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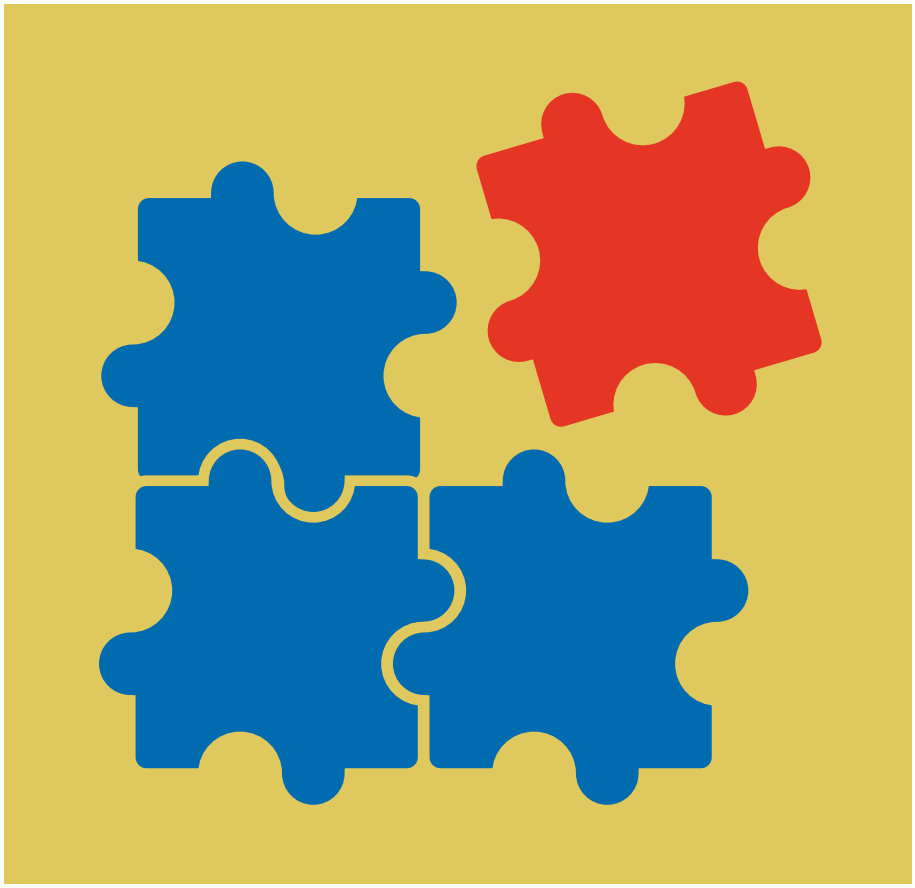

COLLABORATIONS

Recipe for a team

A scientific collaboration is vulnerable to derailment unless members learn to trust each other at the outset.

BY VIRGINIA GEWIN

Marine biologist Benjamin Halpern was part of an 11-person team that met up in 2012 at an eco-resort on the southern tip of Australia's Great Barrier Reef. The group's mission was to develop a scientific method able to identify species-conservation solutions that could minimize costs without unduly affecting any specific group of people. Each morning for a week, the team debated and discussed data, modelling and statistics.

In the afternoons, they all went snorkelling, scuba-diving or birdwatching together. Team members had brought spouses, partners and children, and the meeting felt as much like a social seashore soirée as it did a scientific collaboration. "We got to see many different sides of our colleagues, which I think helped everyone bond more," says Halpern.

By working and playing hard together for a full week at the project's outset, group members built the connections and trust that were needed to share their ideas and develop new ones together. Within weeks, the team had submitted its findings on effective conservation planning, and these were published just three months later (B. S. Halpern *et al. Proc. Natl Acad. Sci. USA* **110,** 6229–6234; 2013). Since then, various members of the group have secured further funding to expand their work and to bring in new collaborators, says Halpern, of the Bren School of Environmental Science and Management at the University of California, Santa Barbara (UCSB). He has participated in about 20 collaborative efforts supported by the National Center for Ecological Analysis and Synthesis at UCSB, an ecology think tank that funds team-oriented interdisciplinary projects. "Good ideas are relatively cheap; it's the execution of them that is hard," says Halpern. "What makes a collaboration succeed or fail is having the right team."

Not every collaborative posse can meet, as Halpern's did, in a luxurious location to forge ties. But group members can take steps to get their project off on the right foot — and to keep it moving forward. They need to take those steps because funding schemes increasingly encourage or even require collaboration, says Koen Frenken, who teaches innovation studies at the University of Utrecht in the Netherlands. It is especially important for junior researchers to do all that they can to ensure that their group — and their standing in it — remains on track.

Word about who the 'good' collaborators are spreads quickly. These people are highly sought after, whereas 'bad' collaborators may never learn about their own unfavourable reputation (see 'Caricatures'). "Academic communities are quite small and people want to avoid conflict," says Linus Dahlander, who studies collaborations at the European School of Management and Technology in Berlin. Most researchers who become frustrated with an ineffective team member never talk about it — they simply do the slacker colleague's work, give them credit and then avoid partnering with them again, says Barry Bozeman, director of the Center for Organization Research and Design at Arizona State University in Phoenix.

FALLOUT WARNINGS

Despite everyone's best efforts, collaborations can fall apart for any number of reasons — misunderstandings, faulty assumptions or personality clashes. One team member could have a strong personality that dominates the others. More often, members assume that colleagues share their views. "Don't assume everyone knows what you know or perceives things the way you do," Bozeman says.

This is a particular problem with international collaborations, when cultural or language barriers can challenge a team. But there are also structural differences in such partnerships, says Melissa Anderson, a higher-education specialist at the University of Minnesota in Minneapolis, who researches the scientific-integrity aspects of teamwork. She says that those differences can include how collaborations are organized and financed in different nations, as well as the federal and national laws that govern the work of each team member in a different country. "Not all countries have exactly the same expectations regarding integrity issues," she says.

And there can be confusion about what constitutes plagiarism, or cultural differences that make it unclear how to address wrongdoing or how to challenge a superior, she adds. Team members can avoid many of these potential problems by making time to meet with one another to discuss the partnership's financial, ethical and cultural issues in person, she says.

Even collaborators from the same country can be derailed by an absence of face time, especially if they span different disciplines. The problem is worsening in the digital era, when scientists need not ever meet in the flesh to join up on a research project.

Steve Fiore experienced first-hand how important it is to make sure that common terms mean the same thing to everyone. He was part of a multi-discipline, multi-university effort in 2010 to develop teams of humans and robots, an endeavour that almost fell apart because of a simple word that had different meanings for everyone involved.

"We were spinning our wheels" on the development and testing of models, says Fiore, a cognitive scientist who studies group research at the University of Central Florida in Orlando. "Then I realized that 'model' meant different things to the engineers, to the computer scientists who were developing artificial intelligence and to the social scientists."

The confusion was exacerbated by the use of teleconferences for group meetings. "There was a lack of in-person cues that could have made the misunderstandings more apparent," he says. Once he realized what was happening, he explained the problem to the team and the collaboration regained momentum. Group members reviewed their discussions thereafter through e-mail to avert any repeat disasters.

SCIENTIFIC PRENUP

How can a collaboration be stopped from going sour? One way is to create the scientific equivalent of a prenuptial agreement (see 'Tricks for tackling teamwork'). In addition to defining team-member expectations, a 'prenup' spells out the overall goals and vision for the team and what constitutes authorship as well as communication and contingency plans.

Junior investigators might struggle to persuade more-senior collaborators to adopt this formalized approach, says Kara Hall, director of the Science of Team Science Team at the US National Institutes of Health (NIH) in Bethesda, Maryland. But they can at least initiate a conversation about the issues that are covered by such a document — determining authorship, for instance.

There are no data on whether the use of a research prenup is on the rise, but Hall says that requests for presentations that discuss the topic have skyrocketed. Collaboration veteran Halpern encourages each group, at minimum, to spend time talking about expectations and authorship and to consider writing down verbal agreements at the outset of every team project. One team with which he worked agreed that individual researchers who were passionate about publishing on a specific idea that had evolved from a group effort should be free to do so, without the expectation that every team member would be an author. As a result, more good work came from the team effort.

It can also help to draw a shared diagram that represents the research problem and every member's place in it, says Paul Hirsch, who studies interdisciplinary collaborative processes at the State University of New York (SUNY) in Syracuse. At the most basic level, team leaders and collaborators should discuss expectations, working styles and how to execute their shared vision. Individual collaborators can devise informal practices and rules that work for them, including collaboration-management procedures.

NIH ombudsman Howard Gadlin, who studied successful collaborations while he was co-authoring the NIH report *Collaboration and Team Science: A Field Guide* (2010), found that team members in successful collaborations had a common vision for the work that they were doing and how their contributions fit into the larger mission (see go.nature.com/ghcwfs). Effective team leadership can also help to ward off conflict. "Group leaders are responsible for creating a culture where people share ideas that benefit the team; otherwise, we get in a situation like Gollum in the *Lord of the Rings*, with no one sharing their 'precious' ideas," Dahlander says.

Word about who the 'good' collaborators are spreads quickly. These people are highly sought after.

Not surprisingly, the promise of a big pot of funding can inspire sharing between team members. Last year, Chris Nomura of SUNY's Syracuse campus was one of a number of 'green' chemists and physicists who were assembled by the Research Foundations of SUNY in a bid to unite expertise in disparate fields across the university's four sites.

The challenge was to get this subgroup to spend a small amount of seed money to pursue joint research priorities connected with green composite materials. But no one knew anyone else, and some people were confused about why they had been selected. Several members, burned by previous collaborations, were wary of sharing their ideas lest they be stolen.

Nomura says that the subgroup signed a non-disclosure agreement before the first meeting so that they would feel comfortable talking openly. They also took time to discuss negative past experiences and they made a pact defining behaviours that should be avoided — chiefly, that any ideas discussed in the group would not be used in individual grant proposals without the permission of the group.

FIND COMMON GROUND

At the time, Hirsch advised Nomura's team to find a way to coalesce around one goal: to identify a shared research aim. Members of the group became collectively excited about developing innovative energy-efficient ways to produce composite materials, a scheme that, as it turned out, could successfully compete for funding from the New York State Energy Research and Development Authority. "Something pretty amazing happened after we talked about our research and decided to

PRACTICAL TIPS

Tricks for tackling teamwork

The secret to a successful collaboration is forethought. The US National Cancer Institute's Team Science Toolkit offers a host of tips (go.nature.com/fyrefu). Below are some more thoughts gleaned from interviews for this article.

- Choose team members who are open to fresh ideas and willing to engage in a thoughtful manner.
- Team leaders should create an environment in which people can disagree constructively and in which there is freedom to ask 'stupid' questions.
- Any 'prenuptial' agreement on roles and responsibilities should be negotiated as a team at the start.
- Team leaders should assign products of the collaboration to the team members who will get the most career benefit from them.
- Junior researchers should organize teaching schedules to allow enough time for joint projects. V.G.

TEAMSHIRK

Caricatures

These are the stereotypes to avoid adopting in a collaboration if you wish to be welcomed into one again.

- **The overcommitted superstar.** The high-profile, highly sought-after researcher who lends wattage to the effort but who cannot offer much time or attention to an individual team.
- **The social loafer.** The team member who is simply not engaged — perhaps owing to a lack of shared vision or a lack of goal alignment.
- **The know-it-all.** The collaborator who dominates the conversation and does not make space for all colleagues to be heard.
- **The lurker.** The team member who withholds her or his own insights while absorbing everyone else's. The lurker is driven by tough competition but often burns bridges. V.G.

apply for grants," says Nomura. "We agreed on an unequal disbursement of the seed money — some groups got less money and some got more, realizing that strategically it would benefit us all in the long run."

Halpern reminds early-career researchers that what they lack in collaboration experience, they can make up for with time and energy. "Offering to contribute is the best way to get involved in collaborations — and possibly shift to the next phase of their career," he says. As a first-year graduate student on his first collaborative team, he offered to lead a meta-analysis of existing data on the conservation value of marine reserves. It was a transformative move that positioned him to work with a network of scientific leaders in marine conservation.

But despite the best efforts to maintain momentum, sometimes a collaboration simply has to be abandoned. A team can grow stale, like any relationship, or the obstacles can become too overwhelming. "I've seen collaborations that fell apart and never recovered," says Gadlin.

Ultimately, however, it is not success — as measured by the number of citations — that has the most substantial impact on the continuation of a collaboration. Often, the longevity of a team project can be judged by the beer test. "If collaborators don't like each other enough to go for a beer after the meeting, it can be a sign of pending doom," Dahlander says. ■

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COLUMN
Match that PhD

Lab leaders discuss how to find the perfect graduate student for a research group.

BY DEBORAH J. MARSH, KIRSTY FOSTER & CAROLYN D. SCOTT

Graduate students can consult reams of material on how to choose a PhD supervisor and select the best and most appropriate research group. But almost no resources exist for principal investigators (PIs) — especially those in the early stages of their own careers — on how to choose a PhD student for their lab or research team. How do these leaders decide who will be the best 'match'?

If you assume the role of supervisor, mentor or PI, you will provide much of the guidance and support that is crucial for a student's career development. Deciding whether to take on such a task requires much deliberation. You will need to consider whether your research group, project and academic environment will allow the student to flourish and receive the proper level of supervision, whether the student can develop the skills necessary to maximize your project's success and whether he or she will be a good fit with your group.

You will need to consult your team. Current members must feel confident that they share goals with their future colleague. As team leader, you will need to ensure that a new member will contribute to the group's work and will not adversely affect the team dynamic. Ask the applicant to talk to your team and find out what members think. You will probably learn about the applicant's research experience, communication and social skills and whether she or he prefers to work in a group or solo.

Setting an exercise for a PhD candidate can also prove useful for evaluating the student's research background and writing and problem-solving skills. We routinely ask candidates to choose and critique one of our published papers and to suggest how the study could be improved. The choice of paper provides clues about the student's interests, and we learn about his or her knowledge of the field, and ability to organize and communicate ideas. We have also found that the task both attracts and dissuades candidates. Once, after assigning it, we did not hear again from the candidate. Other candidates have dived in. "It showed that you cared what I thought," one student told us after completing it.

You should also ask applicants why they want a PhD, why they are interested in your group, which research discovery they are most proud of and what comes most easily to them, whether it be benchwork, fieldwork or something else. Applicants' answers provide information about their attitudes and aptitudes. For example, a student who expresses a preference for data analysis might be best suited to a project that involves extensive statistical or bioinformatic analyses.

Many PhD students want to be asked specific questions. Our students, for example, have indicated that they think that we should ask about evidence of positive relationships with previous supervisors or lecturers, a strong academic record, an ability to work well in a team environment and curiosity about and enthusiasm for their research areas.

Most students are highly motivated to succeed. Great achievement generally takes place in an environment of high standards, so you will need to discuss your expectations. These could include attending conferences, adhering to agreed milestones and participating in seminars and journal clubs.

Choosing the right PhD students for a team is more important than ever if we, as supervisors and mentors, are to make a positive impact on the scientific endeavours that will be led by those whom we train today. ■

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