How to design a chalk talk—the million dollar sales pitch

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ABSTRACT **Each faculty recruiting season, many postdocs ask, "What is a chalk talk?" The chalk talk is many things—a sales pitch, a teaching demonstration, a barrage of questions, and a description of a future research program. The chalk talk is arguably the most important component of a faculty search interview. Yet few postdocs or grad students receive training or practice in giving a chalk talk. In the following essay, I'll cover the basics of chalk talk design and preparation.**

Monitoring Editor
Keith G. Kozminski
University of Virginia

Received: Apr 8, 2019
Accepted: Apr 23, 2019

The chalk talk is a faculty candidate's opportunity to describe his/her proposed research program. The candidate stands in front of a dry erase board with some markers in a room of 10–20 faculty members for an hour. Candidates get 5–10 minutes to present a research program plan and then the committee will ask technical questions, practical questions, and sometimes even insulting questions. The candidate's task is to answer the questions with grace under pressure, convince the faculty members to accept her/him as a colleague, and give him/her *a million dollars* or more for a startup package. Considering that last point, how much time should one should devote to developing a chalk talk? If you're going to ask for a million dollars, you had better have a sophisticated polished sales pitch.

However, describing how to prepare a chalk talk is analogous to explaining how to ride a bike. One can describe the mechanics and steps of bike riding with considerable precision, but riding a bike is not intuitive and takes practice to keep the bike upright. Therefore, you'll need the perspectives of others. Nearly all postdocs can ably critique research programs by others. Yet the same postdocs fall prey to the same mistakes that they easily identify in others' programs. This is analogous to the phenomenon of how alien our own voices sound to us. We hear ourselves clearly when we speak, yet it's surprising to hear how different one's own voice sounds in a recording. It's the same issue with our own science. We're so close to our projects that they sound rich and melodic to our ears, while others perceive our research description with nasal squeakiness that eludes us. Unfortunately, writing down our ideas does not initially lead to recognition of the flaws. Therefore, seek out one to three faculty members that have served on search committees and request their feedback. Talking to other postdocs or lab members may be helpful, but it is essential to get feedback from people that have considerable experience with chalk talks. The organization and style of chalk talks is rarely taught, so few people can offer much guidance. Faculty members can help distinguish mechanistic questions from descriptive proposals, identify overly ambitious goals, and evaluate the attractiveness of a research proposal.

CREATING A RESEARCH VISION

A chalk talk describes the candidate's *research vision* of what he/she hopes to achieve in the next 6–10 years. Some search committees expect a description of the first grant application (e.g., a National Institutes of Health R01). Prepare to discuss both. The committee wants to know the candidate has clear goals with defined outcomes. What problem will be solved? What will the new lab be known for? How will you have advanced the field? What does success look like? If successful, what will we know and/or what will we be able to do?

A research vision is a candidate's approach to resolving a *significant knowledge gap* in the field. Some people describe the research vision as a moon shot. That is, if the program is successful, what will be accomplished? There's a clear outcome that defines the terms of success. In the case of the 1960s moon shot, the unambiguous goal was to send a manned mission to land on the moon, not to collect data to better understand how to get to the moon. Although these components play a role in getting to the moon, the goal is vague. At what point is "understanding" achieved? When there's a plotted trajectory? When there's a rocket ship? A vision needs to anticipate the probable answers. How will the data look? What model do you favor and why? If a vision merely proposes to map/quantitate/collect data, then the committee will not know whether the question can or will be answered.

The high-level problem

The first component of a research vision is the big question or mystery to be solved. It should be at a high level, broadly

DOI: 10.1091/mbc.E19-01-0007
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Abbreviation used: DDR, DNA damage response.

understandable to scientists outside one's field, and interesting. Here are some examples: "How does a cell recognize and destroy incorrectly folded proteins?" "How does the immune system turn off a response after a pathogen is vanquished?"

The knowledge gap

Within the big question, what is the specific problem to be studied? Why study this problem and why now? What is the current state of the field? What is the *knowledge gap*? A knowledge gap is a barrier to progress in a field. Knowledge gaps are mechanistic problems: "How" questions, not "What" questions. For example, if one asks "What proteins are in the Z pathway?" the answer is an open-ended list of proteins lacking context. Alternatively, "How do proteins X and Y regulate the Z pathway?" is mechanistic and enables predictions; for example, protein X contains a predicted kinase domain, Y has consensus phosphorylation sequence sites, and proteins Y and Z have been reported to bind each other in pull-down assays. The "what proteins" question is at least a few steps upstream of the how question and has difficult to predict outcomes. A researcher may well seek to identify the proteins that interact with Z. Yet, until candidates are identified and validated, the direction and potential success of the research program remain murky.

Significance

Significant does not necessarily mean a cure for a disease (or even the equivalent of landing on the moon). Rather, significance is the impact a successful research program will have on the field. Does the research vision result in a powerful new mechanistic model, enable new major questions to be posed, open a new therapeutic avenue for a disease or even create a new field? These are examples of significance.

Approach and aims

How will the knowledge gap be solved? Typically, this information is broken up into three aims. Aims should provide mechanistic insights and help resolve the overarching knowledge gap. The scope of an aim varies depending on whether it's a grant aim or a 10-year research vision aim. For a grant, aims can typically be performed by one to three people over 1–5 years, whereas a research vision aim could be the equivalent of a whole grant. Be careful of being overly ambitious. A common mistake is to make each aim a full 10-year research program. To avoid this problem, consider what satisfactorily answering a question entails. What milestones need to be achieved? How long will it take to get a system up and running? What kinds of controls will be needed? What are the competing hypotheses that need to be tested? Get feedback from senior faculty members.

Aims should have short, clear titles and include the following information: What is the question? What is the prediction? How will it be tested? Are there any innovative tools or techniques that can help resolve the question? Are there alternative approaches? What are the anticipated outcomes? How will results be interpreted? What if the model is incorrect? What is the payoff for successful completion of the aim? Will results of the aim support the main hypothesis?

Below is an example aim from an R01 grant (kindly shared by Mengxi Jiang; www.niaid.nih.gov/sites/default/files/R01_Jiang_Sample_Application.pdf).

Determine the viral DNA triggers that activate the DNA Damage Response (DDR) upon polyomavirus infection. The current view in the polyomavirus field is that viral oncogenes activate the DDR. In contrast, our results suggest that a full DDR activation is dependent on viral DNA synthesis. We hypothesize that replicating viral DNA serves as a major trigger for DDR activation during infection. In this aim we will identify viral DNA structures that are recognized by host cells as damage signals to induce DDR activation.

This aim contains several key elements. The first two sentences set up competing models. The third sentence articulates the hypothesis. Finally, the types of data to be collected and how these data will support the hypothesis are described. During a chalk talk, the candidate would also describe how structures will be isolated, how the host cell recognizes them, and how DDR activation will be measured. There will be some introduction for why the field believes the oncogene model and how the candidate's preliminary data argue against the model. Additionally, the candidate will describe expected outcomes, what the outcomes mean for the hypothesis and larger knowledge gap, and what the candidate will do if the hypothesis is not supported. It could easily take 10–15 uninterrupted minutes to get through this. Do not be surprised or upset if you do not get through all of the aims. This is completely normal.

Discovery driven goals

A common error in science is equating the ability to collect data with automatic understanding of the data and resolving a knowledge gap. Yet this is rarely true. For example, a screen of a long list of molecules or genes has unclear utility. Data and screens are rarely predictable. Data collection and screens depend entirely on what *will* be found. Which outcomes are relevant? What if the screen returns dozens of hits or none?

This is not to say that screens cannot be proposed. Novel screens can be subcomponents of a larger aim with clear questions and predictions. It's very attractive to have performed a preliminary screen and validated some hits. Knowing at least some of the outcomes/components can enable the formation of hypotheses, models, and predictions. I appreciate that it's frustrating to need data to sell a project or get it funded, but that's the nature of most grant-funded research.

Although data need to be collected to answer questions, the actual answering or articulation of questions is frequently missing from many grants and chalk talks. Poor aims are often lists of techniques or data to be collected. *The goal is not the data.* The goal is to test models and hypotheses, resolve conflicts, and determine mechanisms. The data need to be predictable and outcomes interpreted. If the likely outcomes cannot be described, a search committee member will be unable to evaluate the research vision.

Clarity and details

For chalk talks, the challenge is learning how to describe the research vision to a diverse and naive audience. There may be some experts that know the candidate's particular field, but there are plenty of people that do not. Most people probably do not use the same terminology or jargon. Minimize jargon and if jargon is absolutely necessary, explain each term.

Ten minutes is a short amount of time to present an overview. The background must be succinct. I've encountered some postdocs determined to give the *Annual Reviews* version of background for their project. They insist that no one can understand their project without an hour of background. This is not true and it's not possible within the chalk talk format. Some details are obviously important for understanding the science, but not terribly good for telling an engaging narrative.

Consider the narrative of children's fairy tales. For example, one needs to know 1) that Cinderella had a glass slipper, which was critical for the prince to be able to identify her, and 2) that her carriage would turn back into an unusable form of transportation—a

pumpkin—at midnight. However, her shoe size, the specific music pieces played at the ball, or the species of pumpkin are irrelevant details for advancing the story. The same is true of a research vision. Learn to communicate the research vision with only the most salient details. If a committee member wants to know some technical details, let him or her ask that question. In those instances, it is helpful to rephrase the questions and/or add some introduction so that the rest of the committee members will understand the answer.

TRANSLATING A RESEARCH VISION INTO THE CHALK TALK FORMAT

The chalk talk expands the research vision into an ~30-minute presentation composed of an overview and then expansion of the aims. The overview is a 5–10-minute sales pitch that everyone should be able to understand and enthusiastically support. In addition to the components of the research vision, the candidate should also explain why he/she is the best person to do this research now. Does the candidate have innovative tools, a novel data set, unique expertise, and/or a novel hypothesis? Part of the motivation for doing the research should be that candidate has the ability to execute the proposal and the resources/technology currently exists to solve the problem.

Creating a coherent unified story and model is vital. Engineer a logical progression linking each aim back to the main question, an illustrated model that highlights how the aims will solve the question.

After completing the overview, the presenter can dive into each aim with more detail. Prepare to be able to discuss two or three subaims or one or two main aims in detail. Again, focus on the questions, predicted outcomes, how hypotheses will be tested, anticipating technical challenges or outcomes contrary to the hypothesis. The committee wants to see the candidate's ability to plan and to adapt. There will be many questions and these can easily occupy 30 minutes or more of the allotted time. In fact, the candidate needs to steer the presentation. Committee members may unintentionally or intentionally derail the chalk talk into an argument over obscure details. Part of the candidate's task is to answer questions while keeping the talk moving forward.

Importantly, the search committee needs to be excited about the research program. How will you be a good colleague? Why provide you with a million dollars to execute your research vision? An easy to follow proposal with a compelling problem and clear outcomes will increase the enthusiasm of the committee.

PRACTICE

Engineering a chalk talk often takes weeks of effort. Last-minute preparation is readily apparent and does not sound like a million dollar sales pitch. Start preparing well in advance of any invitations for interviews.

1. Design easy-to-draw and interpret figures and diagrams to illustrate the vision. Practice drawing and writing everything in a form easily visible from the back of the room. Do not limit yourself to the 2D whiteboard. Consider creating visual aids to better illustrate a point. I've seen 3D printed sculptures used to effectively illustrate concepts. Similarly, maybe there are useful hand or leg motions or sounds that help people better understand an idea. I remember one applicant that worked on molecular motors and he illustrated motor motions by marching and lifting his legs and arms in an amusing exaggerated manner.
2. Perfect the story and delivery. Practice until delivering the talk is second nature.
3. Practice at least a few times with people outside your lab and field. If they can understand and are engaged by the presentation, this is a good sign. Practice the full chalk talk format with typical questions from the committee. It is important to practice with faculty members that have served on search committees. There is no substitute. If possible, do at least two full-length practices (~1 hour) and get constructive feedback. What worked? What did not? How can something be made clearer or more engaging?

COMMON CHALK TALK QUESTIONS

Many chalk talk questions will involve clarifying details about background, experiments defending an interpretation or suggesting alternative approaches. Additional questions may include the following:

What is your dream experiment and the anticipated result?

What are the project/thesis titles for the first two graduate students?

How will you incorporate undergraduates into your research program?

If you are working with noncommercial technology (e.g., a novel microscope), can you build and maintain that technology?

What will you do if your approach does not work or if you get an outcome radically different from your prediction?

What would you do if someone else accomplished all of your proposed goals before you even start your lab?

If you have a key collaborator, what will you do if that collaborator becomes unavailable?

Who do you see potentially collaborating with in this department and how?

How will you compete with established labs in your field?

How will your research program differ from your postdoctoral mentor's program?

What will you do first in your new lab?

Checklist for the day of the chalk talk:

1. Bring a fresh set of *erasable* markers.
2. Bring and eat a snack before the chalk talk.
3. Maintain your energy level.
4. Bring a beverage. The host may not offer anything.
5. Thank the attendees for their time.
6. Minimize time facing the whiteboard. Engage with the committee.
7. Most importantly, be enthusiastic! This is your research program. You should be proud of it and excited about getting the opportunity to realize your vision.

ADDITIONAL RESOURCES

www.ascb.org/careers/preparing-academic-chalk-talk/
https://blog.addgene.org/designing-your-chalk-talk-for-the-academic-job-interview
https://edgeforscholars.org/qa-how-to-give-a-chalk-talk/
http://vosshall.rockefeller.edu/assets/file/ChalkTalk.pdf

ACKNOWLEDGMENTS

I am grateful to Nelson Spruston for helpful discussions.