

An Insider's Guide to Choosing a Graduate Adviser and Research Projects in Laboratory Sciences

by Marshall Lev Dermer

Where can new and prospective graduate students obtain candid advice to enhance success in graduate school? Not from most college science teaching journals which have almost exclusively published advice for professors regarding teaching undergraduates. Not from national organizations, graduate schools, and university departments; for "official" advice is rarely frank advice. And not from all faculty and senior graduate students as laboratory lore, unless one is a select "insider." Elsewhere (1), I have asserted that faculty ought to provide new and prospective graduate students frank advice about becoming scientists and doing science; here I present such advice.

As a new graduate student you will be making the transition from consuming knowledge to generating and disseminating knowledge. Although you were selected for your excellent performance in undergraduate courses, what counts most in graduate school is conceiving, conducting, and documenting research. This essay is concerned, therefore, with two issues: (1) selecting an adviser who can best train you, and (2) selecting a research project that can be completed in a reasonable length of time.

If you are not yet in graduate school, it is easier to appreciate the importance of timely progress than the importance of a research adviser (2, 3). Consider, however, that you will become a researcher as an apprentice to your adviser who should provide timely, constructive feedback regarding your attempts to understand nature. Your adviser may also provide various resources like space, equipment, supplies, an assistantship, and summer employment. On earning your degree, your adviser will also write vital letters of recommendation. Your adviser may indirectly also determine who will become your close friends and who will become your spouse.

CRITERIA FOR EVALUATING POTENTIAL ADVISERS

I discuss below, some of the most important factors for evaluating potential advisers.

Whom to Avoid

Grant Swingers and Research Millers. Do not equate grant support or the size of an institute or research laboratory with quality (4, 5). Even without grant support, publishing may become more important than doing science when faculty salaries are determined merely by the number of publications. Avoid faculty who submit many short reports in which replication of findings is absent.

Those Not at the Bench. Avoid faculty who structure research so that there are multiple layers of authority and who are rarely at the laboratory "bench" (6, 7). I could not find any studies of the supervision of research but often "the professional message to students and colleagues is that intellectual responsibility and seniority is tantamount to removal from the tedium of data collection" (8). Inadequate research supervision is so prevalent in cases of scientific fraud that the American Association of Universities recommends that "students must be directed by experienced scientists. The director should supervise, teach, and encourage in-depth scrutiny and interpretation of results, emphasizing respect for primary data. Routine audit and review of all primary data by the laboratory director is strongly recommended. It is inadvisable for the director to delegate these important functions" (9).

The Perpetual Administrator. Avoid faculty who repeatedly choose to be officers of professional societies, departmental chairs, or editors. These are important activities that contribute to others doing science (10) and that substantially reduce supervision quality, unless you are only one of a few advisees.

Whom to Look For

Someone with Similar Interests. Seek someone with whom you share research interests; otherwise, you may undertake a project that you do not value and never complete it. But you may not know your interests. A senior doctoral student in chemistry wisely noted: It is not possible for even the most motivated and successful undergraduates to have a clear understanding of their research interests. The projects are way too complex for college seniors to comprehend. The technology will almost always involve equipment and approaches never seen or imagined before. Students at best understand their inclinations: "I like computers," or "I've always enjoyed mathematics." More than that is probably rare.

The search for common ground is usually a case of a research director convincing a willing subject of the compatibility of their interests. It is not the same thing as genuine mutual interests. There is simply too great a disparity between their respective scientific sophistication and their degree of understanding of the entire graduate study process. (11)

Someone with Compatible Interests. All organizations offer people common means to diverse ends. Even if you cannot work in a laboratory in which the research goals are similar to your own, the laboratory procedures may be relevant to your goals. It is quite possible, of course, that as you work in this "second best" laboratory you may become interested in the research problems there. Consider the experiences that determined your current research interests.

Scholars: Renowned Researchers. Seek people who love science and are obsessive about research. They will document their work in articles, published in respected journals, that often describe a series of inter-locking experiments concerned with a single problem. When researchers value their work and others agree, others will extend the work. *Invited* articles and presentations to professional societies suggest that a researcher's work is well-received.

Grant support from major research foundations, for example, the National Science Foundation, indicates that other scientists judge this person to have made significant contributions. Such grant support is allocated competitively; more competitively than is space in major journals. A history of grant support from major foundations is, therefore, very impressive. Most impressive is a researcher who holds a special position where a university or a foundation has granted the person a lifetime of research support.

There are potential problems working with renowned researchers. In areas where research costs require grant support, such advisers may be unable to offer help because they are busy writing grant proposals, justifying grants, administering grants, and supervising post-doctoral students.¹ Another problem is that others will wonder whether you or your adviser conceived jointly authored work and even your dissertation. Complicating all this is the possibility that post-doctoral students may be your actual mentors.

Scholars: Less-Renowned Researchers. These researchers' records will have many of the attributes discussed above; often a record of grant support will be absent. Where research costs are small, such faculty can also be excellent advisers. Seek an adviser who knows quite a bit about your area, is enthusiastic about research, and, of course, readily offers help.

It is possible to have the best of both research types! If there are renowned researchers in your department include them on your research committee (with your adviser's consent), seek their advice and eventually, if all goes well, seek their letters of recommendation and "connections" without the potential liabilities of having one serve as your adviser (12). This option, of course, is only available to students in large graduate programs.

Someone You Can Respect. If your adviser is honest, ethical, loves doing science and is reasonably successful, it would also be nice if you liked your adviser (and vice versa) But choosing or keeping an adviser primarily because he or she is nice is a mistake. A nice person may withhold frank evaluations of your knowledge, skills, and progress. If you have an excellent adviser, your feelings toward your adviser might best be labeled as respect.

ACQUIRING INFORMATION ABOUT POTENTIAL ADVISERS

Having outlined criteria for evaluating potential advisers, it is appropriate to discuss acquiring relevant information.

Getting Started

It is best to decide on potential research areas and three or four potential advisers by your last semester in college (13). You can best make these decisions by working as an assistant in a research laboratory where you can consult with the faculty and post-doctoral staff. Alternatively, discuss selecting potential research advisers with your undergraduate adviser and the faculty who teach courses in the areas that most interest you.

Correspond with Potential Advisers

Corresponding with a few potential advisers can be very helpful, after you are familiar with their work. In your initial letter be sure to describe your background, training, grade point average, research experience, and your interest in the researcher's work. Write carefully; writing is public thinking. Ask for recent reprints and copies of manuscripts in press. You might also casually mention your interest in where this potential adviser studied and a list of his or her publications. Potential advisers may send you their vitas, saving you much detective work

Talk with Graduate Students

If you have exchanged letters with a potential adviser, ask for the names and telephone numbers of senior graduate students, so that you might learn more about the laboratory and the graduate program. Call the students at their homes where they are most likely to have a private telephone. Items not covered above include determining: what proportion of this professor's advisees earn the Ph.D., how much time is typically required to earn the Ph.D. in this laboratory, and do graduates continue working in the area upon graduation? For researchers who are assistant professors ask about their chances of being granted tenure. It is unwise to study with a person who will not be re-hired in a few years and may leave you stranded

Discovering Publications and Grants Sans Vita

The *Science Citation Index* and the *Social Science Citation Index* can help you locate a researcher's publications and the extent they have stimulated other scientists. Grant support and whether an article was "invited" are usually indicated in an article's first footnote.

Face-to-Face Interaction with Your Prospective Adviser

Meeting potential advisers may be scary; but you *must* develop strong, positive, self-presentation skills if you are to succeed. You can meet potential advisers and their students at professional conferences. A too-little exercised but most useful option is working on a summer project in a laboratory. If you arrive at graduate school without an adviser, then do interview all potential advisers. You will learn quite a bit about the work in your new department and, consequently, have a good idea about whom to select for your research committee.

When the Search is Not Over

The adviser-graduate student relationship is much like a marriage. It is important, for example, to consider carefully whether there is a good match between your personalities, and the expected pace of work. Some marriages, of course, sour. Accordingly, you always have the right to change advisers. Once you have started a research project, however, no other professor may feel qualified to supervise your work.

Changing advisers is a delicate matter, particularly if your adviser has invested much time in your education. When considering changing advisers, it is best to have an honest discussion (14). Perhaps working conditions or your relationship can be changed. If you do change advisers, it is courteous to give your adviser adequate time, perhaps a month or two if research is in progress, to plan for the change. Remember, just as some divorced couples remarry there is always the possibility that you might want to work with your original adviser, so follow the "golden rule."

If you believe your adviser is unethical then you should definitely find another one. If some serious instance of your adviser behaving inappropriately is discovered, for example, fraudulent treatment of data, your reputation will suffer too.

By the way, if you believe your adviser has intentionally engaged in serious, inappropriate behavior then it is most important that you immediately and carefully document it. Have the date of documentation certified by a notary public. The notary where you bank will most likely do this gratis. The next step depends on many factors. "Dealing with Sexual Harrassment" (15) provides excellent advice appropriate to many kinds of complaints. Other help can be found under the Library of Congress subject heading "Grievance procedures--United States."

SELECTING A RESEARCH PROJECT

I believe that the best scientists (and potential advisers) replicate and extend their research. Below, I outline the approach and describe the consequences of your adopting it or other approaches when selecting research projects.

Replication and Extension

Pavlov's laboratory best illustrates the replication and extension approach (16). As a new student, you would have replicated the last dissertation conducted there. This tested your ability to follow a write-up, and motivated Pavlov's senior students to work most carefully. Your dissertation would have been some logical extension of this preliminary work. You neither had to survey the entire research literature nor wonder if the equipment could be constructed. The work had just been completed in your laboratory. Consequently, the duration and other costs of new research could be estimated well.

Unlike Pavlov, your adviser may not be very active and you may be unable work with a better one. In this case, you can

search journals and attend conferences to locate a procedure and problem that *currently* is important to you and other researchers. A portion of your research can be a fairly literal replication of a recently published work, whereas the remainder can be an extension that contributes to the solution of the problem. After consulting with your adviser, you may want to outline your interests in a letter to the original investigator and ask if you can visit his or her laboratory. If the procedure is very valuable, the investigator will still be using it. While visiting you will be able to see the procedure in action and talk with knowledgeable laboratory members.

If you replicate work in another laboratory, it is likely that when you submit your report for publication that the original researcher (or one or more collaborators) will be a reviewer. This reviewer will, of course, be quite happy to see his or her recent work independently replicated and extended. If you picked an important procedure and problem, then other reviewers will be similarly impressed.

Other Approaches for Selecting a Project

Another conservative approach is to select a problem for which *any* answer is interesting; it is difficult, however, to specify the defining features of such problems. One possibility is that for some problems there may only be a finite number of possible solutions. Even if a study does not solve the problem, a well-done study will rule-out one or more such possible solutions (17).

If you are ambitious, of course, you may want to develop an entirely new procedure (18). You should discuss the ensuing risks and benefits with your research committee *before* you begin the work. A six-question test has been proposed for faculty to assess the quality of a student's research idea (19); these questions may help with your research.

FURTHER READING AND DISCUSSION

Essentially my conservative advice is to select an adviser who successfully uses the replication and extension approach to understand important problems and do likewise for your dissertation and other research.

There is, of course, no magic formula that will provide personal satisfaction, professional success, or enhance the quality of science. Furthermore, there are plenty of important issues I have avoided like "Should you attend graduate school in the same department in which you earned your undergraduate degree (20-22)?"² It is important, therefore, that you discuss the issues raised here with students and faculty.

As first noted, advice is available from "official" sources including professional associations, graduate schools, and departments. Frank advice, of course, is more likely found in "unofficial" sources including: texts (23-32), biographies (33), and a few journal articles (34-36). Library of Congress subject headings for locating more recent texts are available (37). Frank advice is also exchanged on the USENET conferences: "soc.college.grad," "sci.edu," "sci.physics," etc.

Finally, you might propose that an upper-level, undergraduate/graduate seminar be created to discuss these important issues. A molecular biophysicist put the matter this way: "Beginning graduate students must make what may well be the most important choice of their careers adviser and research topic at a time when they are most lacking the knowledge to choose well" (38). I, of course, consider providing frank advice a professional obligation. I believe that other scientists would agree and would enjoy discussing these issues in a seminar (39).³

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Footnotes

¹ Still, such advisers may offer the very best advice and they certainly have the best "connections" to help place you on earning your Ph.D.

² I do not discuss selecting a graduate school because I consider this far less important than finding a first-rate adviser.

³ I would appreciate receiving advice from readers about how this "open letter" could be further improved. My INTERNET address is: dermer@convex.csd.uwm.edu.

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