ll be decoupled (mostly) from external funding sources
- Access to new opportunities, e.g., workshops
- Excellent for your CV

- As a result, graduate fellowships are considered recognition of you, not just the research you’re doing
  - However, a strong proposal is indicative of your ability to do research
  - Same is true for faculty young investigator awards
The NSF GRFP essay

In a clear, concise, and original statement, present a complete plan for a research project that you may pursue while on fellowship tenure and how you became interested in the topic.

Your statement should demonstrate your understanding of research design and methodology and explain the relationship to your previous research, if any. Describe how you propose to address the two NSF Merit Review Criteria of Intellectual Merit and Broader Impacts. Refer to the program announcement for specific guidance.

Format: Include the title, key words, hypothesis, research plan (strategy, methodology, and controls), anticipated results or findings, literature citations, and a statement attesting to the originality of the research proposal. If you have not formulated a research plan, your statement should include a description of a topic that interests you and how you would propose to conduct research on that topic.

2 pages!