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# Writing Successful NIH Research, Fellowship, and Career Development Applications: A slightly different spin...

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# A general overview of the next 90 minutes

Walk through a series of core principles in writing research proposals – NIH style but similar principles apply to all

Much focus on the Specific Aims page both as the critical first impression of reviewers and an outline of your research

The cognitive goals and structures of Significance and Innovation sections

An overview of training-related sections

The goal is to demystify the process – this is all learnable stuff!!!

Writing, thinking and refining research is synchronous – you can't see writing proposals as time AWAY from science

Think of writing a proposal as an invaluable tool for improving your science even if it is not funded

# What do you have to achieve in a proposal?



- Demonstrate the research you are proposing is important, feasible, a logical next step, and hopefully innovative/novel
- Show that you really understand the field, both the broad topic and the precise niche you are in – including best techniques
- Show that you are actually working in the field
- Demonstrate your prior research accomplishments are excellent and appropriate for your career stage
- Write in a way that is crystal clear with every word serving a purpose – and for multiple types of reviewers
- Convince the reviewers that you are a legitimate member of the research community

# You can't think about writing without first understanding how review will occur



In science we write for reviewers. To be a successful writer you have to start from an understanding of:

- What reviewers are used to seeing
- What they want to see
- The criteria they are using to judge what they read
- Their likely approaches to their task
- Knowing and writing to these shows you are legitimate

Your task is to turn the reviewer into your advocate:

- Make the work of the reviewer as simple as possible
  - Convince them your work is VERY important
  - Convince them you know what you are doing and you can conduct the research you propose
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# Writing for different types of reviewers

The expert, someone who knows as much, or more, about the topic as you do

The sophisticated non-expert

The skilled scientist who knows almost nothing about your specific topic

The technical expert – e.g. biostatistician or epidemiologist

A non-scientist who may still have a lot of input into review decisions and outcomes

**KNOW YOUR REVIEWERS!!! You are writing for THEM.**

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# NIH Information and Videos on Grant Review

Recently created videos are well worth spending 20 minutes viewing....

<http://cms.csr.nih.gov/ResourcesforApplicants/InsidetheNIHGrantReviewProcessVideo.htm>

Guidelines for Reviewers

<http://cms.csr.nih.gov/PeerReviewMeetings/ReviewerGuidelines/>





# “Recent” changes in the NIH grants and their review

The review criteria and scoring system changed 5 years ago

- In theory, designed to put more weight on Impact and Significance – importance of the work

Review criteria are changed in subtle ways

Page lengths for most proposals substantially changed as of January 25, 2010

Minimal changes in emphasis and review of fellowships and K awards

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# Remember the review criteria for research grants...



Overall Impact – the score that matters

## Core Review Criteria

- Significance – may be global or within a field
  - Investigator(s)
  - Innovation
  - Approach
  - Environment
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# Significance

***Significance.*** Does the project address an important problem or a critical barrier to progress in the field? If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved? How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?

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# Investigator(s)

***Investigator(s).*** Are the PD/PIs, collaborators, and other researchers well suited to the project? If Early Stage Investigators or New Investigators, do they have appropriate experience and training? If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)? If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?

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# Innovation

***Innovation.*** Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions? Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense? Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?

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# Approach

***Approach.*** Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project? Are potential problems, alternative strategies, and benchmarks for success presented? If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed? If the project involves clinical research, are the plans for 1) protection of human subjects from research risks, and 2) inclusion of minorities and members of both sexes/genders, as well as the inclusion of children, justified in terms of the scientific goals and research strategy proposed?

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# Environment

***Environment.*** Will the scientific environment in which the work will be done contribute to the probability of success? Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed? Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?

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# New Review Template

Bulleted list of reviewer comments on strengths and weakness for each criterion

Much quicker to prepare and read – not necessarily easier to decode

Strong goal of reviewers to ‘fill in the blanks’ so it is to your advantage to help them do so – be explicit rather than hoping they will find things

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# Page Limits and Grant Types

R01 and similar others – 1 page Specific Aims plus 12 page Research Plan – used to be 25

R02, R13, R21 – 1 page Specific Aims plus 6 page Research Plan – used to be 12

K08 and K23 – 12 pages for Candidate Information and Research Strategy – used to be 25

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# Page Change Implications

Specific Aims page continues to be critical first impressions

Overall writing style must be very compact and crisp – no wasted words!

Less focus on Background – very targeted historical perspective with the purpose of establishing Significance and Innovation

Preliminary data must be streamlined if you have a lot

Carefully choose details given in the Approach section – potentially broader brush than in the past

Important to make impact/novelty/innovation very obvious but it must be legitimate! – Critical to the field if no direct health impact

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# The overall writing style should ‘tell a story’

Think of it as guiding or controlling the thinking of the reviewer – cognitive control

This includes consciously considering what a reviewer might be thinking and writing to it

- Particularly critical if there is controversy in the field and/or what you are proposing might challenge current thinking!

Don’t forget to write toward different levels of reviewers

**MUST** employ rigorous technical writing standards

- Paragraphs really do need meaningful topic sentences
- Each sentence must be logically connected
- The last sentence of a paragraph must sum it up and/or make clear to the reader where they are headed in the NEXT paragraph – see videos on sentences and paragraphs

<http://www.northwestern.edu/climb/>

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# Grant Sections – what to accomplish in each



## Specific Aims – 1 page

- One page synopsis of the proposed research
- Starts from setting the context – a funnel with steep sides
- What is the problem or need?
- Why is it important/significant?
- What is known – from other's work to your own?
- What new information do you hope to uncover?
- What is specific question(s) are you asking and/or the hypothesis you are testing?

Bulleted list of Specific aims – what you plan to do – usually with a sentence or two of detail

## Impact Statement

Crystal clear to the reader why what you are proposing is important and what you will do

**Often make or break for reviewer enthusiasm!**

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# Online Tools for Grant Writing

Developed by communications expert who worked with us for 18 months – Karl Keller

Animated PowerPoint presentations with audio – each 15 minutes or less

Vivid display of the patterns that reviewers see and expect to see in grant judged as high quality and fundable

Classic cultural capital which funded PIs have acquired but seldom can articulate what they are doing or why

<http://www.northwestern.edu/climb/resources/written-communication/index.html>

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# Research Strategy – 3 Sections

Significance = importance

- Previously “Background and Significance”
  - Much less emphasis on Background but builds the context behind the question and proposed research
  - Establishes the logic path to what you propose to do – easy to forget to make logic clear – you know it and fill in blanks
  - Expands what is provided briefly in Aims page
  - Convinces the reviewer you know the field and what is important to pursue vs. less important
  - Preliminary Data might come in here – or mentioned here to be expanded upon in Approach
  - Likely 1-2 pages of 12 page R01
  - **Work MUST be significant even if not highly innovative!**
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# Research Strategy – Innovation

Innovation = novelty

- New section – new emphasis

Either not included or lower contribution to fellowship (F) and Career Development (K) awards

The logic may be innovative or the methodological approach – may bring new observation in one field to another

New technologies open up possibilities for innovation

In theory, innovation should give permission for higher risk science but still not always ok with reviewers

Innovative work still must be logical and being reasonably feasible!

Sometimes hard to separate from Significance

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# Research Strategy – Approach

This is the section where you say exactly what you plan to do to achieve each Aim and test each hypothesis – organized by each Specific Aim

Aims should relate to each other but not be dependent on a specific outcome for a previous aim

You can have a section on methods that apply to the entire project but more common recently in each Aim – but not repeated

Scores on Approach most closely predict Impact score

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# Preliminary Results

## Where to include them is not strictly specified

- Best to ask yourself: “When does the reviewer most need to know about them?”
  - Where will they have the most impact?
  - Often best to mention in more than one place with different levels of detail - often first mentioned in Specific Aims
  - Often in Approach with the Aim they apply to
  - If preliminary data sets up the entire approach it can be provided as a beginning section or can be in Significance
  - Make a clear distinction between reference to your own previously published and unpublished data
  - Must keep them compact – no room for large number of tables and figures
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# F32 Award Sections and Page Limits

<http://grants1.nih.gov/grants/guide/pa-files/PA-11-113.html>

Specific Aims – 1 page

- Differences of opinion on whether to include career development aims as well as research aims – research should predominate

Research Strategy – 6 pages

Respective Contributions of Trainee and Sponsor – 1 page

Selection of Sponsor and Institution – 1 page

Training in Responsible Conduct of Research – 1 page

Goals for Fellowship Training and Career – 1 page

Activities Planned Under This Award – 1 page

Doctoral Dissertation and Other Research Experience – 2 pages

Sponsor(s) and Co-Sponsor(s) – 6 pages

Biographical Sketch – 4 pages

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# F31/F32 Scored Review Criteria

<http://grants.nih.gov/grants/guide/pa-files/PA-11-111.html>

## Fellowship Applicant

Are the applicant's academic record and research experience of high quality?

Does the applicant have the potential to develop into an independent and productive researcher in biomedical, behavioral or clinical science?

Does the applicant demonstrate commitment to a career as an independent researcher in the future?

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# F31/F32 Scored Review Criteria



## Sponsors, Collaborators, and Consultants

Are the sponsor(s)' research qualifications (including recent publications) and track record of mentoring individuals at a similar stage appropriate for the needs of the applicant?

Is there evidence of a match between the research interests of the applicant and the sponsor(s)? Do the sponsor(s) demonstrate an understanding of the applicant's training needs as well as the ability and commitment to assist in meeting these needs?

Is there evidence of adequate research funds to support the applicant's research project and training for the duration of the fellowship?

If a team of sponsors is proposed, is the team structure well justified for the mentored training plan, and are the roles of the individual members appropriate and clearly defined?

Are the qualifications of any collaborator(s) and/or consultant(s), including their complementary expertise and previous experience in fostering the training of fellows, appropriate for the proposed research project?

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# F31/F32 Scored Review Criteria



## Research Training Plan

Is the proposed research plan of high scientific quality, and is it well integrated with the applicant's training plan?

Is the research project consistent with the applicant's stage of research development?

Is the proposed time frame feasible to accomplish the proposed research training?

Based on the sponsor's description of his/her active research program, is the applicant's proposed research project sufficiently distinct from the sponsor's funded research for the applicant's career stage?

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# F31/F32 Scored Review Criteria



## Training Potential

Do the proposed research project and training plan have the potential to provide the applicant with the requisite individualized and mentored experiences that will develop his/her knowledge and research and professional development skills?

Does the training plan take advantage of the applicant's strengths, and address gaps in needed skills? Does the training plan document a clear need for, and value of, the proposed training?

Does the proposed research training have the potential to serve as a sound foundation that will facilitate the applicant's transition to the next career stage and enhance the applicant's ability to develop into an independent and productive research scientist?

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# F31/F32 Scored Review Criteria



## Institutional Environment & Commitment to Training

Are the research facilities, resources (e.g., equipment, laboratory space, computer time, subject populations), and training opportunities (e.g. seminars, workshops, professional development opportunities) adequate and appropriate?

Is the institutional environment for the applicant's scientific development of high quality?

Is there appropriate institutional commitment to fostering the applicant's mentored training toward his/her research career goals?

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# K Awards – the K Kiosk

<http://grants.nih.gov/training/careerdevelopmentawards.htm>

Be SURE to determine any unique requirements or idiosyncrasies for K awards at the Institute you are applying to - talk to the Program Official well in advance

Read the instructions very carefully

ALL sections of the application must be strong – any one that is weak is likely to drag down the rest

A unique blend of capturing how great you are but how you still need extended support to be greater

Never view a K award as an ‘end’, always as a means to an end – your successful independent career

Critical to make clear the thrust of R01 proposal you likely would submit by the start of last year (up to 5 years)

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# K08 Scored Review Criteria

Mentored Clinical Scientist Research Career Development Award

<http://grants.nih.gov/grants/guide/pa-files/PA-14-046.html>

## Candidate

Does the candidate have the potential to develop as an independent and productive researcher?

Are the candidate's prior training and research experience appropriate for this award?

Is the candidate's academic, clinical (if relevant), and research record of high quality?

Is there evidence of the candidate's commitment to meeting the program objectives to become an independent investigator?

Do the letters of reference address the above review criteria, and do they provide evidence that the candidate has a high potential for becoming an independent investigator?

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# K08 Scored Review Criteria



## Career Development Plan/Career Goals and Objectives

What is the likelihood that the plan will contribute substantially to the scientific development of the candidate and lead to scientific independence?

Are the candidate's prior training and research experience appropriate for this award?

Are the content, scope, phasing, and duration of the career development plan appropriate when considered in the context of prior training/research experience and the stated training and research objectives for achieving research independence?

Are there adequate plans for monitoring and evaluating the candidate's research and career development progress?

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# K08 Scored Review Criteria



## Research Plan

- Are the proposed research question, design, and methodology of significant scientific and technical merit?
- Is the research plan relevant to the candidate's research career objectives?
- Is the research plan appropriate to the candidate's stage of research development and as a vehicle for developing the research skills described in the career development plan?
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# K08 Scored Review Criteria



## Mentor(s), Co-Mentor(s), Consultant(s), Collaborator(s)

Are the mentor's research qualifications in the area of the proposed research appropriate?

Do(es) the mentor(s) adequately address the candidate's potential and his/her strengths and areas needing improvement? Is there adequate description of the quality and extent of the mentor's proposed role in providing guidance and advice to the candidate?

Is the mentor's description of the elements of the research career development activities, including formal course work adequate?

Is there evidence of the mentor's, consultant's and/or collaborator's previous experience in fostering the development of independent investigators?

Is there evidence of the mentor's current research productivity and peer-reviewed support?

Is active/pending support for the proposed research project appropriate and adequate?

Are there adequate plans for monitoring and evaluating the career development awardee's progress toward independence?

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# K08 Scored Review Criteria



## Environment & Institutional Commitment to the Candidate

Is there clear commitment of the sponsoring institution to ensure that the required minimum of the candidate's effort will be devoted directly to the research described in the application, with the remaining percent effort being devoted to an appropriate balance of research, teaching, administrative, and clinical responsibilities?

Is the institutional commitment to the career development of the candidate appropriately strong?

Are the research facilities, resources and training opportunities, including faculty capable of productive collaboration with the candidate, adequate and appropriate?

Is the environment for scientific and professional development of the candidate of high quality?

Is there assurance that the institution intends the candidate to be an integral part of its research program as an independent investigator?

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# K Award Sections and Page Limits

Specific Aims – 1 page

- Differences of opinion on whether to include career development aims as well as research aims but research should predominate

First 3 items of Candidate Information and Research Strategy – 12 pages

- Candidates Background, Career Goals and Objectives, Career Development Training Activities During the Award Period

Training in Responsible Conduct of Research – 1 page

Statements by Mentor, Co-Mentor, Consultants, Contributors – 6 pages

Description of Institutional Environment – 1 page

Institutional Commitment to Candidate's Research Career Development – 4 pages

Biographical Sketch – 4 pages

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# Why is grant writing so hard to learn?

In the past has not been seen as a concrete, teachable skill

Informal mentoring as a process is very idiosyncratic with high degree of variability in skills taught

Often tacit (or even explicit) belief among some scientists that being able to figure it out by yourself is one of the determinants of whether or not you 'belong' in the Community





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All of our approaches and research are challenge these myths and assumptions

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# Faculty Grant Writers Groups – began in 2008



Every 4 months – “Whose writing a proposal?”

Start by determining level of experience and stage of design/writing for all – can mix to a certain degree

Session 1 deconstructs the elements of what each person is writing

Session 2 – everyone comes with paper copy of research questions, hypotheses or Specific Aims (if they are that far)

In real time, read then discuss each one – I model talking through what my brain is hearing from what I read – others do as well once they see the method

Each week refine and revise questions, hypotheses, aims, aims page

Move on to Significance, Innovation, other sections of F and K

Especially effective done early during writing

Have added recording of oral interchange – moving more toward using oral processing methods



## Grant Writers Groups - continued

Typically everyone begins to ACTIVELY engage and give feedback to each other with increasing skill and acuity

Much easier to learn what to look for and how to fix things on OTHER'S work than your own – but begins to transfer

Very effective teaching and learning approach

Usually spend 4+ weeks or more on Specific Aims page

No reason to go on to the rest until this page really good – make-or-break both conceptually and rhetorically





## Grant Writers Groups - continued

May go on to Approach but most often these are beyond the expertise of the group, but not always

Still requires input of scientific mentors, and other mentors for K, but focuses that time on the science while we develop writing skills and give fresh eyes to improve writing

Audio recording of discussion BIG improvement - captures thinking and discussion which otherwise often lost



# What is happening during writers groups?

Development or refinement of scientific thinking, ability to define research questions, hypotheses,

Scientific writing skills – down to level of sentence construction

Viewing proposal writing as a highly refined stylistic pattern – including rhetorical patterns

Detailed knowledge of what goes into each section and why

Developing ability to ‘think like a reviewer’

Demystification – grant writing is a very learnable skill

Simulation of grant review process and realities

Positive peer group – all in it together

Career development guidance – sometimes harsh reality check

Some realize it is not for them – often a positive outcome!

But can't salvage weak science!



## Participants so far...

250 different people since 2008 – also many repeats

Roughly 30-50% stay the course in each group

Some realize they need more time, preliminary data, pubs

Always positive reinforcement – many return to new groups

Excellent connections among those who persist

Many referrals from colleague to colleague

Faculty mentors referring Fellows and junior faculty to the group

NO instances of mentors reacting negatively

As could be expected, difference of style and content between group and mentors pop up – good teaching tool, careful not to be dogmatic or proscriptive about only one way to write



## More on participants and what happens

At least 50+ proposals funded to people who have been in groups  
– many pending and in various stages of resubmission

Can't definitely say cause and effect of course

High number of responses indicate perception of substantial value

Many anecdotal successes...

One in first group went from planning to not resubmit to funding!

Frequent expressions of appreciation and amount learned

If group too small or diffuse does not work well – shift to one-to-one

COACHING TO COMPLEMENT MENTORING



# Take-Home Messages

Writing research proposals is an invaluable element of high quality research

Writing research grants is a teachable, learnable skill

- Often not approached as such because of the focus of research training on informal mentoring
- Effective grant writers (i.e. mentors) often can't explain or deconstruct why they write the way they do and why it works

The ability to write and sound like what reviewers expect is a central ingredient of being judged as a legitimate member of the research community – strong social underpinnings

It is extremely difficult to become a skilled writer by yourself – look to colleagues and groups as invaluable resources

Don't let writing proposals hold you back!

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