Writing Compelling Research Proposals
(to NSF and other agencies)

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Outline
• How to write your proposal to impress the panel
• Panel dynamics
• Example proposals

Objectives
• Provide ideas to increase chances of getting funded
• Aimed towards
  • NSF (almost always uses peer panel reviews)
  • NASA (often uses peer panel reviews)
  • DOE (sometimes)
  • Other agencies – AFOSR, ONR, ARO, DARPA not so much – more focused on Program Managers needs, but many pointers still useful
1. Have at least one really good, novel, clever idea

- “Business as usual” proposals don’t sell
- Even if the idea isn’t particularly well formulated or is very speculative, panels give a lot of credit to proposals that are new and innovative
- Panels try to find a reason to like proposals with a good idea, no matter what weaknesses might exist

Tip #1

2. Pose specific, testable hypotheses

- Don’t say “we will measure the effect of x on y. Blah, blah, blah…”
- Do say “based on the material presented in the introduction, it is our hypothesis that y will decrease as x increases, until x reaches a critical value, after which y will increase”
- Show that you have a specific goal in mind, i.e., that you have an idea and intend to test it
- Use pictures to describe what you will do

Tip #2
3. Avoid the “kitchen sink” mentality

• Don’t say, “we will do detailed and extensive measurements of everything using every imaginable diagnostic tool and vary every possible experimental parameter” - it shows that you have no idea what’s important, so you’ll just measure everything and leave it to someone else to understand the problem
• Do say, “here is the minimum set of measurements and conditions needed to test these hypotheses; if we have time and money left over after this is completed, here are the cool things we will do”

Tip #3

4. Explain your end game

• What you will do once you have the data?
• Many proposals go describe interesting experiments or computations, but don’t say what they will do once they have the results and how it can be used to test a hypothesis
• Don’t say, “computational results will be validated by experiments” – this assumes they will agree
• Do say, “computational results will be compared to experiments”
5. Don’t dwell on past work

- NSF proposals are limited to 15 pages, most agencies have similar limits
- Some proposers brag about what they’ve done and don’t get to the point of what they propose to do next until page 11
- For NSF, at least one page at the end needed for “broader impacts”
- Thus, sometimes only 4 pages of real “beef” in the proposal

6. Don’t say “just trust me”

- Doesn’t necessarily apply to young investigators, but senior faculty write “trust me” proposals
  - “I’m great, look at how much great stuff I’ve done in the past, now I’ll do more of it. I have a forest of lasers and an army of supercomputers. I don’t need to be specific since I’m so great. Just trust me to do great work again and give me twice as much money as a young PI.”
- Panels give benefit of the doubt to junior (e.g. untenured) PIs because they are struggling and if they are not funded and encouraged, they will drop out of academia altogether
7. “Broader impacts”

- NSF must consider “broader impacts”
- **You MUST have support for graduate students** in your budget
- Proposals that fund summer salaries, postdocs, etc. go nowhere
- Have undergraduate support, even if just a few K
- Outreach can include
  - Participation in NSF REU, RET
  - Incorporating women/minorities (leverage this with any available programs such as WISE)
  - USC Viterbi Merit Research Program
  - Where your graduates will be employed and why they will be valuable to industry
  - How your research results might be used by a constituency other your narrowly-focused research community
  - Workshops at any level

**Tip #7**

**CAREER flow chart**

- Good practice for CAREER proposal – shows you have a holistic, integrated plan for your future

![CAREER flow chart](image)

Fig. 3 Overview of the PI’s career path, the CAREER project, and long-term goals.

*Courtesy P. Branicio, MFD*
Where's the beef?

• Above all else, ask yourself, as though you were the reviewer rather than the author,
  • What is the one important idea in this proposal?
  • What will be the one important consequence if it is funded and the approach is successful?
  … and write the proposal to “sell” these points
• Get the panel curious about your idea, make the panel ask themselves, “hmmm, I wonder what would happen…?” or “hmmm, would that really work…?”

Tips – summary

<table>
<thead>
<tr>
<th># pages</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction - what your topic is and why it is important</td>
</tr>
<tr>
<td>3</td>
<td>Previous work - what has been done in this area; complain about what knowledge is lacking</td>
</tr>
<tr>
<td>1</td>
<td>Objectives - very specifically what will you do and why it is better</td>
</tr>
<tr>
<td>1</td>
<td>Hypotheses - what you think will happen</td>
</tr>
<tr>
<td>5</td>
<td>Approach - how you will test these hypotheses – experimental or computational apparatus, etc.</td>
</tr>
<tr>
<td>2</td>
<td>Closure - what you will do with the data once you have it</td>
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<tr>
<td>2</td>
<td>Broader impact – applications of the research and educational merit</td>
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Panel dynamics

- Typically ≈ 8 panel members, 25 proposals
- Each proposal read by 3 reviewers – 1 lead, 2 others
- Each reviewer discusses his/her opinion
- Entire panel gives comments / feedback
- Reviewers may revise comments based on panel discussion
- Proposals are ranked after all are discussed
- You must have a champion – someone who believes in your proposal and is willing to argue for it
- Every panel has different personnel and different dynamics
- Learn these dynamics first-hand: ask relevant NSF program officer(s) for invitation to be on a review panel – also looks good on your résumé
- Good idea to cite likely panel reviewers in your proposal