Writing Successful Technical Proposals

Tips from the Trenches
—or —
Things I've Learned the Hard Way

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With thanks to the fabulous Physics faculty at Illinois who put up with me

My purpose is to share some strategies and tips that will make your proposals more attractive to funding agencies and compelling to reviewers.

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From the program officer:
  Ask what kind of projects have been supported.
  Describe your project and ask for suggestions.
  Request referrals to other investigators or prospective collaborators.

From your colleagues
  Ask them to read a first draft of the proposal and give you constructive criticism.
  Ask them to share copies of their successful proposals.

Tip: Have someone not particularly familiar with your field read the project description without taking notes. Then ask him or her to tell you—from memory—what you are planning to do, how you will do it, and why it is significant. If the answers are not clear and immediate, start rewriting. Pay attention to the questions the person asks.

From your business office
  Ask them for boilerplate and templates.
  Ask them to prepare the budget—or at least double-check your numbers.
  Ask them what the procedures are for submitting a proposal.
  Find out what **the business-office** deadlines are; frequently, a proposal must be submitted to the business office well in advance (days) of the agency's deadline.

Use the Elliott equation* to estimate the time it will take

$$t = 3h + \varepsilon, \qquad [1]$$

where *t* is the time it <u>actually</u> takes to prepare, check, and submit a proposal, and *h* is the number of hours you think any idiot ought to be able to do it in.

*based on >20 years of solid empirical data

This expression approximates the time it actually takes to get a proposal written, uploaded, checked, and submitted.

The PI may not submit the proposal to the agency—your business office or institute may be the actual submitter. Very often all parts of the final proposal must be submitted for institutional review *days* before the funding agency's deadline.

It *always* takes much longer than you think it will—always. (You heard it here first.)

Don't propose too much

Narrow and deep usually trumps broad and shallow

Don't bite off more than you can chew. Be realistic in what you say you can accomplish, given the time and $$ constraints of your proposal.

Reviewers are skeptical people, and they know what things cost, what one person or a small team can reasonably be expected to do, and how long it will take.

If you overpromise, you risk underdelivering and putting your *next* proposal in serious jeopardy. Nearly every funding agency asks, as part of its proposal review process, "What did you accomplish with the money we gave you last time?"

**According to Dr. Sally Rockey,
Deputy for Extramural Research, NIH:**

"So, often times, new investigators have so many great ideas that they come in with ten or twelve objectives and that really would not be accomplishable in a three- to four-year time frame. And reviewers pick up on that. So, first and foremost, you want to try to put some boundaries around your objectives...Usually we say no more than four objectives or specific aims in an application for a new investigator."

NIH, "Grant Writing for New Investigators," interview with Dr. Sally Rockey, April 30, 2010,
http://grants.nih.gov/podcasts/All_About_Grants/episodes/Grant_Writing_April_2010.htm

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Use meaningful, content-rich headings to guide the reviewer…

"Background and Introduction"
"What we still don't know about high-T_c superconductors"

"Experimental Set Up"
"Novel Scanning SQUID Microscope"

"Broader Impacts"
"The Nanoworld for Middle Schoolers"

…and give her something to remember!

Don't use content-less headings; they're boring and they represent a huge missed opportunity.

Tip: Make a list of just the headings and subheadings of your project description. Could somebody who simply leafed through that section understand what your project was about and why it was important—just by reading the headings? (Some panel reviewers may do exactly that.)

Do your headings reiterate and emphasize your most important points? If they don't, you're missing a valuable opportunity to make an impression on the reviewer.

Once you've got decent headings, make them pop off the page with graphical highlighting—color, **boldface**, *italics*, different font

Set Off the Headings with Extra White Space

Don't use ALL CAPS, however. It looks as if you're shouting, and text rendered in all caps is *much* harder to proofread.

Position your important points strategically—at the beginning or end of sections of the proposal—that's where people pay the most attention.

Don't bury your most important points in the middle of long blocks of text.

Provide an "overview" or "goals" section at the beginning of your technical narrative and a "summary" section at the end that recaps and emphasizes your key points.

Take it from a mother, stating a critical point three times is not overkill.

Provide "quotable" points; make it easy for reviewers to spot them and extract them to write their reviews.

Don't make reviewers think too hard or sift through mounds of information to ferret out the reasons why your project should be funded—*tell* them explicitly. Several times. (Refer to the "mother" rule on the previous slide.)

Most reviewers will remember your images better than your words

Figures promote reader interest, provide supporting evidence, help explain complex ideas and relationships quickly, and give the reader something to remember, blah, blah...

Rubidium atoms isolated in an optical lattice
Courtesy B. DeMarco

And they'll look at the figures first, too

Use engaging, visually interesting figures to draw a reader in to your story.

Use figures to emphasize your important points. A reader will think about that important point at least three times (mother rule) if you illustrate it—once when he scans the proposal before he digs into it, once when he actually reads the text, once when he looks at the image again when he encounters the call-out in the text.

Make the figures memorable—people remember visually interesting pictures far better than they remember words (q.v. any of the Edwin Tufte books; *Visual Display of Quantitative Information* should be mandatory reading for all scientists).

But don't dilute the impact of your important figures by festooning your narrative with "eye candy."

"As for a picture, if it isn't worth a thousand words, to hell with it."

--Ad Reinhardt, American artist

Okay, what are the four reasons why you should include figures in your proposal?

Three reasons?

One reason?

Do you remember what the image was on the previous slide?
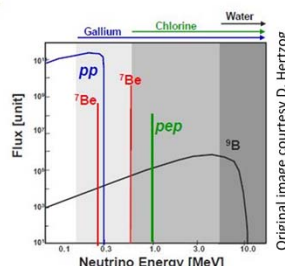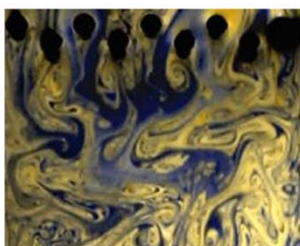
I rest my case...

Reviewers will remember your figures—if they are clear, visually engaging, and meaningful—much longer and better than they'll remember your words.

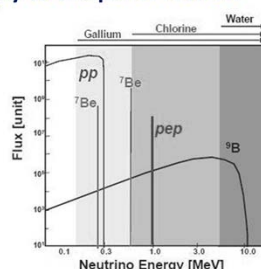Be careful about using color alone to convey information. A reviewer may not "see" what you intended. And your figures may look different on a tablet or mobile device.

To see what your image will look like to someone with color blindness, there's a very useful, free emulator at http://aspnetresources.com/tools/colorblindness.aspx. Note that you may not upload files <500 kB, and only .gif, .jpg, and .png files are supported—no .tif or .eps files.

Another good resource is http://www.colourblindawareness.org/colour-blindness/.

Include some extra sections in your project narrative

Qualifications of key personnel

Timeline

Specific deliverables

Contributions to research infrastructure and human resources

Plan B

Plans for sustainability (think "business plan")

Summary section

You are usually allowed to add some sections to the project description, provided you do not exceed the page limits for that section.

Good things to include:

1. Qualifications of key personnel—use this section to explain why your team is particularly well suited to be successful in the project. Not every reviewer will look at the biosketches.

2. A timeline—(best one may be a figure instead of narrative text)—show the reviewers that you have developed a carefully thought out, feasible project and really know what you're doing.

3. Specific deliverables—required reporting, attendance at PI meetings (be sure to include necessary travel in your budget), sharing of lessons learned with the community.

4. Contributions to research infrastructure at your organization, plans to share facilities with other workers, young scientists that will be trained on the project and what skills they will gain.

5. Plan B—what will you do if the proposed method doesn't work? Show the reviewers that you've considered the possibility and have a back-up plan.

6. Plans for sustainability—what is your plan to ensure that the project lives on after the funding runs out?

7. Summary section—leave room on the last page for one paragraph that succinctly answers the Heilmeier catechism questions and summarizes your key points. End with a memorable bang instead of trailing off with a whimper.

You won't know you've uploaded the budget justification in the project-summary slot unless you print out the file from the server.

I've done it all—uploaded the PI biosketch twice, once for the PI and the same one for the co-PI bio; had a 77-page file transfer only the first 38 pages; forgot to upload a section—the permutations of what can go wrong are endless (to first order), particularly when you're trying to do everything at the last possible minute.*

Special caution for proposals submitted to grants.gov and NIH:

When you "attach" a section of the proposal to the Adobe forms, a copy of the file is actually embedded in the Adobe document; it doesn't just point to the original file on your computer. So if you *change* the original file, you must delete the attachment and re-upload it in the Adobe package.   Otherwise, the uncorrected version is what the reviewers get.

*See Elliott equation.
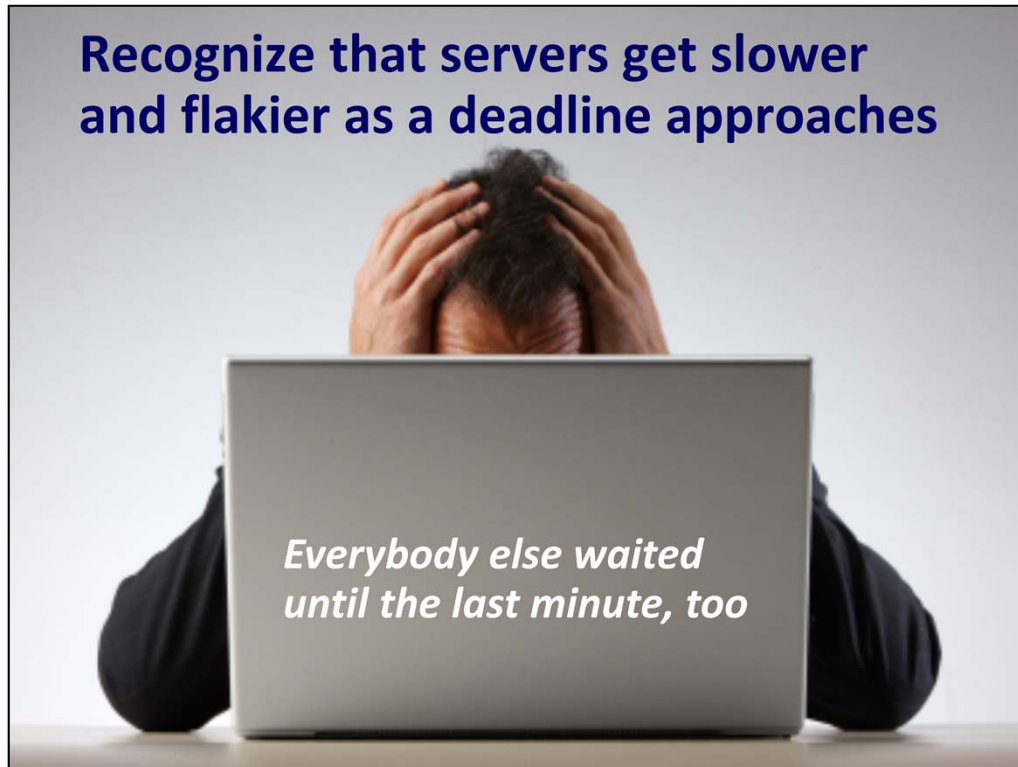
Everybody else waited until the last minute, too, and they're all trying to upload their 24-MB, high-resolution graphics-heavy project descriptions at the same time.
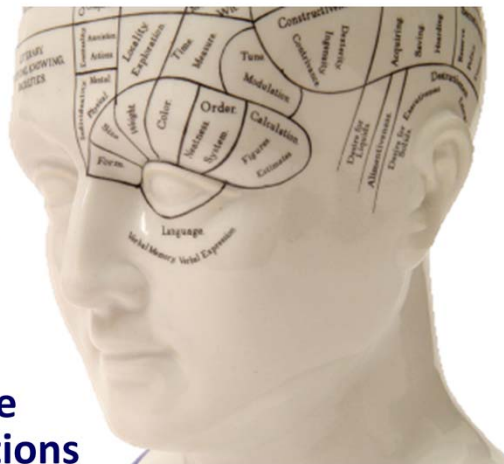
Believe me. I know.

Most proposals do not fail because of bad science—but because of

- **Failure to follow directions**
- **Poor logical organization**
- **Lack of persuasive detail**
- **Failure to consider the funder's objectives**
- **Failure to anticipate reviewers' objections**

Failure to follow instructions

        Not submitted by deadline

        Exceeds page or budget limits

        Mandatory information omitted

        Non-compliant with agency formatting and margin requirements

Remember that decisions are made on the margins. Assume that all of the proposals that you're competing with will represent solid science. It's the other elements of the proposal package—the alliance with other funder goals (education and outreach, diversity, tech transfer), the perceived qualifications of the PI and other personnel, the strength of the management plan, the planning for obstacles—that often mean whether a project is funded or not.

And the parts of a proposal that you don't care about—the biosketches, the facilities description, the broader impacts, the narrative budget justification—may well be the tie-breakers.

If your proposal fails (and some will)...

- <u>Read</u> the reviewers' comments
- Find out what kinds of projects *were* funded
- Talk to the program officer about resubmitting
- Investigate other funding agencies
- Rewrite it and submit it again, or—
- Recognize that there is no "market" for the project, at least for now, and move on

Don't give up!

Take a deep breath, put your ego aside, and consider the reviewers' comments objectively. If they didn't understand what you want to do and why it's important, perhaps they really aren't idiots; perhaps you didn't explain it well enough.

Talk to the program officer. They are usually very candid and can give you good advice about resubmitting.

Other sources of good advice:

Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty
http://www.hhmi.org/educational-materials/lab-management/for-early-career-scientists

NIH Grant Process YouTube Videos (includes tips)
http://public.csr.nih.gov/aboutcsr/contactcsr/pages/contactorvisitcsrpages/
nih-grant-review-process-youtube-videos.aspx

NIH "All About Grants" Podcasts
http://grants.nih.gov/podcasts/All_About_Grants/index.htm

NSF Regional Grants Conference Presentations
June 2015, http://www.nsf.gov/bfa/dias/policy/outreach.jsp#future

Questions, notes, and feedback: cmelliot@illinois.edu

Don't try to write down these long URLs. If you're interested, send me an email request and I'll send you the lecture notes.

The next NSF regional grants conference will be held in Tampa, Florida, June 1-2, 2015. See http://www.nsf.gov/bfa/dias/policy/outreach.jsp#future for additional information about the conference and registration.

"Rejection and Its Discontents," Michael J. Spires, *The Chronicle of Higher Education*, May 20, 2013
http://chronicle.com/article/RejectionIts-Discontents/139403/