



Published in final edited form as:

J Investig Med. 2012 June ; 60(5): 779–784. doi:10.231/JIM.0b013e3182508317.

Developing your Career in an Age of Team-Science

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Abstract

Academic institutions and researchers are becoming increasingly involved in translational research to spur innovation in addressing many complex biomedical and societal problems, and in response to the focus of the NIH and other funders. One approach to translational research is to development interdisciplinary research teams. By bringing together collaborators with diverse research backgrounds and perspectives, these teams seek to blend their science and the workings of the scientists to push beyond the limits of current research.

While team-science promises individual and team benefits in creating and implementing innovations, its increased complexity poses challenges. In particular, since academic career advancement commonly focuses on individual achievement, team-science might differentially impact early stage researchers. This need to be recognized for individual accomplishments in order to move forward in an academic career may give rise to research-team conflicts. Raising awareness to career-related aspects of team science will help individuals (particularly trainees and junior faculty) take steps to align their excitement and participation with the success of both the team and their personal career advancement.

Introduction

Interest in developing academic interdisciplinary research teams has grown in order to push the boundaries of discovery and to translate research advances into tangible societal benefits. Among many factors promoting this are also NIH funding priorities (such as the Clinical and Translational Research Awards¹) and a congressional mandate that patents retained from government-supported research be commercialized.² Interdisciplinary teams are being embraced to catalyze the translational (basic to clinical to practice) research continuum. The belief that research teams will foster innovation stems in part from highly publicized and successful interdisciplinary projects (such as sequencing the human genome, and addressing SARS) and from industry, which widely uses the team approach in bringing products of research to market.³ Thus academic researchers are looking to master the skills needed for developing and implementing successful team-science.^{3,4}

While research collaborations are common in academe,⁵ the use of highly integrated interdisciplinary teams is not. And accommodating to the team-science approach has been cited as one of the more difficult adjustments for academic researchers who transition into industry.⁶ Interdisciplinary teams represent a shift for the academic research culture which has typically supported distinct department structures and has valued individual achievement (e.g., in peer-recognized, quality scholarship/research, in being able to secure funding, and in service and teaching) for promotion and tenure of faculty. In academic biomedical research, norms for evaluating individual accomplishment in the context of a team effort have not been established, much less widely implemented. And although the nature of any direct associations between increased collaborations, and resulting negative or positive trends in faculty promotions and tenure, remain to be elucidated, reports on academic interdisciplinary research suggest that potential impacts on career advancement is an

issue.^{3;7;8} Therefore, as early-stage researchers become involved in interdisciplinary teams and work at being successful team players on their own and others' teams, it is important that they include potential impacts (helping and/or hindering) on personal career development in evaluating the cost/benefits of participation and in navigating their chosen research paths.

This paper can hardly begin to address the broad and complex topics of career development and academic promotion and tenure. So, readers are referred to professional organizations such as the Association of American Medical Colleges⁹ and the American Association of University Professors¹⁰ who routinely monitor and provide guidance on academic and faculty matters and their continued evolutions.¹¹ Additional related resources, references and websites are also provided at the end of this paper. And, since the requirements and procedures for promotion and tenure vary across institutions, it is important to be familiar with the specifics (policies, procedures and involved people) at one's own institution.

This paper instead will briefly discuss some aspects of science collaborations that might particularly impact early-stage researchers' careers due to influences on requirements for academic advancement, and perhaps to a heightening of some of the hierarchical realities of academe. Many of these aspects are not specific to large or interdisciplinary teams. They often stem from interpersonal disagreements and thus can arise even in very limited collaborations. But their frequencies and complexities are likely to be increased with the greater size, diversity, integration, and competing interests found in larger and interdisciplinary groups. By raising awareness to potential sources of team disagreements and some reactions to them, it is hoped that individuals will have the context in which to use available tools (such as those presented in the accompanying articles^{4;12}) to productively manage conflicts and align their research collaborations with successful career advancement.

Promises and Pitfalls of Interdisciplinary Team Science

The team-example for this discussion is a highly integrated interdisciplinary research collaboration. These teams can have multiple PIs of similar academic rank/stature, as well as additional faculty, staff and trainee members. Table 1 briefly outlines some general benefits and challenges of interdisciplinary team science.^{3;13} Many of the points address interpersonal aspects of teams and focus on improved communication, trust and conflict management.⁴ Note that some of the same factors appear in both lists. Thus those actions that mitigate circumstances under which a beneficial factor becomes a challenge help to facilitate successful team building and management.^{3;14}

Why choose an interdisciplinary team?

Translational research projects are being aggressively promoted by institutions and funders. And researchers are turning to interdisciplinary collaborations because project complexity requires both broad and in-depth expertise. These projects' potential for significant impact and the excitement that their novelty generates can be strong attractions particularly for new investigators.⁸ New fields, looking for new investigators, may be more welcoming to new researchers. Thus many factors are encouraging researcher involvement in team science.

However, these opportunities for involvement in innovative and pioneering research often come with greater uncertainty as regards their science (e.g., the new methods and the integration of cross-discipline techniques and theories) and its acceptance by the research community. Innovations may challenge the status quo¹⁵ and there may be limited numbers of colleagues, who can fully understand the new field and offer constructive feedback and review. Fewer journals may be dedicated to publishing these works. Taken together, these pose formidable barriers to timely research completion, acceptance and peer recognition,

which are all critical considerations for academic advancement. In considering the pros and cons of participation in these projects, one response might be to avoid them until one is more established. An alternative however, might be to seek supportive and enabling collaborations.

Pick your collaborators well

Pushing the boundaries of science can be risky whether a researcher works alone or as part of a team. And teams can have advantages. Team colleagues and mentors can offer support and perspective, in addition to their scientific contributions to the current work. They may form a network of valuable collaborators and connections for future research and serve as current and ongoing career advisors.

For a project's science, interdisciplinary collaborations provide in-depth expertise from different fields, which few, if any, individuals could provide on their own. For example, consider a project that explore associations of clinical phenotypes with biochemical markers and that also requires complex data analyses. When successful, the collaborating clinical and basic researchers are each able to extend their research beyond the limits of their own disciplines. And yet, in doing this each investigator's work comes to depend on the others. If standards differ across disciplines or unresolvable methodological disagreements arise, the advantages of the multiple areas of expertise may be lost. Should it be needed, finding a substitute collaborator, if even possible, could prove extremely difficult on many levels. Thus, also maintaining the supportive and mutually beneficial collaborations is necessary.

Personal timelines and branding

Two added challenges, of particular relevance to academic promotion criteria, are research timelines and individual attribution. In undertaking interdisciplinary team projects, the need to develop new scientific methods, and to plan and implement the activities that integrate large numbers of diverse team participants can lengthen a project's timelines. And when teams succeed in integrating their members' works, they then face the challenge of appropriately recognizing and crediting individual member contributions. Using a cooking analogy, if we work together to make a soup, it may then be difficult to separate out each cook's contribution and impact on the final product. One study of the rating of author contributions to collaborative research suggests that, as one might expect, the greatest contribution is credited to the principal investigator(s).¹⁶ However, the expertise and reputation that help a researcher attract collaborators to form a team are often lacking among junior investigators. And while the now common practice of listing authors' specific contributions in publications is helpful,¹⁷ greater uniformity in assessing these contributions and in interpreting authorship criteria are still being called for.¹⁸ So in earlier career stages, while striving to head one's own team, one might seek to carve out a defined sub-project/section to lead and to connect with supportive senior collaborators who enable this. Recalling the soup analogy, while the reviews focus on its overall characteristics, there also may be note taken of any still identifiable components. Identifying a specific, circumscribed aspect to spearhead might help to brand one's individual contributions.

Additional Case Examples

Our hypothetical discussion cases (see initial case presentation- this issue page??) provide some added examples of team-science and career considerations. While actual scenarios will vary widely with local circumstances and the characteristics of the individuals involved, the discussion cases highlight some commonly encountered situations. First, consider the case of Dr. Bond, a post-doctoral fellow in a lab with other post-docs and a mentor who is also involved in co-founding a company. Reviewing Dr. Bond's concerns, most relate to

obtaining recognition and reward (e.g., authorship), and to moving towards independence (e.g., figuring out how much work is needed to finish his fellowship, identifying what projects/reagents he can take with him or have access to, and deciding whether to continue in academe or consider a move to industry, potentially in his mentor's company). Conflicts relating to attribution, recognition and reward are not unique to large or interdisciplinary research collaborations. At all academic levels and for varied modes of acknowledgment and reward (e.g., authorship, leadership roles, conference presentations, promotion) these disagreements can pose tough hurdles to overcome. This case describes a relatively small, well-defined translational research collaboration. A larger team, with increasing complexity and more collaborators, divergent standards and practices, and an implementation plan that integrates members' works, could be even more challenging to orchestrate.

Developing trust and a prior written collaborative research agreement may go a long way in addressing these issues.⁴ However, that said, initiating and developing this is often not quick and not easy particularly for junior team members who need to negotiate with senior team members and mentors. Differences in academic rank and in team positions often result in unbalanced dependence, which puts parties at an uneven negotiating table.¹⁹ While direct negotiations will often succeed, managing conflicts that involve unequal relationships may benefit from external aids or assistance. The AAMC, for example, has developed templates for written research contracts between students or post-doctoral fellows and their advisors.^{20:21} These sample documents can help trainees both initiate the necessary conversations and develop their personalized agreements. For students who are in degree-granting programs, institutional policies and resources are often well developed to provide useful external support. Similarly for faculty, institutional policies generally outline requirements, benefits and procedures as well as the institutional bodies to whom questions and concerns may be addressed. Using available templates for collaborative research agreements²² and for initial job offers²³ can assist with these negotiations. Postdoctoral fellows, who often move out of their training institutions and who are not in degree-granting program, perhaps face greater challenges in their moves towards independence.²⁴ Recognizing a need to assist at this pivotal career stage, the NIH²⁵ and professional organizations (for example, a group specifically for postdoctoral fellows²⁶) are offering supportive and collegial resources.

Now turning to the case of Dr. Day, an assistant professor, several advantageous aspects of junior faculty participation in team research are described. Dr. Day has had a positive history of collaboration with her colleague, Dr. Chase who now is opening up a new opportunity to her through his own collaboration with Dr. Ally. Dr. Day already has a specific, recognized and sought-after technical expertise and this could help to spotlight, at least in part, her specific contributions to the team's project. With the interest in her technical capabilities, requests for collaborations may increase. Keeping her own research goals in mind will be important as Dr. Day decides whether and how to participate in proposed projects, so that she also continues to solidify her own research branding.

An additional consideration for Dr. Day relates to the project's multiple PIs. In developing an agreement with Dr. Chase about her role, responsibilities and rewards, it is important that she also assure that the co-PI (Dr. Ally) agrees. In a complex team structure, although junior researchers may not directly be involved in the genesis of a disagreement between senior PIs/Mentors, or in facilitating their resolutions, the fallout, if unsuccessful, impacts the whole team. In this case, having a research agreement that has been vetted with all PIs and team investigators, might afford Dr. Day greater independence in moving forward with her work, and, if necessary, in developing options for restructuring/completing her work should other team agreements fail.

Considerations and Supports

Taken together, Table 2 summarizes these and other career-related considerations for participants in interdisciplinary team science. Some points relate to balancing the benefits, risks and uncertainties of the science, while others focus on clearly defining roles, expectations and the provisions for recognition and quality outcomes that are needed to attain individual career milestones. Raising these points is not meant to discourage, but rather to promote proactive consideration and action. They clearly emphasize the importance of keeping one's individual goals, needs and realities in shaping one's team participation specifics. As you are swept up in the excitement of your current project, keep potential future projects in mind. For example, in addition to acquired transferable skills, consider resources you might take with you (data and materials), next-step projects you might take on, and funding opportunities you might apply for.

And with these discussions of potential career benefits and challenges, the importance of supportive mentors cannot be overstated, both for their guidance regarding the science and for their help in navigating career moves. Seek a supportive home institution and department where promotion policies credit team-research, and where mentors, as well as with others involved in the institution's promotion processes, can and do provide strong backing for your participation in team-science. Trust is critical, as is the recognition that these choices may need to evolve. If support is not there or the efforts for collaboration overwhelm the science, one might need to reconsider these choices and being part of that team.²⁷

Many institutions have developed programs (such as those funded through the Clinical Research Education and Career Development awards¹) to assist trainees and junior faculty in developing research collaborations as well as their independent research programs.²⁸ Professional societies, for example the AFMR (www.afmr.org), FASEB (www.faseb.org), AAAS (www.aaas.org), and AAMC (www.aamc.org), offer many career resources, educational programs, and mentoring opportunities. As noted, seeking and finding supportive mentors and colleagues is critical. And colleagues and advisors from outside one's team and institution who offer an unencumbered perspective may be particularly helpful.

Moving Forward

To support career advancement in this age of growing team science, changes are taking place at academic centers including efforts to expand the definitions of scholarship for faculty,^{29:30} and to revise promotion and tenure criteria to incorporate aspects of collaborative research.^{3:31} We have already seen the initiation of multi-PI grant mechanisms and funding opportunities,³² and NIH is taking specific steps to facilitate the move to independent funding for early-career researchers.²⁸ There is growing study of the science of team science^{14:33} and in recognition of the need to prevent and address disagreements, programs and positions (such as ombudsmen) have been created to provide assistance and training in conflict resolution, science-team management and leadership.^{14:34:35}

Studies are also considering researchers' characteristics (e.g., gender^{36:37}) in evaluating science collaborations and academic advancement, and their potential links.

There is no single plan for developing a successful research career and no single set of actions to address the challenges of team science. While academic advancement is often purported to be merit-based, promotion and tenure decisions generally depend on more than just one's good works. How a career develops can depend on one's goals, opportunities, choices, personal strengths and limitations, and even luck, or whatever one terms that which brings a person to the right place at the right time and able to seize opportunities. Since

many of these career challenges are not specific to participation in team-research, recommended actions often will mirror general academic career strategies^{24;27;38–45} for developing one's own research identity and maintaining good relationships in the process. Table 3 lists a few actions for individuals to consider and many parallel the group model for successful team building reviewed earlier in this series by Drs. Bennett and Gadlin.⁴

As you consider incorporating these actions in your career planning, keep in mind that it is YOUR career. So know thyself — your own strengths and limitations, personal interactive style (for example your conflict style^{46;47}), priorities and goals, as well as your enthusiasm for the science and for your ideas. Increased self-awareness will serve you well as you navigate the intricacies of engagement in interdisciplinary research. And in your assessments, recognize that cultures differ - not just the cultures of a team or an institution, but the personal and community cultures of team members.⁴⁸ This diversity can impact your own and others' perceptions and interactions, as it also contributes to the innovation and richness that interdisciplinary teams create.

Hope for the best and plan for varied contingencies. Recall the many possible benefits of research teams as you use the various resources and tools to address challenges and to productively manage conflicts. In so doing you may better align your science with a successful career in this exciting and challenging age of collaborative team research.

Acknowledgments

This is based on a presentation at the AFMR Career Development Workshop, Productive Translational Research: Tools for Connecting Research Cultures and Managing Conflict (2010 Experimental Biology Meeting, Anaheim, CA; April 24, 2010). This was sponsored by the AFMR and supported by a grant from the NCRR/NIH #R13 RR023236. I thank Dr. L. Michelle Bennett, Dr. Howard Gadlin and Dr. Florence Lin for their reviews of the manuscript and their helpful suggestions.

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Table 1

Benefits and Challenges of Interdisciplinary Team Science

<u>BENEFITS</u>	<u>CHALLENGES</u>
<ul style="list-style-type: none"> • New fields • New Opportunities (e.g., scientific, grants) • Unique Path- opportunities • Multiple contacts • More viewpoints • Multiple mentors • Support 	<ul style="list-style-type: none"> • Uncertainty <ul style="list-style-type: none"> – Technical – Evaluative • Unique Path-limitations • Multiple Contacts • More viewpoints • Multiple mentors • Dependence • Time (start-up, management, etc) • Getting “glost” in the crowd (sharing recognition, credit, and power)

Table 2

Career Challenges of Interdisciplinary Collaborations

1	Acceptable risk/benefit ratios <ul style="list-style-type: none">• Effort/Time• Uncertainty - Options
2	Contribution and Credit <ul style="list-style-type: none">• Separating the “soup ingredients”• Keeping track – Be proactive and prospective
3	Future Plans - What next? <ul style="list-style-type: none">• Developing your own identity• Developing transportable skills• Negotiating trajectories- leadership positions• Future resource use agreements
4	Promotion/tenure <ul style="list-style-type: none">• Understanding the criteria, process, players• Meeting the criteria
5	Finding support <ul style="list-style-type: none">• Supportive home institution/department• Supportive mentors/colleagues
6	Finding appropriate reviewers <ul style="list-style-type: none">• Constructive Input• Non-conflicted review

Table 3

Considerations for Conflict Prevention and Negotiation

- Clarifying roles BEFORE you leap
- Recognize the uneven table
- Keep your end goals in mind from the start
- Acknowledge what you want and what you need.
- Seek ACKNOWLEDGED leadership roles
- Re-evaluate often—have a plan for prompt action should issues arise!
- Identifying a primary mentor AND advocate
- Colleagues can help (internal and external)
- Seek institutional support – AND take advantage of it
- Identify and Act EARLY
- Uphold your faith in yourself, your enthusiasm, your curiosity
- Hope for the Best- Prepare for Contingencies