Agency Models for Introduction and Background

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Writing the *Introduction and Background* (or *Introduction and Overview*, or simply, the *Introduction*) section of the research narrative confronts the author with the ***Goldilocks Dilemma***. While admittedly not as challenging as the dilemma facing astrobiologists attempting to determine the habitable zone around a star, this one is more challenging than the problem confronting Goldilocks whose porridge is either too hot or too cold and whose bed too large or too small. When it comes to the *Introduction and Background* section of the proposal, the research narrative must ***capture the interest of reviewers early and quickly***, but early drafts of the section tend to run too long or too short, too detailed or too general, too irrelevant or too redundant, too lacking in the appropriate focus or context, or too much belaboring the obvious, etc.

For example, how far back should you begin an explanation of the importance of your science? It doesn't require offering a history of your discipline beginning with the ancient Greeks; if you are conducting high-precision, time-dependent scientific work, you need not explain the history of the cesium atom and the atomic clock nor reference English poet John Dryden's (1631-1701) famous line, "*till like a clock worn out with eating time*." If you are writing a proposal in response to a solicitation to broaden the participation of women and minorities in STEM disciplines, you do not need to belabor the importance of diversity—after all, that is why the agency is funding the project. If you are writing a proposal to an agency funding a program on climate change and water sustainability, you needn't convince reviewers and program officers that climate change is a fact and that it impacts water sustainability. If buffers are not important to your proposed research, do not belabor buffers. **Bottom line: *Don't squander valuable space in the first page of the research narrative belaboring the obvious***!

A well-written proposal opens with a *Introduction and Background* section that tells reviewers and program officers what you are going to do; why you are going to do it; why it is important to do it; why you have the capacity to do it; the nature of your research rationale; and how, once completed, it will impact the field and bring value-added benefits to the agency research mission. These questions all must be answered in a specific context and in a way that contrasts your proposed research to the current state of the field at various scales. For example, demonstrate how it will impact the agency program area, the agency-wide mission, and the national state of knowledge on the topic.

For example, an agency may ask that you explain why your research is "*at the scientific forefront of the field or addresses a grand challenge area in engineering or science,*" or how your "*proposed research is aligned with the core research activities and priorities***"** of the funding agency, particularly in the case of mission agencies like DOE, DOD, NASA, NOAA, etc. Similar requirements are common, regardless of funding agency or the scale and scope of the research project. They can be particularly challenging in large-team and center-level grants that require applicants to answer background and context questions that "**set the stage**." Agencies use these statements to place the proposed research in a larger research context and

thereby help reviewers and program officers to better understand how the research fits in a disciplinary field(s) and its value and impact in advancing the field(s), or an agency's mission objectives.

Given the above, it is often helpful in grant writing to look for models, e.g., funded proposals or other materials, that can help you write a stronger proposal. Reviewing the *Introduction and Background* section (or the generic equivalent) of funded proposals will be helpful in this regard. One other place to look for models is to the funding agencies themselves. In many cases, funding agencies write the equivalent of an Introduction and Background section in a funding solicitation (or BAA or Notice of Intent to Issue) to set the stage for the research vision, goals, and objectives of the agency that motivates the funding of the research, something similar to the task confronting the author writing the initial section of a research narrative.

In reviewing these agency models, you will find that they include a brief and concise description of the research to be funded, some background on the research area, a discussion of the current state of the field, the importance of the research to the agency mission, the role the research will play in impacting the field, etc. Basically, in many solicitations, the agency gives potential proposers a nice overview of the research context to which they must map in order to succeed at the agency. Moreover, this research overview often provides an excellent model for a better sense of what constitutes a well-written introductory section of a research narrative at the particular agency.

For example, in the recent DOE solicitation for **Next Generation Electric Machines: Megawatt Class Motors**, the introductory section of the funding solicitation answers key questions about the research area, significance, background, context, impact on the field, etc. important for an applicant to understand—***the very points the proposer will want to make when responding to the solicitation***: "*Manufacturing* **[defines the research]** *is the use of energy, equipment, information, services, and capital to convert raw materials, components, and parts into goods that meet market expectations. As an economic sector, manufacturing generates 12% of U.S. Gross Domestic Product (GDP) and employs 12 million Americans* **[importance of research]**. *The DOE Office of Energy Efficiency and Renewable Energy's Advanced Manufacturing Office (AMO) makes research, development, and demonstration (RD&D) investments in advanced manufacturing process and materials technologies* **[research context]**. *These technologies are foundational, pervasive, and promise crosscutting industrial applications and impact in reducing industry's energy footprint and greenhouse gas (GHG) emissions, as well as supporting the global competitiveness of clean energy products* **[significance, value, impact of research]**. *By targeting the development of energy-related advanced manufacturing technology, AMO's work* ***can create completely new supply chains and stimulate significant economic growth and job creation*** **[value of research]**.

"AMO's Next Generation Electric Machines (NGEM) program is an RD&D effort ***leveraging recent*** *technology advancements in power electronics and electric motors to* ***develop a new generation*** *of energy efficient, high power density, high speed, integrated MV drive systems for a wide variety of critical energy applications. Improvements to these systems can be realized through the application of key enabling technologies, such as wide bandgap devices, advanced magnetic materials, improved insulation materials, aggressive cooling techniques, high speed bearing designs, and improved conductors or superconducting materials.*

Through this development program, ***NGEM will facilitate a step-change that enables more efficient use of electricity, as well as reduced drive system size and weight, developing lasting capabilities for motor material development, design, and analysis that are cost-shared with industry stakeholders****.*

This specific Funding Opportunity Announcement (FOA) *is focused on developing MV integrated drive systems that* ***leverage the benefits of state of the art power electronics*** *(i.e., wide band gap devices) with energy efficient, high speed, direct drive, megawatt (MW) class electric motors for efficiency and power density improvements in three primary areas:*

1. *Chemical and petroleum refining industries*
2. *Natural gas infrastructure*."

Bottom line: the above offers a useful model for writing an introductory section. While it is solicitation specific, it is also sufficiently generic to provide an excellent instructional tool in how to craft the introduction section of the research narrative.

A final and abbreviated example comes from the recent NSF **Dear Colleague Letter - EAGERs for Cellular Biomanufacturing**, which states: *"Advanced biomanufacturing is* ***a field that builds upon groundbreaking discoveries*** *in engineering and biology to produce the* ***next generation of therapeutics, diagnostics, and manufacturing processes for biochemicals****. These include, but are not limited to, cell-based therapies, microdevices with cells organized to provide appropriate biological complexity, also referred to as organs-on-a-chip, as well as design methods of cellular catalysts.* ***Advanced biomanufacturing capitalizes on recent discoveries*** *in bioreactor technology, 3D additive manufacturing, micro and nanofabrication, novel biomaterials, stem cell technologies, cell reprogramming and transdifferentiation processes, systems and synthetic biology, genome editing, and mathematical modeling at the molecular, cellular, cell population, and tissue levels, to spur research and development, education, and industry growth and innovation.*

"Cellular biomanufacturing is a critical component of advanced biomanufacturing. Cell-based therapies and diagnostics have the potential to revolutionize human healthcare in different contexts, including personalized medicine. Additionally, cells are used for the biomanufacturing of protein therapeutics. Processes with cells as products present major engineering challenges, and indeed new therapies and cell-based products may depend critically on robust and reliable manufacturing approaches at the cellular level.

"This Dear Colleague Letter (DCL) is aimed at identifying opportunities to ***leverage and synthesize conceptual, scientific and technological innovation across disciplines*** *in order to promote developments in cellular biomanufacturing towards accelerating solutions to critical challenges in the field. Although some of the challenges are specific to particular types of cells, such as autologous cells, others are more generic and encompassing, applicable to both autologous and allogeneic cells. Projects are not limited to particular cell type(s); however, the project description should indicate the range of cell types for which the scientific questions or technological developments addressed in the proposal are relevant. Topics may include, but are not limited to…"*

The above examples demonstrate how "***setting of the stage***" can be done in an "*Introduction and Background*" or "*Introduction and Overview*" section of the Research Project Description, although different authors and agencies may denote the section in different ways,

depending on preference. But basically it comprises the first section of the research narrative in which you introduce your research by answering the above questions, or similar questions posed in the funding solicitation.

It is challenging to distill the core significance of your research into a concise, clear, and easily understood description that will convince reviewers and program officers to fund your project over others. However, describing the impact of your research in the context of the field and/or agency mission--at a program level, agency level, and national level--is more challenging yet. This crucial context that illuminates the importance of your research for reviewers and program officers is challenging to write effectively, particularly with respect to achieving a suitable proportion of primary to secondary information and of excessive to minimal information .

As is the case in all sections of a well-written research narrative, ***you must define a hierarchical narrative structure reflecting the relative (weighted) importance and order of the information you choose to provide*** reviewers and program officers within the page and section limits of the proposal. Moreover, while the possible information you could present to reviewers is open ended, agency constraints in the form of questions that must be answered will ***require significant information triage and culling*** to achieve an effective response within the proposal's page limits. This "***what to say and what not to say***" dilemma is the persistent challenge for anyone writing grants. However, it is particularly demanding when writing some variant of the generic "*Introduction and Background*" section of the research narrative.

Remember, the background section sets the stage for your research idea. ***Your research idea is the lead character on this stage*** and all other information serves as the illuminating backdrop to your proposed research. Moreover, many center-level grants give the applicant freedom to select core research topic areas, e.g., the NSF Engineering Research Centers or Science and Technology Centers, while other grants, many of those offered by mission agencies, are more focused on addressing a specific agency research objective, such as the currently open Specialty Crops Research Initiative by USDA/NIFA.

In this latter case, all proposals submitted will fall within a more narrow and common research area. In this case, writing the background section presents the additional ***challenge of avoiding a statement numbingly similar to those written by other applicants and thereby either annoying or boring the reviewers***. In effect, the more narrow the research objectives of the funding solicitation, the more likely that the background sections of all the proposals will overlap, presenting another challenge to writing a persuasive statement.

Of course, background sections will be poorly written, among other reasons, when writers resort to generic background information. This, in turn, gives writers the illusion of making narrative progress when, in fact, they are struggling to generate narrative text describing the importance of their research. No one who has written grants will deny that some panic can set in when staring at the initial blank page of a new project narrative. Nor can any author be blamed for beginning a project narrative with text that clearly will be deleted in future drafts but at least gets the narrative started. That said, once the project narrative starts to come to life, it is time to go back and cut and shape the background section to ensure that it does only what it needs to do and not more: to demonstrate the importance of the proposed research to advancing a field described carefully enough to give reviewers a sense of how it compares to current practice and to judge the value-added benefits it brings to the field or agency mission.

Finally, a poorly structured background section will put reviewers to sleep. Do not introduce reviewers to your research by boring them with irrelevant, excessive, or generally known information. ***Opening a proposal with irrelevant and redundant information does not bode well for the attention reviewers will bring to the rest of your project narrative***.

The above models by DOE and NSF are but two of many that can be reviewed as you develop your own strategies for writing a winning Introduction and Background section to your research narrative.