Navigating the NSF CAREER Award (in CSR)

Randal Burns

Professor and Chair
Dept. of Computer Science, Johns Hopkins University

Presentation to the:
2018 NSF Workshop for Aspiring Principal Investigators in Computer Systems Research

11 May 2018

What this is about?

- A summary of my experience with CAREER
  - as a proposer, recipient, and reviewer
- Supported by evidence from recent, successful CAREER proposal
  - Anonymized excerpts of 6 proposals and their reviews. 2 CSR.
  - Summarizing successful strategies
- Focus on differences between CAREER and NSF research grants

My intent = glib, honest, and opinionated…….hopefully accurate.

What makes a CAREER Proposal Different

- Scope of research agenda
  - Not just 3 years vs. 5 years. It is a “CAREER” investment by NSF CSR.
  - Think of this as your 5 year plan…..reviewers will.
- Integrated research and education
  - Mandatory. But, I have found CAREER-like education plans useful for all proposals.
- Departmental letter of support from Chair
  - Matters. Must show institutional support for PIs activities.
- Funding rates, funding opportunity, application pool
- It is treated as an Award by Universities
  - More than just a research grant

Reviews: First Sentences in Summaries

“The proposal addresses nontrivial technical issues related to the problems of great importance.” (C)

“This is a strong proposal. It covers important theoretical problems with significant practical applications.” (VG)

“The proposal aims to develop innovative algorithms to assemble and analyze the XXX. The solution to this extremely important problem can have substantial and profound impacts on the field.” (HC)

“This is a strong proposal with an interesting problem. Panelists agreed this is an important problem, and that the approach presented was comprehensive and included a nice mix of both theoretical and algorithmic approaches.” (C)

“This proposal is very well written, especially the education component that attempts to integrate this research into a series of courses ... In fact this proposal has one of the best education plans among all proposals reviewed in this panel.” (C)

HOWEVER…...You don’t need to be perfect

“However, the PI's credentials are less clear with regards to the parts of the proposal dealing with performing user studies and metric creation.”

“However, it would be nice to see a little more detail on what methods might be used to attack these problems.”

“There were concerns that the goals of the proposal may be somewhat conservative, **however**, and given the PI's previous work, that the stated deliverables of the proposal may not encompass a full 5-year timeframe.”

Every proposal has detractors on the panel and aspects that are not well received. These were not fatal.

The process is noisy

“The proposal will have very large impact because the software that the PI previously developed, XXX, which is the software that will be extended in the project is widely utilized by the YYY community.”

“The proposal could be strengthened by expanding the scope of the proposed work beyond an extension of the XXX approach perhaps taking into account ZZZ.”

- These are adjacent comments in a panel summary (HC).
- This was a second submission of a similar research agenda.

First Sentences in Summaries (Conclusions)

- Be ambitious. Be bold.
  - In one or all of the dimensions of the CAREER program
- Your proposal must develop passion in reviewers
  - Most successful proposals have champions in panels
  - All summary statements are declarative, defensible, and positive
- Not all proposals are uniformly well received
  - 4 of 6 funded proposals were not E or HC
  - You don’t need to please everyone in all dimensions

Good proposals are good. Proposals with exceptional aspects get funded.

Education

- CAREER panelists take integrated education seriously
  - “The proposal includes a fairly basic educational plan.” for just new ugrad coursework
- It is not “make or break”, but it is “break”
  - For full disclosure, two surveyed proposals included “a fairly basic educational plan”
- And the NSF takes it seriously (paragraph 2, NSF 17-537)

Integration of Research and Education **-** All CAREER proposals should describe an integrated path that will lead to a successful career as an outstanding researcher and educator. NSF recognizes that there is no single approach to an integrated research and education plan, but encourages all applicants to think creatively about the reciprocal relationship between the proposed research and education activities and how they may inform each other in their career development as both outstanding researchers and educators. These plans should reflect the proposer's own disciplinary and educational interests and goals, as well as the needs and context of his or her organization. Because there may be

Example Education Strategies

- Workshop for “first generation college students”
  - From local teaching colleges, to attract them to careers in CS with peers and support groups
  - Modelled after CIC/Walmart program that PI attended in 2014
- Online teaching materials connected to yearly bioinformatics contest
  - Expansion of a 1000 person contest (from HS to PostDoc)
  - From qualifying institution without an undergraduate program
- Undergraduate minor in computational biology at JHU
  - With support from the Chair’s letter.
- Program to train Masters for Cloud computing industry
  - With new curriculum development, internships, and metrics to measure success

“

Broad Strategies can be Effective

- One education plan included:
  - Workshop for first generation students
  - Undergraduate research
  - Puzzle solving at local charter school
  - Seminar for specific CS theory sub-community
  - New course development
- As a reviewer, I would have been suspicious. But, PI had evidence
  - Demonstration of prior activities that show commitment to claim
  - Specific relationship (and letter of support)
  - Appropriate budget to support level of activity
  - Significant text dedicated to each

Example: Puzzle Seminar (Goal/Description/Relationship)

studies and recreational mathematics. My goal will be to demonstrate that mathematics and algorithms are accessible to students of all ages and backgrounds. Initially, I plan to hold weekly sessions with the

version of soldiers and boys [126] will introduce the notion of recursive computation. The set of puzzles will be carefully chosen to illustrate an algorithmic or mathematical concept such as recursion, divide-and-conquer, and parallelism. My approach is not new: simple puzzles are well known tools in problem solving education and cognitive science [73]. Among other examples we will cover the "Jealous Husband," and the Chinese "Three Sisters" problem. I will emphasise the historic significance of these problems and use

excited about this opportunity to collaborate. I will work directly with the Math/Technology teacher [redacted] to organize and maintain our meetings. As evidence of a strongly growing relation, the [redacted] School [redacted] provided me with a letter of support. This proposal, if granted, will help to implement my

Conclusions: Education and Integration

- Focus on integration of research into education
  - Translate your expertise to creative education activities and products
  - This is the mandate
- Think beyond your institution, but aligned with institutional capabilities
  - Identify underserved communities in which you have an authentic interest.
  - This can be local, scalable (online), or related to your personal history

CAREER Budget

- Minimum 400K for 5 years
- Checking NSF Award Search (https://www.nsf.gov/awardsearch/)
  - Awards in 2017 93-128K/year in CSR
  - But, that may be deceptive. Money is not necessarily balanced by year.
  - Difficult to figure out exact award amounts.
- Budgets of my sample proposals
  - 409K$ -- 1.5M$.
- Let’s ask NSF program managers about expectations
  - Policies have changed over time
  - In 2004, minimum awards at $400K to support as many as possible
  - In 2011?, effort to bump awards up to >$500K to give PI more support

Building a Budget

- Start with an estimate
  - You will iterate with budget analyst, but you will choose and allocate money
  - Understanding how far $400K will go is disappointing
- Line items
  - Your salary: 1.0 mo x 5
  - PhD student
  - Tuition
- What's left?
  - Benefits/fringe
  - Travel
  - BI + education
  - Inflation
- Maybe 100K+ more

Item	**Yearly**	**Total**
PI Salary	140K x 8.33%	58.3
PhD Salary	32.5K	162.5
Tuition	50K x 20%	50
Total		270
w/ 60% overhead		**405**

Building a Budget (ii): The Spreadsheet

- Details matter……get a spreadsheet from your financial analysts
- Other costs
  - $4K/yr travel: this is reasonable if small. Two cheap trips to conferences.
  - $8K/yr BI+education: my outlook is 5-10% of budget is reasonable
- What didn’t we pay for?
  - Capital equipment or cloud computing
  - Laptops, supplies
  - Undergraduate research
  - Staff and services
- This is a reasonable budget to propose (for JHU)
  - But it’s lean and mean
  - Depends on support from startup funds, department, or institution (from overhead)

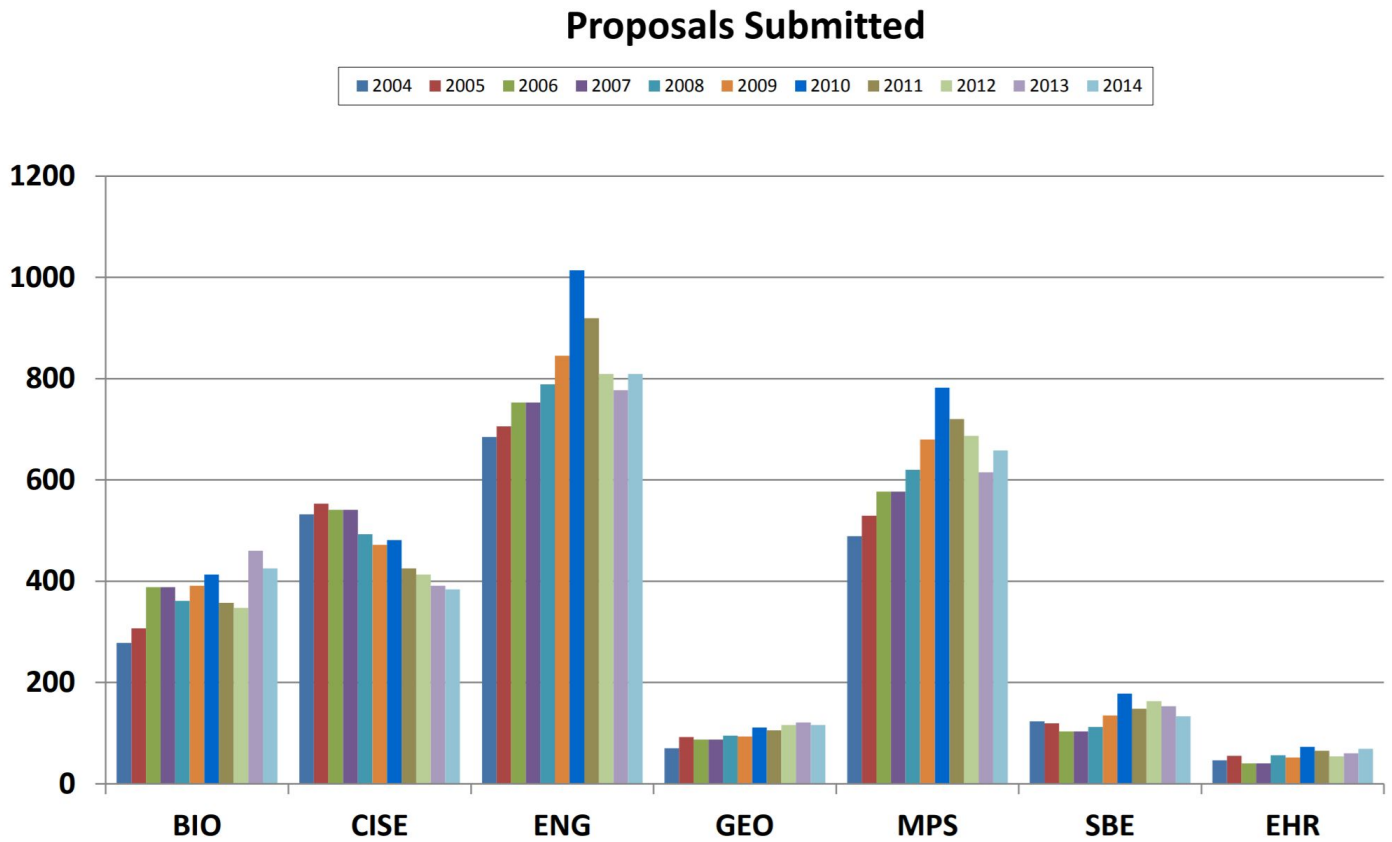
Tweaking a Budget

- Levers you can pull
  - 9 mos versus 12 mos support for PhD.
  - Your effort. (I don’t like this for CAREER)
  - Other costs are hard to shift
- Why 1 month of PI salary?
  - Not more. You have to save space to be on other grants. 2 month NSF limit per investigator.
  - Not less. CAREER is an important award and your effort must be commensurate.

Budget Conclusions

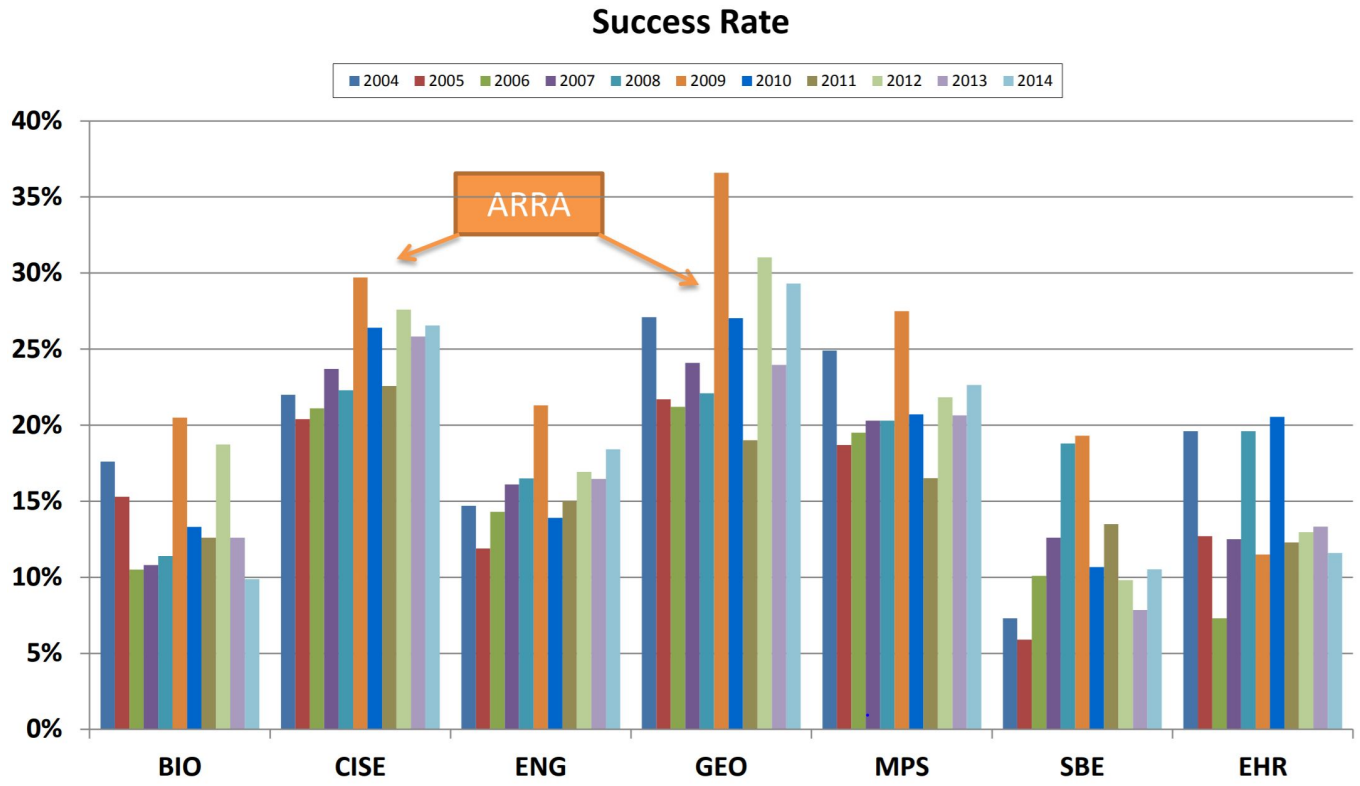
- Propose the real cost of research and education activities
  - Unrealistic budgets can negatively affect outcomes
  - From both sides. I’ve seen proposals fail for unrealistic greed and inadequate funds.
- You won’t necessarily get your proposed number
  - Post-recommendation rebudgeting is common
  - New budgets involve new justifications, which can change the scope of activities

2014 CAREER Submissions



From: https://www.nsf.gov/mps/dms/career_and_pecase_information/career_webinar_slides_2015.pdf

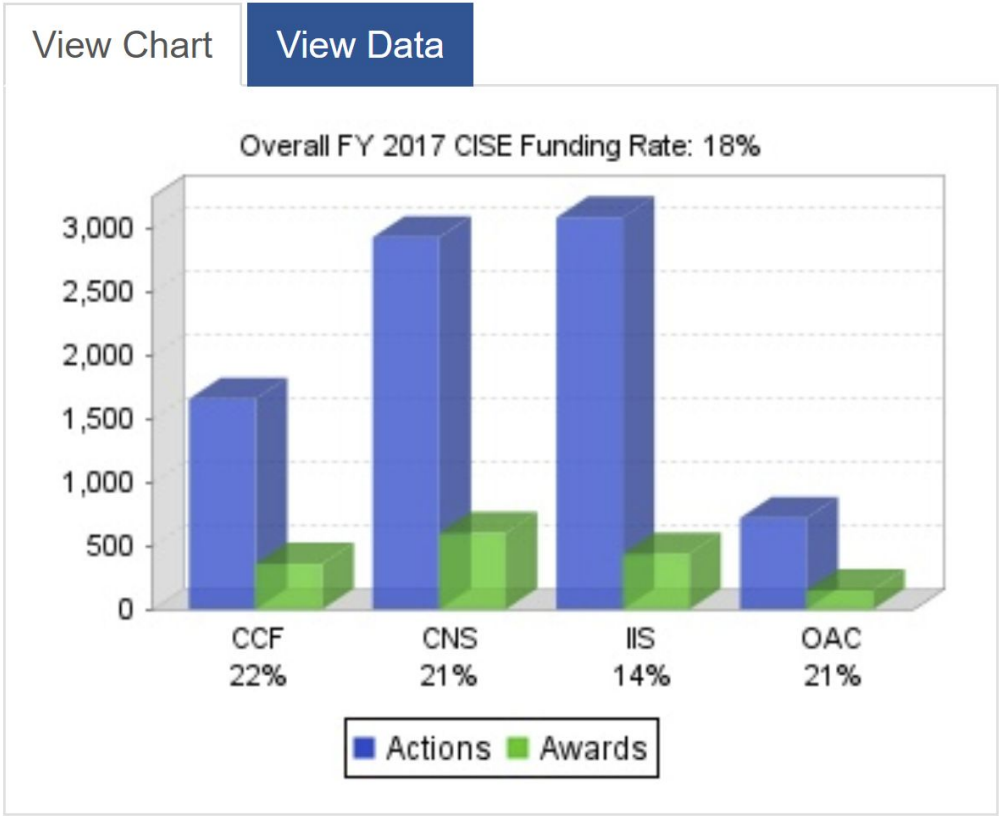
2014 CAREER Success Rate



From: https://www.nsf.gov/mps/dms/career_and_pecase_information/career_webinar_slides_2015.pdf

CISE Funding Rates

- CAREER seems comparable to overall award rates
- RB opinions (disclaimer)
  - This is deceptive
  - Single PI research awards are funded at much lower rates
  - My panelist experience is 10-15%



From: https://www.nsf.gov/funding/funding-rates.jsp?org=CISE

Thoughts on Proposal Success

- Experienced PIs are more successful
  - 66% of CAREER proposal by new PIs, 54% awards to new PIs (2014)
  - Consider writing other research proposals early as you develop your CAREER plan
  - In my 6 examples, 4 were already NSF PIs
- CAREER is limited submission, apply thoughtfully
  - One submission per year, three total
  - My examples are distributed from year 2 to year 6 of Assistant Professor appointment
- (RB opinion) Write fewer, better proposals
  - Rushed submissions are not fun and don’t tend to produce plans that inspire champions
- Develop and use mentors
  - In department and from community. Inside and **outside** expertise area.
  - Write 2 months ahead of time and prereview proposals with mentors.

The Chair’s Letter

- Important to state specific support for proposed activities
  - Resources not in budget.
  - PI time for non-traditional activities
- Not all chairs know how to write these letters
  - Particularly from non-research institutes that may not have many CAREER recipients
  - It’s reasonable to encourage your Chair/Head to do this thoroughly and thoughtfully
- According to the NSF, the chair’s letter must include:
  - *“A statement to the effect that the PI is eligible for the CAREER program... “*
  - *“An indication that the PI's proposed CAREER research and education activities are supported by and advance the …..goals of the department and the organization…”*
  - *“A description of a) the relationship between the CAREER project, the PI's career goals and job responsibilities, and the mission of his/her department/organization, and b) the ways in which the department head (or equivalent) will ensure the appropriate mentoring of the PI,”*

Snippets: Necessary Statements

“I attest that the PI satisfies all of the eligibility requirements of the CAREER program, and I further confirm that the career-development plan is supported by, and integrated into, the educational and research goals of the department and the …”

“The department and school have an established mentoring program for junior faculty.”

“I endorse both the research directions and his teaching plan.”

Snippets: Specific Resources

“...our department and school commit to providing approximately $YYYK of additional discretionary support to any junior faculty member who receives a CAREER award. The PI has full freedom in using these funds to further their research and teaching activities.”

“he has access to substantial computing resources through our data intensive computing institute, and he will have access to a 14,000 core cluster….”

“we have provided as part of his startup package support for a programmer to help him to develop and maintain his very popular software packages.”

Snippets: Chair's View

The Chair's letter can also express how the PI or proposed research is critical to the department of school. This is a valuable, qualitative statement of support.

"XXX is simply the right person in the right place at the right time for our department. He is doing relevant, high impact computer science research that is highly needed and recognized within YYY community."

"In my view, (this research) is of the high risk, high reward type, but in this case, the high risk is mitigated by the qualities of the person."

The “Award” of CAREER Award

- More than a research grant
  - Publicized by University press releases
  - Fill out that Awards section of your CV
  - Consideration for PECASE Award
- But it has also become a standard for success
  - On Quora ‘It's hard for me to judge how "common" the award is, because I work in the kind of department where just about everyone gets one (and, perhaps unspoken, is that they are more-or-less expected to get one).’
  - This type of thinking is prevalent and wrong-headed. Many exceptional senior faculty did not receive this award.
- CAREER is a good opportunity, not mandatory.
  - Good funding rates, long time horizon
  - I enjoyed the 5-year relaxed luxury of my CAREER award.

Some Last Thoughts

Think of CAREER award as a tenure plan

- Research that extends 5 years and will establish you as a leader in the field

Long term plans require planning ahead

- Create a grant strategy and discuss with mentors
- Prepare a complete proposal by May to get pre-reviewed
- Think broadly to find mentors (past winners, people in extended community) I’ve never said no.

From: https://www.nsf.gov/mps/dms/career_and_pecase_information/career_webinar_slides_2015.pdf

CAREER Urban Myths

- "You cannot apply because you have another award"
- "It is an entry program, so apply to CAREER first"
- "I need to see a successful proposal to write a successful proposal"
- " I read on the web that to succeed, I have to...."
- "CAREER proposals are more portable"
- "The education component does not matter"
- "You have no chance, if you are not from a research-intensive institution"

Resources

NSF CAREER FAQ https://www.nsf.gov/pubs/2017/nsf17050/nsf17050.jsp

NSF CAREER Solicitation https://www.nsf.gov/pubs/2017/nsf17537/nsf17537.htm

2015 Webinar from Sonia Esperanca https://www.nsf.gov/mps/dms/career_and_pecase_information/career_webinar_slides_2015.pdf