Research Student *and* Supervisor

Council of Graduate Schools

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THE COUNCIL OF GRADUATE SCHOOLS

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TABLE OF CONTENTS

FOREWORD

This publication updates a brief but popular booklet that CGS first published in 1990. I am grateful to the Science and Engineering Council of Great Britain for granting permission to adapt their original report to the US context, and to Leigh DeNeef and Margaret King for significantly expanding and enhancing that document in the present edition to ensure that it reflects some of the best and most recent thinking about the relationship between research students and their advisors.

Despite the nearly two decades that have elapsed since Research Student and Supervisor first appeared, and the national differences that distinguish graduate education in the US from graduate education in the UK, the evergreen nature of much of this publication speaks to aspects of the graduate research experience that are both common across different contexts and enduring. The framing issue for the first edition was time to degree, and the relationship between students and their advisors remains an important factor in ensuring that students complete in a reasonable time period. Today, however, while time to degree is still a common concern, large differences in times to degree by discipline and by institutional type, and greater numbers of non-traditional students, have challenged many of us to question some of our tried-and-true notions of the appropriate duration for master's or doctoral study. One issue on which most of us now agree is that all students who are admitted to a graduate program should be expected to complete their degrees. The role of mentors and of research supervisors is one of the fundamental factors that can position programs and graduate schools to capitalize on those expectations.

The chapters of this revised edition provide guidelines for supervision at each stage of study, checklists of considerations for good practice in supervision for both the department and supervisor and for the student, as well as a "Hall of Scholars" featuring personal reflections by winners of the CGS/UMI distinguished dissertation award and their supervisors on the ingredients of success in doctoral study. Since 1981, these awards are conferred annually to individuals who have completed dissertations representing original work that makes an unusually significant contribution to their discipline. The award is sponsored jointly by CGS and UMI Dissertations Publishing, a Division of ProQuest Information and Learning. CGS is grateful to ProQuest/UMI for making this important national recognition of excellence in the scholarship of graduate students possible

through their generous contribution.

Research Student and Supervisor is designed for faculty and graduate students as they work together to ensure that the research program of study meets their mutual expectations. We hope that department chairs, directors of graduate study, and graduate school staff who share responsibility for the quality of graduate education will also find this publication a useful reference document for promoting good practice in research supervision at both the doctoral and master's levels.

Debra W. Stewart
President
Council of Graduate Schools

INTRODUCTION

In 1982, the Science and Engineering Council of Great Britain, concerned about the increasing amount of time it was taking students to complete the PhD degree, published a pamphlet with the same title as the present document. The Council generously allowed the Council of Graduate Schools, which had the same concerns about increasing times to degree in the United States, to modify its document to make it more directly relevant to PhD education in America and to graduate students in fields other than the sciences and engineering. From all indications, that modification has been a useful resource for faculty and students in all disciplines. But much has changed in graduate education in the last 25 years. More minorities, women, and non-traditional students now pursue and achieve graduate degrees; increased attention has shifted to concerns about completion rates, as well as time to degree; and more graduate programs reflect interdisciplinary research that places new demands on the advising relationship. This revision of the earlier document strives to account for these and other changes.

Two things have not changed: doctoral education in the U.S., as in many other countries, is largely the product of a relationship between an individual student and a research adviser or supervisor. While it is important to have multiple mentors in a doctoral program and a supportive program environment, ultimately the timetable and likelihood of degree completion largely depend upon the student's relationship to his or her advisor. Any attempts to reduce excessive time to degree or increase completion must therefore focus on this relationship.

The responsibilities for completing a PhD or a research master's degree, and for doing so within a reasonable length of time, are shared by the student and the supervisor. The purpose of the present publication is to discuss ways to make each party more aware of the problems encountered en route to the degree and of the processes for ensuring success. Research Student and Supervisor offers practical advice to both students and supervisors in the hope that their collaborative experience will be mutually beneficial. The authors are particularly grateful to recent winners of the CGS/UMI Outstanding Dissertation Awards, and their supervisors, for their thoughts on the challenges to degree completion in their respective fields.

INTELLECTUAL PARTNERSHIPS

This short guidebook is addressed to graduate students and faculty in programs requiring independent research and a thesis or dissertation as prerequisites to receiving a graduate degree. Such requirements are typical of Doctor of Philosophy (PhD) degrees, as awarded by many universities in the United States, and may characterize a research-oriented master's degree in a field related to professional practice or a specialized field of study.

Students enter graduate studies in the United States with diverse backgrounds. Some enter directly from an undergraduate degree program. Others reenter graduate school after a period of work; military, government, or national service; travel or study abroad; distance education or work-related certificate programs. Any of these experiences can lead a student back to graduate school for more intensive study in a specialized area. Many employers provide support for graduate or continuing education; advanced study may be suggested or required for success in a career or professional area.

However students arrive in their graduate program, if they expect to receive the degree they must pay attention to the general procedures and the intellectual requirements of the program and discipline they have entered. Graduate education should be a satisfying experience for all parties involved—the student, the faculty, the department or program, even the university itself, usually through its administrative graduate school. If students know what is expected of them and the time-frames within which they will be required to complete each phase of the degree program, it is more likely that they will have a positive intellectual and personal experience and will complete the degree in a reasonable time. Along with intellectual achievement and satisfaction with new knowledge and skills, they should also anticipate the sheer enjoyment of intellectual inquiry and the new friends and colleagues, some of whom may be around for life, that it will provide.

The core of graduate education in the U.S., as in many other countries, is the close relationship between the research student and the supervisor.[1] They begin as master and pupil and ideally end up as colleagues. Obviously, under these circumstances, it is imperative that the student and supervisor be as carefully matched as possible. But because there are so many factors

[1] The term supervisor is used here in the literal sense of a faculty member who oversees the program of a graduate student. Implicit in this use are correlative responsibilities of a dissertation advisor and mentor.

involved in defining a good match, this can be extremely difficult. In many cases, the student is coming from another institution and there has been little or no chance for conversations with prospective supervisors to allow both individuals to make up their minds about the other. To deal with this problem, many departments encourage students who apply to their programs to visit the campus or to speak, or communicate by email, with faculty in their fields of interest before the academic year begins. Many universities provide regularly scheduled opportunities during the first year for students to meet all departmental and program faculty and to learn about their particular research focuses. Even when students select a specific institution for graduate work because of the desire to study with a particular individual, it is essential to keep an open mind before finally choosing a supervisor. The relationship between student and supervisor is personal as well as intellectual, and both parties need to take that into account when forming this partnership. As with all human relationships, there are many ways for the student-supervisor partnership to go wrong. The ideal is a collaboration which leads to a productive working relationship that is challenging to both and that is considerate of the student's need to complete the degree in a timely fashion.

There are two general aspects to faculty supervision. The first and more important has to do with creativity; it involves the ability to stimulate and excite students about the discipline or the field, to select appropriate problems to be solved, and to provide a steady stream of good ideas and questions, and, where necessary, timely criticisms. The second aspect involves the mechanics of ensuring that the student makes good progress.

It is difficult to provide general guidance on the first of these aspects since it is so dependent on the characteristics of the persons involved and on widely differing institutional and disciplinary contexts. Still, a few generalizations may be warranted. As the statements of advisors and former graduate students included in the "Hall of Scholars" chapter confirm, the best supervisors are those who make the effort to maintain a steady presence in the graduate student's life, who seek to understand the student's own interests and needs, who encourage students to collaborate with others and to avail themselves of the many opportunities graduate school provides them, and who use their own network of collaborators and colleagues to help promote the student's graduate program and subsequent career. An excellent resource for more extensive discussion about strategies for good supervising is the CGS manual, On the Right Track: A Manual for Research Mentors, by Margaret King, which focuses on the complexities of research mentoring and

the ethics of graduate research supervision. Research Student and Supervisor complements that publication by describing concrete strategies for ensuring that students make good, steady and satisfactory progress. Its general thesis is that such progress is dependant upon a definite plan for graduate study, which may well be different not only for each discipline, but probably for each department, and, in some cases, for each student. We will refer to this plan as a framework since it should serve as a structure for defining and supporting the student's entire graduate program. With such a framework, it will be easier for both the supervisor and the student to recognize when adjustments may need to be made in the relationship to ensure the student's continued progress and success.

Elements of a Partnership

Graduate students, graduate faculty and supervisors in the department, or program, and the graduate school itself are all elements of an effective intellectual partnership. For graduate students, study toward an advanced degree is a means to an end—usually career development and gainful employment. Intellectual growth and development, curiosity, and a passion for research are also elements in this mix; so too are considerable investments of time and money, at times at some cost to personal or family life. Curiosity and intellectual stimulation are the primary drivers of a student's decision to pursue a graduate degree in research, but few individuals in graduate education are there solely for intellectual experience. Indeed, for what has been called the "millennial generation" of students who are considering entering graduate students in the early 21st century, deliberations about program outcomes (such as time to degree and likelihood of completion) and subsequent job opportunities may play a greater role than before in the decision making process.[2] Once students are enrolled, however, under the pressure of day to day study and research, it is easy for students (and their supervisors) to forget that the ultimate goal is not just a PhD or master's degree, but a job, often a career.

While the institution, department or program, and individual supervisor are partners in graduate education, graduate students themselves are the very center of the intellectual life and development of an institution. They perform services, some for direct compensation, others as part of routine academic collaboration. They run labs, teach undergraduate courses, even mentor undergraduates as they themselves are being mentored. They are the

[2] Stewart, D.W. "Getting it Right: Graduate Schools Respond to the Millennial Challenge," CGS Communicator 40:7, 2007.

bridge between the cutting-edge research of the faculty and the foundational education of the undergraduates, and in this role they are the heart of most departments. They form a core energy of intellectual curiosity and drive that is the subtext of any intellectual enterprise in an academic institution. Graduate students are often the intellectual link between and across departments and disciplines as they chart new avenues for scholarly exploration and interdisciplinary approaches to traditional scholarly interests.

Institutionally, it the responsibility of departments, programs, and the graduate school itself to provide the guidelines and policies that set expectations for accomplishment within an academic environment. It is imperative that these guidelines and policies be fair across disciplines and departments, that they be as explicit as possible, and that they be understood and accepted by faculty and students alike. Ideally, these guidelines should not only be in writing, but should be followed up by frequent individual and collective discussions among students and faculty in all programs. For the sake of fairness and academic integrity, it is important that such policies be reviewed periodically by the graduate school or an appropriately delegated faculty committee representing the institution as a whole.

The Framework

The existence of a framework, accepted by all faculty within the department or program, which marks out the stages that a student is expected to have completed at various points in the period of study, is the key element in good supervisory practice. All graduate students—not just newly-matriculating ones—have a right to know what is expected of them. They need also to understand that part of their graduate training is, in fact, learning how to manage their own time and to organize their activities. Like many aspects of advanced study, time-management is a skill that will be essential to any subsequent job or career.

Students also need to understand—to be reassured—that the supervisor, like all faculty in the graduate program, is there not to judge them but to help them successfully complete their degree. The framework is an important tool in providing this assurance. The framework document should be published as well as publicized and discussed in various departmental or program meetings, and should include:

- The anticipated length and structure of formal coursework;
- The method of assessing this coursework and its relation to the

rest of the graduate program;
- Requirements concerning lab rotations or expected teaching sequences;
- Expectations regarding financial awards, if any;
- A clear description of the examination(s) for admission to candidacy that evaluate(s) the student's potential for independent work;
- A general timetable for submission of any formal written work (progress reports, drafts of a research prospectus, etc.); and
- An overall multi-year plan of study, including independent research, which articulates the date by which the degree should be completed.

Whatever the individual components of this framework, its overall aim is to encourage the student to develop good work habits to achieve a measured set of clearly-defined stages, to train the student to establish a personal schedule, and to assure the student that evaluation of progress in the program is fair and objective.

Time the Enemy

There can be no doubt that a major enemy is time. Everything takes much longer than the inexperienced student expects. When developing strategies for addressing time to degree concerns, it is worth considering some of the anecdotal but generally accepted reasons for long completion times or failure to complete, such as students' lack of early exposure to research; perfectionism and distraction from main lines of inquiry at the dissertation stage; and limited faculty and funding accessibility.

Early Research

For a student who has just started graduate work and who may not yet realize the huge differences between undergraduate and graduate study, the necessity of advanced planning, particularly about a dissertation project that is now just a long-distance dream, may not be particularly obvious. This is especially true if the only early formal opportunity the graduate program provides for students to speak with faculty is related to coursework. And here, perhaps, is one clear reason for late completion: namely, a slow start in the process of independent research. Particularly in those disciplines

characterized by a large body of received knowledge and a highly structured core curriculum, students may continue to operate in a relatively passive (undergraduate) mode for a long time. Making the change to the more critical, questioning role of the independent scholar can be very difficult. It is important, therefore, that departments consider carefully how to integrate students quickly into the ongoing research of the discipline. Without that integration, the student's engagement with the intellectual issues of the program, including the formulation of research ideas and projects, and such other initial activities as are desirable (e.g., attendance at departmental lectures and other venues), will be delayed and steady progress towards completion of the degree will inevitably slip.

Perfectionism

A second common cause of delay is the student and/or supervisor who is never satisfied, who can always think of a way to improve results, or who cannot bring anything to a conclusion. For students who feel keenly the competition with their peers for notice by a prospective supervisor, this failure to complete work on time can occur early in the formal coursework. Faculty, hoping that students will choose to work with them, are often overly lax about holding students to these early timetables. But such early lapses in meeting established deadlines may foreshadow serious problems with productivity and time management later in the program, with potentially greater consequences. Although perfectionism to some extent can be a virtue, the inability to complete required work on time is definitely a liability.

Faculty can help students deal with this problem by holding them to deadlines, by having them write up what has already been achieved, even if obviously incomplete or not fully digested. Subjecting written work to the objective glance of others can easily clarify whether any improvement is actually necessary or desirable, what additional amount of effort would be required, and whether it is sensible to attempt that amount of work in the time available. This kind of interaction between student and faculty, even from the earliest stages of the educational program, can contribute to the effective planning of time and to a more productive relationship with the subsequent supervisor.

Distraction and Diversion

A third common cause of delay—particularly for students further along in the program—is distraction from the main line of inquiry. Some students get "hooked" on new methodologies or novel approaches; others may not be able to resist the temptation to explore every tangential path and byway that arises during the course of a research project. Like the quest for perfection, the urge to be all-inclusive or "cutting edge" can lead students far afield from their original interests or their initial plan of study. This kind of distraction may be more common among the humanities and social sciences, where doctoral and some master's students tend to work independently rather than in the collaborative laboratories of the sciences and engineering. Distraction into subfields of inquiry is even more likely in research that is interdisciplinary or cross-disciplinary. Sometimes such forays are necessary and yield a richer, more provocative final project. But even then it is likely to prolong the time required to complete that project. Students and supervisors need continual and honest discussion of the course of research in order to ensure that any distraction from the main line of inquiry is warranted and not simply wasting valuable time.

Faculty and Funding Accessibility

A fourth cause of delay is more faculty related, since faculty are entitled to periodic leaves and funding for research is not always as consistent as everyone involved would like it to be. These are special problems about which departments and programs need to be particularly vigilant. In instances of faculty leaves, electronic communication often allows student and supervisor to continue close contact. Where this is impossible, other members of the doctoral committee will need to increase their attention to the student. In the more difficult cases, it is appropriate and necessary for the departmental leadership to be involved in ensuring that no unusual delays develop for graduate students due to faculty personnel or to occasional funding problems.

Most supervisors are familiar with time problems and have tried to cope with them as best they can, but for the student they can be particularly stressful. Increasingly graduate schools themselves have become concerned about excessive time to degree and attrition rates, especially in departments or programs whose statistics seem out of line with others in related disciplines. This is not to say that graduate schools expect all students in all

disciplines to finish their degrees in the same length of time or at the same rate of success. Different fields have distinct expectations and requirements, and the courses of study vary widely. But here, where issues of time play such a major role in the success or failure in graduate programs, clarifying the problems faced by students at all stages of study is a responsibility of all partners in the system. It is our belief that with careful planning and a well-defined framework, students, faculty and programs can work together in ways that ensure the program is completed without undue delays.

THE EARLY STAGES

The transition from undergraduate student or working adult to graduate student is abrupt and difficult. Many students have incomplete or inadequate knowledge of what graduate study is all about. They may receive inadequate support or feedback from the faculty in their programs; they may lack advice regarding the expectations of the program; they may feel isolated even from their fellow students. But this need not be the case. Departments and programs that provide the kind of detailed framework we have been discussing will go a long way toward alleviating student anxieties and toward integrating students smoothly and efficiently into the research activity of the department. Such a framework should define the following expectations for each stage of study, including precise timelines for the various components:

- the nature of the coursework that is required
- the amount and form of initial research activity
- expectations of teaching, service, and/or departmental participation
- the structure of any laboratory rotations or teaching obligations
- the structure and function of each of the examinations students will be required to take
- the requirements for forming a dissertation committee and selecting a supervisor
- likely funding expectations
- thesis or dissertation requirements

It is important that students have, from the start, a clear overview of the total PhD or master's program and that they know, at each stage, what is required of them and to whom they can turn for help when in need. This framework should be given to all students in the program annually; it should be the subject of extensive orientation sessions for new students and for periodic discussions among all faculty and students of the program. The framework should, ideally, provide at least an annual meeting between the director of the graduate program and each student to discuss progress towards the degree.

The first two years of the PhD or two semesters of the master's program are critical times for faculty and students, for this is when a decision will usually be made as to whether the student is to continue for the PhD or

successfully complete the master's. In the sciences and engineering, where formal selection of a supervisor may begin as early as the student's first semester, the supervisor alone may have the power to decide whether the student is or is not likely to complete the degree successfully. In other fields, particularly in the humanities and some of the social sciences, students may not yet have selected their supervisors, and the decision about continuation is more institutionalized in the form of a qualifying examination. Generally, this exam is given at the end of the first or second year and is intended to test whether or not the student has achieved mastery of the basic principles and methods of the discipline, either from earlier study or from the formal coursework of the first year. In programs that administer qualifying exams, it is essential that the nature of those exams be fully spelled out for new students: what do they cover? how should they be prepared for? what are the exams supposed to test? how are they graded? and what, exactly, are their consequences?

Whether a student's continuation in a program is determined by the supervisor or the faculty who evaluate qualifying exams, it is important that the student, as well as others in the department or program, see this decision as just and fair. To this end, all students and faculty need to know at various stages how well things are going and that someone is providing the student with proper advice and direction. Whether through an individual supervisor (as in the sciences) or a program-designated initial supervisor (often a Director of Graduate Studies), there must be candid and open communication between the student and the faculty. Fixing regular times during each semester when student and supervisor can meet to discuss progress ensures that the student is not neglected and that clearly defined stages of progress have been reached.

Departments and programs can often be of invaluable help to incoming students by providing both formal and informal opportunities for them to speak with advanced students and even alumni. Students frequently learn (or hear) practical advice about graduate programs more readily from their advanced peers than from faculty members. This is an institutional resource programs themselves should make deliberate use of.

Much of the first year or so of graduate study naturally focuses on the formal portion of disciplinary training. Research papers, lab reports, quizzes and examinations all provide some measure of student progress. But in order to ensure a successful and independent research program, many other activities should be initiated during this period, particularly ones related to becoming immersed in the field and getting started in research. These will

vary enormously according to the nature of the program or field, but it is during this time that the student should be made aware of the nature and pace of work that is expected and appropriate to the field of study. As students are introduced to the research methodology of their discipline, they should also be introduced to the responsible conduct of research (RCR) in their fields. Issues such as the use of human and animal subjects, where appropriate, as well as issues such as the management and presentation of data, conflicts of interest, and attribution of credit in publications should be integrated into every research degree program. If the research field or discipline has a formal code of research conduct, a copy of this document should be given to all students. Students should be introduced to and encouraged to discuss thoroughly the nine instructional RCR areas described by the Office of Research Integrity of the U.S. Department of Health and Human Services.[1] Of particular importance here is the area concerned with mentor and trainee responsibilities.

Students should also be initiated into the regular exchange of disciplinary scholarship: they should be included in departmental lecture series, speaker series, brown bag lunches, and other discussion groups. Wherever possible, they should be invited to talk about their own research interests. Whether through contact with advanced students or faculty instructors or supervisors, they should also be reminded that they are merely beginning a process that does not end with their receipt of the degree but will continue during a challenging career. This latter perspective may be important in helping students understand the reason for various "requirements" of the graduate program.

From the very beginning of their graduate work, students worry about how to pick a supportive supervisor and the larger doctoral committee. Should I work with the biggest name? The faculty member with the most grant support? The younger, more exciting researcher, but inexperienced supervisor? There are no easy answers. In some fields, students are assigned supervisors at the start and have an opportunity to change later on if both student and supervisor agree. In most, supervisors are not formally assigned until the end of the first or the beginning of the second year. Still, students wrestle with the challenge of finding supervisors who are best suited to their research interests and also, personally, a joy to work with.

[1] See Steneck, N. Introduction to the Responsible Conduct of Research. (2004) Washington, DC: US Government Printing Office. Council of Graduate Schools, Graduate Education for the Responsible Conduct of Research (2006) discussed the rationale for RCR programs and best practices in program start-up; Council of Graduate Schools, Best Practices in Graduate Education for the Responsible Conduct of Research (2008) describes strategies for delivery, outcomes assessment, and sustainability.

Students themselves do not always know what kind of supervisor would be best for them, nor do they fully appreciate the range of responsibilities that dissertation directors assume or the variety of strategies they must adopt to provide the appropriate mixture of nurture and challenge. Departments can do much to assist students in exploring their options and in selecting appropriate supervisors. Many programs now offer a seminar series for all new students in which faculty present their research interests. Some programs offer laboratory rotations as a way of introducing students and prospective supervisors. Course work offers other opportunities.

One of the most useful but also least used resources for students about prospective advisors is program alumni: departments can make available the names and addresses of former students who have worked with current faculty. And, of course, advanced students also represent a body of knowledge about faculty supervisors. By listening to what advanced and former students say about their supervisors, new graduate students can learn at least some of the characteristics they should look for.

None of these sources should substitute for one-on-one talks with prospective supervisors, but they can help provide a general picture of the kind of support faculty members usually give their own students. For example, in programs where the average time-to-degree is seven years or less, one might be very cautious about agreeing to work with a supervisor whose students always take at least ten years to complete the degree! Given the centrality of the student-supervisor relationship to graduate study, it is imperative that this decision be undertaken carefully and with as much information as possible.

It is important to help all graduate students find appropriate supervisors as soon as possible within the disciplinary constraints of each program. Even in those disciplines where there is not a large body of received knowledge and a large core curriculum to master, it often takes a year at least for a student to select and be accepted by a supervisor. For students who come to graduate school expecting to work with Professor X, the delay in formation of a PhD committee can produce much anxiety. Faculty are often unaware of this concern: they have seen graduate classes come and go, and most students do eventually find a supervisor and work their way towards completion (although it must be noted that completion rates vary tremendously across departments and institutions). Students lack this comforting perspective. Shy, less aggressive students as well as students who may for whatever reasons feel isolated sometimes need extra help, usually from the departmental director of graduate studies, in identifying supervisors and committees.

Setting a deadline by which all entering students must select a supervisor and form a committee, and sharing the responsibility with the students for seeing that those deadlines are met, are crucial ways that program faculty can help keep students' progress toward the degree on track.

Of course, even with the most thorough and careful process for securing good matches between student and supervisor, there are no guarantees. If trouble develops between student and supervisor, the student will invariably be the one who suffers. For this reason, most departments try very hard to ensure that students remain free to change supervisors if conditions warrant. Students should be aware of their options, and departments should have procedures in place to deal with the issues of funding and intellectual property that often arise when a change in supervisors is necessary.

Once a student and faculty member have agreed (even informally) to work together, the next matter is the choice of the student's research topic. In some areas the student normally becomes involved in one of the main ongoing lines of research within the supervisor's lab. In other areas, the supervisor may have a general idea of several possible research directions but leave it to the student to make the final decision about a particular research topic. Some students have a very clear idea of the topic they wish to pursue, and here the student and the supervisor must work together to define a project that can be completed in a reasonable period of time within the context of the overall PhD program. Other students have only the vaguest sense of what they would like to work on, and here it is important that graduate programs provide opportunities for, or perhaps even require, exploratory research proposals early in the student's career to encourage serious thought about possible research avenues.

Master's degrees, of course, operate in a different and more compressed time frame. Some do not require a thesis or independent research program, but rather a write-up of research conducted in a given lab or on a given project. In either case, adequate, appropriate and timely supervision remains the primary need of master's students as well. No matter what program a student is in—PhD or Master's—it is critical that early exposure to research be provided in addition to whatever formal coursework the program requires. In all disciplines, when suggesting or approving a particular research topic, the supervisor should be confident that given hard work and reasonable activity, the student can bring matters to a satisfactory and timely conclusion. Supervisors who do not have such confidence must be prepared to state their concerns clearly and in detail to the student and to their own faculty colleagues. In laboratory settings such as those in the sciences

and engineering, a supervisor generally has greater say in the research of a particular student, especially if the student is being funded on their research grants. In the humanities and social sciences, where students are generally working in areas often quite distinct from those of the supervisor, the burden on the supervisor may be greater in determining whether or not the proposed research topic is feasible. In all cases, supervisors must understand that occasionally an exciting line of research appears in which the outcome is uncertain; in these instances, the supervisor should have a fallback position in case some unexpected difficulty arises. More important, student and supervisor need to work continuously to refine a research topic that is feasible (it can be completed in the allotted time) and meaningful (it will add to critical knowledge in the discipline or field).

What follows, then, is based on the assumption that students begin to be involved in research during this first stage of graduate study. In the sciences and engineering, this represents the usual scenario. In the humanities, students may not begin serious research until later, after admission to candidacy, when all course work is completed. In all cases, however, students embarking on PhD programs need to be thinking about the kind of work they want to do for their dissertations, and refining their thoughts through reading and discussions with their peers, their program faculty, and their supervisors, either temporary or permanent. Departments and programs need to make certain that the framework they provide for each student stresses the importance of such thinking from the very beginning of the graduate career.

In most fields, a literature survey forms an important starting portion of the dissertation, and much of this work should be carried out in the early stages of graduate study. Even students who have not settled on a specific research topic more than likely have a relatively narrow field in mind. During the early period of study, the contours of this field should become clearer, and definition of the research topic should sharpen markedly. Such focusing does not occur in isolation. Here is where continuous and regularly scheduled conversations between student and supervisor really matter. Here is where the supervisor can begin to teach the student how to ask important and meaningful questions, as well as how to think about strategies and methods for resolving those questions. Here too the student should be trained in the virtues of systematic recording of data and/or other relevant information, the importance of keeping and maintaining a clear record of everything that has been undertaken and read. In short, by the end of the first two years, the student should have a fairly clear idea of what the nature and the purpose

of the research is to be, should understand the necessary background information for the relevant work, and should possess a systematic record of everything thus far accomplished and attempted. Finally, through the assessment of written reports prepared by the student, as well as a review of the formal coursework and/or laboratory training received, the supervisor should know whether the student is capable of writing a coherent, connected account of the work. A weakness in this area will cause the student a lot of trouble later on and must not, therefore, be ignored.

At this point, the student should be ready to take the examination for admission to candidacy. But before sitting for this exam, another "hurdle" must be passed: the formation of the doctoral committee. In practice, the function of the doctoral committee differs not only across departments and disciplines, but even within departments. This very diversity is a cause for much anxiety among students. But students and supervisors should be encouraged to think of this committee as a collaborative resource.

Ideally, at least one of the members, other than the supervisor, should be a person who is very familiar with the specific area of the student's interest, and there should be another member who is at most just working in the general area. The fourth person could well be a faculty member with whom the student has studied and whose advice and judgment the student and supervisor would welcome. Departments and programs may have more specific requirements for the creation of this committee: in some disciplines there is a clear distinction between the preliminary exam examining committee and the student's subsequent dissertation committee. In others, these committees often comprise the same individuals, although their responsibilities differ from the preliminary exam to the final dissertation defense.

The preliminary exam, or "prelim," can be one of the most terrifying experiences for a graduate student. When they are unsure about what is expected on this exam, ill-informed about what it is intended to reveal or what function it serves in the overall educational program, convinced that they do not yet know enough, and filled with horror stories about how former students were unfairly grilled on topics they had no idea they would need to know, students are likely to delay taking this exam for as long as they can. The development of a framework for graduate study, as suggested earlier, can help to alleviate some of these anxieties. Graduate programs should articulate clearly the function of the preliminary exam: is it simultaneously, for example, a check on the student's general knowledge of the field (i.e., familiarity with the primary methodologies and the general

research questions that drive its research), as well as a measure of how sharp his or her own prospectus is for the subsequent dissertation? In many fields, the "prelim" has been formally divided into component pieces: a written examination covering, in some sense, the scope and nature of the "field" itself; a dissertation prospectus, submitted either at the time of the preliminary exam or within a specified period after the written exam; and an oral "defense" of that prospectus. Such a format is by no means universal in graduate schools across the country or from discipline to discipline, but in most graduate programs the preliminary exam looks both backwards to work the student has already done and forward to the dissertation that is to come. In this sense, it is a clear staging point, a passage from a developing researcher to a fully engaged one.

No matter what form the preliminary exam takes, many departments encourage students to develop formal or informal student study groups to prepare for it. Faculty should ensure that such study groups understand the function of the exam in that department or program and what is expected of them. The worst approach is to let students flounder in ignorance and isolation, which can only foster the suspicion that the department and its faculty have no general sense of what function the preliminary exam serves so that every exam must be simply an ad hoc event at the whim of each particular examining committee.

In summary, there should exist in the first two years of PhD study, or in a more compact time frame for the master's degree, a framework which will enable both the supervisor and the student to recognize whether the student should continue on for the PhD. It should also ensure that the student has adopted appropriate and relevant methods of work so as to guarantee that the remainder of the time is spent fruitfully, with a high probability of completing the task within the allotted span. A clear and well-defined process of assessment allows the student to know where he or she stands, makes for a reasonably objective judgment of his or her likelihood of success, and can be of value in detecting and correcting problems.

THE MIDDLE STAGES

Upon successful completion of the first part of the graduate program, the student should enter the middle stages knowing what is to be done, with thorough background knowledge, and, in many cases, with a start made on the research work itself. An effective framework in the first years will have encouraged the student not merely to accept but to expect a suitable schedule for the remainder of the program. Indeed, much of what we have said about the early stages applies with equal force to the subsequent years, and departmental communications should emphasize this. Unfortunately, it is often the case that failure to set carefully marked goals or stages makes the years after the preliminary exam particularly difficult. For science and engineering students, the increasing demands and responsibilities of laboratory work sometimes take time and energy away from the student's own particular area of interest. For humanities and some social science students, teaching responsibilities often increase in the middle years of graduate study and demand more and more of the student's attention and time. For many social science students, the need to conduct research abroad is both time-consuming and expensive. Unless the student and the supervisor are alert to these dangers and continue to meet often and regularly, it is easy for a student to lose sight of the larger goals of completing the research, writing up its results in the dissertation, and finding a job.

Obviously, the most important decision students and supervisors must make in this middle phase of a graduate program is the precise nature of the dissertation project. In most instances, this decision is largely an individual and intellectual one, but some general observations may be appropriate. As stated earlier, the dissertation topic should be both feasible and meaningful—easy terms to use but difficult to define. Students often are overly optimistic about how much they can do in the time remaining in their program (this is most evident in the time schedules and prospectuses they offer for writing up their research) and overly confident that they can make broad, discipline-shaking arguments. Supervisors must carefully and cautiously seek to challenge such over-reaching plans and help the student see the virtues of a more focused and "doable" project.

There are other, critical matters to be considered when finalizing the precise nature of the dissertation. For example, should a supervisor encourage a student to pursue a research project which involves industry or government funding and which might, because of that funding, raise questions about

whether or not the conclusions of the research can be published? The same complication may affect research that involves potential patents. Many graduate schools have policies governing such situations, but it is imperative that the supervisor alert the student early to these possible problems. It would be unethical for a supervisor to enlist the student in a research project in which his or her participation would be subject to publication restrictions that could jeopardize a future career.

A different kind of issue arises from the way electronic submission of dissertations has changed the very nature of this document. On the positive side, of course, it is now possible for students to use multiple and mixed media in the presentation of their research, a possibility that offers a variety of inter- and cross-disciplinary opportunities as well as more visual illustration, confirmation of lab results, complex modeling, even film documentary. But there are also new risks here. The most important of these is the fact that electronic submission exposes students to immediate access by web search-engines and web-crawlers, and thus to fairly constant oversight of their compliance with general Fair Use policy. Students need to be more careful about learning and following these policies. Some graduate departments and schools, in fact, have created new partnerships with university libraries and/or law schools in an attempt to offer students and faculty an overview of Fair Use and other electronic publication issues.

Once the dissertation topic is finally set, much of the middle stage of graduate study involves obtaining the bulk of the results or argument that will form the body of the dissertation. Obviously, it would be ideal if appropriate milestones could be established, determining the points which the student should have reached at various times. One must, however, remember that we are talking about original research where, by definition, things do not necessarily go as intended. Dissertation writing involves creativity, and the path to the thesis is therefore rarely a straight one. The original shape of the outline may also undergo substantial transformations. And periods of brainstorming and gestation, which might to external observers appear idle or stagnant, may be followed by great periods of productive output. Nevertheless, it is important at this stage for the student and the supervisor together to do their best to lay out a clear and precise path, as detailed as possible, perhaps even to particular arguments about individual chapters. This plan should be reviewed at various times throughout the year, and become more sharply defined as time goes by.

The research plan should contain ample allowance for unexpected additional work. This is the nature of research. But it is also important that

initially established timelines be kept clearly in mind. Equally important, supervisors should continually assess whether it is likely that the student will be able to bring the work to a timely conclusion or whether the difficulties are such that the student must modify the topic or even switch to another more likely to produce a dissertation in a reasonable time. One cannot emphasize enough the importance, therefore, of continual and periodic assessment of progress during these middle years. If schedules begin to stretch out here, it is likely that they will continue to do so, and the odds of completing the dissertation in a timely fashion will go down.

It is implicit in what has been said so far that we have been talking about the student who is engaged in a research collaboration with only the supervisor. But this is certainly not the only, or even necessarily the best, way of carrying out research today. More and more, in nearly every field, research is conducted in collaborative teams. Even where the research is relatively independent, as in the humanities, the kinds of interdisciplinary and cross-disciplinary work being done today often results in numerous collaborations. Where teamwork of any kind is involved, there will usually be senior academics that understand the necessity of meeting deadlines and of ensuring the work is progressing in an efficient and satisfactory manner. The problem in this case is not so much to set up milestones for the project as a whole, but to define the student's specific contribution to the work—to make sure not only that those contributions are made but that the student has a thorough grasp of the project as whole.

When many people are involved—as in the laboratory sciences—there is far less chance that the student will fall behind or go off track without someone noticing, since others are dependent on the student completing the tasks assigned. The bigger risk here is of not seeing the forest for trees. In this case, it is almost essential for the student to be asked occasionally to explain to the group not merely what he or she is up to, how much has been achieved and what problems are foreseen, but also to explain how this piece fits into the whole research project. There is nothing like having to explain yourself to other people for clarifying the mind.

This strategy is helpful for students in all fields. In focusing on the details of any particular research project, students sometimes do not realize that colleagues other than their supervisor may be interested in the wider aspects of the project and its impact on the whole body of disciplinary knowledge, or that they may have different views about the significance of the research itself. For these reasons, students should be given as many opportunities as possible to present the results of their research at departmental seminars

involving faculty and other graduate students.

Collaboration, more broadly conceived, is not an in-lab, in-department, in-house activity. As all effective supervisors know, the ultimate goal of good scholarship is to increase the body of disciplinary knowledge. It is difficult to overemphasize the usefulness, for the student, of exploiting all available resources (particularly the other members of the dissertation committee) and of presenting research results at professional conferences. Other than obvious benefits of making the student known among other researchers and even prospective employers, such public presentations help solidify the student's confidence in the viability of his or her research and help clarify the kinds of additional work needed to confirm the arguments. It is important that such presentations are begun as early as possible in the middle stages of graduate study, for they provide crucial experience for the later tasks of writing up all of the research and defending it before a body of scholarly peers.

THE FINAL STAGES

For some students, the dissertation may be the first really extended piece of work that they have ever written. In such cases, it is critical to spend significant time with the supervisor in laying out a precise plan for writing up the research. Even for students who have been writing scholarly articles since their initial years of graduate work, the thought of writing an extended study which may cover, for example, many years of history, multiple figures, or a variety of species can be daunting. In such cases, writer's block can be a very real problem. For this reason, some graduate schools and many individual departments have created dissertation-writing workshops for their students. Others encourage students in their final year to meet often informally to read and critique each other's reports. Still, most of the responsibility for constructive work here falls again on the relationship between the supervisor and the student. Now, more than ever, close and steady contact is essential, and now is when the faith that each has in the other really pays off. Students need to be able to talk to their supervisors about troubles they are having in writing, and they need, in turn, to receive back from their supervisors candid and constructive assessments of what they have done so far. Timelines remain important, of course, but now the arguments and the details must also be subject to careful and constant scrutiny.

A potential ally in this final phase is the student's doctoral or dissertation committee. Some supervisors are reluctant to have the student show individual pieces or chapters to other members of the committee until they have seen the whole work. Although understandable, this reluctance deprives the student of potentially helpful collaboration and constructive criticism at the crucial stage of completion. Of course, there are occasions when committee members differ about what should be done about a certain problem, and this can add serious anxiety to the student trying desperately to finish on time and to satisfy both the supervisor and the committee that this is the best work that s/he can do. But here too, if the graduate framework has been fully laid out and there have been steady and periodic meetings between the student, the supervisor, and the entire committee, these matters should not pose undue stress or create unnecessary hurdles. The supervisor is, of course, the final arbiter of such matters, but occasionally it is necessary for the director of graduate studies or another administrator of the program or department to help the student and the committee overcome differences

of opinion about matters of content or methodology. In all cases, it is the department's responsibility to ensure that the student is being treated fairly in these deliberations.

Two additional points should be made here. First, given the nature of collaborative research these days, many dissertations, particularly in the sciences, are in fact compilations of articles jointly authored by several people, including the student. Individual graduate schools are responsible for establishing the policies governing such dissertations, but even within institutions, policies may differ from department to department. Second, given the nature of the dissertation as an original and significant contribution to knowledge, as well as the culminating exercise for the satisfactory completion of a particular graduate degree, it is necessary that it highlight the specific contribution of the individual student. It is typical, therefore, that only articles in which the student is the primary author are included in the compiled dissertation. But even this is not so easily determined. In some fields, the director of the laboratory is automatically listed as the "primary" author, even though he or she did not actually write the article or the report. In such cases, two things are extremely important. First, that graduate students and supervisors discuss publication and dissertation policies from the very beginning so that everyone understands the ground rules. Second, that graduate schools keep abreast of the particular nature of collaborative work within discrete fields so that students can be duly acknowledged for the actual work that they do.

PROFESSIONAL DEVELOPMENT AND CAREER ISSUES

As we have already said several times, it is never too early to think about the next stage of one's work or career. As graduate students proceed through the stages described in this guidebook they should keep in mind their expanding career options. One of the strengths of U.S. graduate education programs is their relative flexibility in preparation of students for multiple career opportunities. In the past many graduate supervisors acted as if students had somehow failed if they pursued any career path other than that leading to an academic position in a research university, but this is no longer the case. In some disciplines, up to half of those who graduate with PhD's pursue non-academic career paths directly after graduation, and non-linear pathways leading to and from academe are increasingly common. Many graduate programs currently work hard to ensure that students remain open to a variety of career options, and graduate schools should strive to keep careful records of the career trajectories of former PhD students. Students should see whether this information is available for their own graduate programs, for it could give them a clearer sense of the possibilities that have been open to those who preceded them. Even at the dissertation stage of a PhD, however, it is difficult to predict all of the areas of future work that may be of interest or available. Preparation for multiple possibilities may actually enhance one's preparation for professional employment in a chosen field.

Most institutions provide some kind of placement services and career counseling opportunities to graduate students. These can vary from one-on-one mentoring relationships to full-time placement offices with professional staffs. Many individual graduate programs maintain close ties to former graduates who work in a variety of professional, technical and academic fields. Students should seek out these individuals and offices and discuss career planning and options early and regularly as their graduate program unfolds. Often there will be campus seminars and workshops devoted to these issues, and they will certainly be a topic of informal interaction among fellow students. In some institutions, versions of the national Preparing Future Faculty program offer both formal and informal avenues for exploring the expectations and possibilities of careers in different kinds of academic settings, from the technical and community colleges to small liberal arts colleges to comprehensive universities to major research institutions (see "Resources and Further Reading"). Throughout these discussions of career

options, students should consider how the academic and intellectual work of completing an advanced degree can best match up with the opportunities for jobs in public and private sectors.

These options should be continually in mind as students prepare research, teaching, and course materials in the campus environment. Graduate students are developing skills that will serve equally well in a private sector career or in careers working with various levels of local, state, national or international government agencies. The websites and resources listed at the back of this publication can serve as a beginning point for currently existing references and as a connection to places that serve graduate students in professional career development. But these resources are constantly changing, so students should make sure that as they meet and interact with faculty, visiting scholars, and alumni, and as they attend professional and disciplinary conferences, they keep open the prospects of future jobs and career alternatives. All such interactions—both on campus and off—are potential testing grounds for new ideas, networks, technology and communications skills that will demonstrate the multiple career and advanced-study options available to graduates in every field of study. Students should seek out colleagues who are on the cutting edge of the discipline or in multiple disciplinary fields, because the growth of knowledge and subsequent career possibilities are moving rapidly in the twenty-first century and are likely to continue to do so.

SUBMITTING AND PUBLISHING THE THESIS, DISSERTATION, OR FINAL PROJECT

Submission of the dissertation is the penultimate step in completion of the PhD degree, and the thesis is the typical culminating milestone for achievement of the research master's degree. The completed dissertation or thesis is tangible evidence that students have been well trained, that they have learned the techniques and methods of their disciplines or subdisciplines, and that they are capable of writing an extended and coherent report on individual research. Successful completion of a dissertation in a student's PhD training marks the transition from student to independent scholar. But there are two final steps to be considered: first, is the simpler matter of what to expect at the formal dissertation defense and, second, of what the publication prospects are for your dissertation.

The defense of the dissertation is, at most institutions, an ostensibly "public" event, which can be attended by other students and faculty as they wish. In reality, this is rarely the case. And while it is also true that a student can actually "fail" the defense, this too is a very rare occurrence. Still, it is important that students have some understanding of what is expected of them at the defense. Formally, policies governing the defense are, in all likelihood, set by the graduate school, not the individual program, but in practice, the handling of the defense is more or less left up to the graduate department. Usually, all members of the student's dissertation committee participate in the defense, each generally asking a number of specific questions related to the work under consideration. It is not unusual for members of the committee at this time to suggest alternative ways to account for the material in question or alternative approaches or methods that might have been used. It is also common for members to inquire about future research that might be undertaken as a consequence or result of what has been discovered in the present research. Ideally, this conversation is precisely that—a congenial discussion among scholarly peers of the strengths and possible weaknesses of the approach utilized in the dissertation, an exploration of the soundness of the argument and potential applications of the findings, and an initial probing of next scholarly steps. It is therefore difficult to be specific about how one should prepare for such an "exam," for it is unlike anything else encountered in one's graduate career. Perhaps the best advice is for the student at this

moment to try to stand back from the dissertation and consider it as if it were someone else's work. Rather than trying to defend the particulars of the argument or project, the student might more objectively assess what s/he thinks has been accomplished at this stage of research and what yet remains to be done. If it is true—and many believe it is—that in order to become a good scholar one must learn to ask deep and meaningful questions, then this is the opportunity for students to consider more deeply and more meaningfully the work that has been done, to situate it within the broader mission of the particular discipline. This is not to suggest that the student need be modest about what s/he has achieved: it is only to suggest that all scholarly achievements take place in the context of the collaboratively-generated knowledge of a disciplinary or a cross-disciplinary field.

One of the final affirmations of valuable scholarship is its publication. In many graduate fields, of course, students will have published reports on their research long before completing the dissertation. And, as already noted, some dissertations are actually compilations of articles already published. But there are a few special concerns about publication of the dissertation that need to be noted.

First, it is important that students and supervisors talk candidly about publishing policies, both written and unwritten, in their respective disciplines. This is particularly true in fields where most research is collaborative and in which most scholarly reports are the products of various kinds of joint authorship. Obviously, students need to learn these policies early in the graduate career, but they need to be kept clearly in mind also at the end of that career. Second, in many fields, especially those in which career prospects generally depend upon the rapid publication of a book rather than an article or a series of articles, it is easy to underemphasize the difference between a dissertation and a publishable book. Students often want to delay completion of the "dissertation" until they are certain it is a publishable "book," and supervisors are often willing to support this delay. This is unwise. It forgets the fundamental premise that completion of the PhD degree is but a step in the process of becoming a scholar, not the end point. In this sense, encouraging the student not to finish the degree in a timely manner is somewhat like suggesting that s/he accept a two or three-year postdoctoral research position before handing in the dissertation. In both cases, the delay might sometimes be good for scholarship but, despite the obvious ego boost it offers, may not always be fair to the student. Students should be encouraged to complete their dissertations before beginning the next phase of their careers.

A final point here might be made about another consequence of the electronic submission of dissertations. As mentioned earlier, this process now makes dissertations immediately accessible to individuals using a variety of web search-engines and web-crawlers. For scholars who need time to turn their dissertations into the first books on which their subsequent careers will depend such immediate availability of their ideas can pose a serious problem, particularly at a time when book publication is growing increasingly more difficult. UMI/ProQuest, which processes all dissertations submitted electronically, does have an optional delay policy that will provide up to 2 years between the date of the submission of the dissertation and its electronic accessibility. But this may well not be sufficient for the scholar whose initial year or so in the profession is totally consumed by new teaching responsibilities. Nor does the UMI delay cover conditions at the local, institutional level. Early publication, as articles, of key arguments of a student's research may help alleviate this problem, but it remains of considerable concern in some fields of study (particularly in the humanities). This being the case, students should be made aware of the prospects early enough in their graduate careers to take whatever steps they deem necessary to preserve their opportunities to publish their work.

A HALL OF SCHOLARS: CGS/UMI DISTINGUISHED DISSERTATION AWARD WINNERS REFLECT ON THE INGREDIENTS OF SUCCESS IN DOCTORAL STUDY

Since 1981, the CGS/UMI Distinguished Dissertation Award has annually recognized individuals who have made unusually significant contributions to their discipline in two broad areas. The areas include: biological sciences; social sciences; mathematics, physical sciences and engineering; and humanities and fine arts.

CGS asked recent recipients of this award and their research advisors to reflect on what they consider to be the aspects of their supervisory relationship most important for contributing to the success and quality of the research and dissertation. The ten reflections below provide compelling, and at times poetic, testimonials to the challenges of degree completion and the factors that contributed to the award winners' completion in a timely manner.

Some Aspects of Successful PhD Advising *

A key theme: Learning to ask good questions (interesting, deep, yet [partially] answerable) is a key to becoming a research scholar. Answering other people's questions is important too, but developing a broader view of the field and the ability to ask the right questions is crucial to becoming an independent researcher. Ergo: don't spoon-feed students.

Perfectionism can cripple smart people. Try to strike balances: e.g., between an exhaustive literature survey and plunging in naively; between perfecting the killer experiment or model simulation and actually publishing something. But don't rush to publish trivia!

Research and teaching are inseparable in the university environment and can mutually reinforce. One often only REALLY understands a topic when one teaches it (and sometimes only when one teaches it the n'th time). Again, one needs to strike a balance, but some TA/instructor time is usually helpful to the student's development.

Some nuts and bolts:

Access: An advisor should hold regular (weekly) research meetings for the group and/or individuals. The advisor should not travel too much and should keep hands-on involvement with research. Advisors & research group members should quickly respond to email questions, etc.

Freedom: Encourage students to collaborate with others, take a broad range of courses, attend multiple seminars. Don't keep them locked up in lab or computer center.

Collaboration: Get postdocs and colleagues involved in mentoring students. Encourage collaborative work, while keeping the student's own project and major contributions distinct. But don't farm out students to a big lab staff! [This reflects my own style; I have colleagues who discourage students from interacting outside their immediate groups, who feel that total focus on the PhD project is essential. I think students benefit from broader exposure and a range of influences.]

Exposure: Have students give several oral presentations in lab meetings and seminars each year. Encourage (and fund) conference attendance, especially in years 2-5 (5=graduation). Introduce student to advisor's various communities. Help arrange exchanges with groups in other institutions. Use internships in industrial labs, summer courses, etc., to expand on the local scene (e.g., Woods Hole Summer Neuro Program; NSF Math Institute Workshops and Summer Schools).

**Basis for these thoughts: 28 PhDs (2 more expected in summer 2007), 3 MScs, currently advising 6 PhD students & 4 postdocs.*

Phil Holmes
Professor of Mechanical and Applied Mathematics
Princeton University
Co-advisor of Eric T. Shea-Brown, CGS UMI award winner, 2004

Five Tips for Advisors and Mentors

1. *Match the research project to the student's needs and strengths. For example, there are many possible tacks on most theoretical neuroscience problems, from analysis to simulation. Some mistakes I made as a mentor involved failing to take advantage of this flexibility in effectively matching students with problems. For example suggesting highly abstracted approaches with highly idealized models (and hence those for which exhaustive computation, asymptotics, or proofs are possible) to students more interested in direct contact with physiological experiments can be a mistake—and vice-versa. It is more than worth taking the time to understand a student's interests and skills at the outset, especially in interdisciplinary areas where the range of techniques and problem styles is so utterly vast. It is also important to continually evaluate how such a project fits into a student's evolving academic goals -- and be willing to adjust tack -- as she or he and the field itself are likely to be changing just as rapidly from year to year.*

2. *Provide the student with opportunities to seek outside feedback on their work at every stage. A good strategy is to use one's own network of collaborators and colleagues to students' advantage (and to return the favor). One should also encourage students to share their progress with a research group and with their peers at frequent and highly informal meetings -- and immediately think about organizing such meetings if they're not already in place.*

3. *Get involved in the fine points. In some of my most effective meetings (at either end of the desk), the research mentor has tried to check as many steps of a calculation as she or he can, or to work through a simple example in complete detail. As a graduate student I found that such close involvement answered many questions that I didn't know I had or was afraid to ask, and gave me new ideas on how to proceed.*

4. *Provide the opportunity, but not the requirement, to interact with the mentor almost every day. A best practice is to simply pass by each student's office each day to ask if there are any small issues to cover right away or larger ones that would need scheduling of a time to discuss.*

5. *Consider joint mentorship with one physical sciences/mathematics and one biology advisor, for example, for interdisciplinary projects. Please see the article below on this. As one data point, this worked very well for me. http://www.sciencemag.org/cgi/content/full/301/5639/1485, retrieved on 5/21/09.*

Eric T. Shea-Brown
New York University
CGS UMI award winner, 2004
Courant Institute of Mathematics Sciences Selecting an Advisor

Selecting an Advisor

Perhaps one of the most critical decisions made in the life of a graduate student, and the most influential with respect to degree completion, is the selection of a thesis supervisor. Certainly, it is important that the selection process is driven by the identification of a supervisor that shares the student's research interests. However, what often seems to be underestimated is the importance of identifying a supervisor with whom one can work productively and cohesively over a number of years and establish a relationship that can endure the periods of significant stress that frequently accompany the dissertation process. A number of factors can profoundly influence the success of a productive working relationship and should therefore be considered, including: compatible personalities, communication styles, and problem-solving strategies as well as similar expectations with respect to work-life balance and the appropriate balance between student independence and supervisor intervention. A lack of clarity around these issues and expectations can result in a poor student-supervisor relationship, which can adversely affect a student's ability to complete his or her dissertation in a timely and productive fashion.

A student who is interested in pursuing graduate study should therefore approach the process of selecting a research supervisor with careful consideration. As a first step, it is important that students are thoughtful and honest with themselves about their personal goals, expectations, and limits. With this knowledge, one can begin the process of identifying potential supervisors on the basis of both research interests and relationship compatibility. Students should take time to gather independent information and feedback about each potential supervisor and the working relationships that they maintain with others, including the students and post-docs in their labs and other faculty members in their departments. Also fundamental to the selection process is an open and honest discussion with potential supervisors, during which both parties establish a clear and mutual understanding of one another's expectations. This requires effective communication; students must be prepared to explicitly articulate their interests, questions and concerns as well as the results of their own self-assessment. Armed with this information students can make an informed decision and maximize the probability of establishing the foundations for a successful graduate career.

Tadzia GrandPré
Research Associate
Baylor College of Medicine
Center for Educational Outreach
CGS UMI award winner, 2003

How Good Mentorship can Motivate Students to Leap the Hurdles of Graduate School

Having recently warmed the seat of a graduate student's desk for seven years, I don't have to go far to recall the major challenges that graduate students experience, some which have the potential to serve as obstacles to degree completion. Possibly the biggest challenge is the feeling of being in no-man's land. While developing abilities during one's graduate career of self-direction and self-confidence are invaluable, unfortunately the motivation for acquiring these often comes from a panicked-sense of being lost in a world surrounded by large academic egos and the record achievements of senior researchers. As a student, you are known by few others, often little is asked of you with regards to civil or academic service, and you have yet to acquire a sense of identity, pride, or ownership of a particular body of work, because let's face it, early graduate students are still green. So often throughout the tortuous path of graduate work, students worry that their long hours in research are in vain, continuously asking themselves whether or not what they are doing will really make a difference in the world. The temptation to leave this position in no-man's land for a job in the real world with higher pay, regular demands from your boss, and more frequent benchmarks and tangible achievements is something that leads some students to forfeit their graduate career, at least for a time. I have, however, met many students who returned to graduate school after learning that the "real world" was not going to be as satisfying as they had hoped without first having achieved a higher level of graduate education.

A good supervisor can do a lot to help graduate students avoid such obstacles and rise to the top in their fields of research. When I was searching for the right PhD program, my number one criterion was to find a good mentor. I sought this person by asking as many graduate students and postdocs in the field of Ecology as I possibly could whom they would recommend. Professor Terry Chapin at the University of Alaska, Fairbanks came back the winner, hands-down. When I was fortunate enough to be given the opportunity to study with him, I discovered that the all praises of him were entirely deserved. While Terry did offer a general topic for research (methane emissions associated with thermokarst in Siberia), he did not offer me a rigorous set of objectives or framework for a study design. Instead, he allowed me to flounder around a bit in no-man's land, searching for the right research questions and approaches. In accordance with Terry's wise foresight, the frustrations of no-man's land turned out to be invaluable growing pains because through the process of designing and fulfilling my research, I gained confidence in my ability to ask good science questions and interpret results for work that stemmed from my own interests. Terry made himself available to meet with me as often as I needed, despite the incredibly busy schedule I knew that he maintained as one of the nations most in-demand ecologists (although Terry never told me himself that his schedule was busy). Not only was he available, but he made me feel important. His attention was undividedly upon me and my research project when I was with him in the office or field setting, something that for me was very humbling because I knew how many other important things he had on his plate. Terry listened thoughtfully, considered my ideas, and tested the weakest of them with gentle, yet challenging questions until I saw their particular faults myself. Never did Terry utter a word of discouragement. He was always encouraging. He believed in me even when I doubted myself, and gave me opportunities to rise to more mature positions in science by asking me to peer-review research proposals of other professors; recommending and supporting my participation in local, national and international professional conferences; and encouraging me to present and publish my results in an array of journals, including those that are the top in science. Terry also had the incredible ability to read, edit, and return drafts of papers within a matter of hours to a couple of days- record breaking time as far as I know of any other academic. The amazing thing is that mine is not the only

testimony of Terry's qualities. All of this other graduate students and colleagues can say the same thing about him- all a tribute to his incredibly hard work, brilliant mind, and commendable respect for others. I have been deeply inspired by my PhD advisor, not only by his abilities as a scientist, but equally if not more importantly, by his qualities as a human being. With a mentor like that behind me, the thought of forfeiting my graduate program never entered into my head, but rather, in its place was the motivation to strive for a top place at the finish line.

Katey Walter
Research Program Manager
Prince William Sound Oil Spill Recovery Institute
CGS UMI award winner, 2006

Maintaining a Presence

It is challenging to offer general advice about graduate advising because situations vary from one student and one discipline to the next. Perhaps the most uniform recommendation I could give is for advisors to be present in the graduate student's academic life. When a PhD student is writing a dissertation, particularly away from campus, it is easy for time to pass without regular communication between the advisor and the student. While each advisor needs to judge how much supervision and support is needed for each student, maintaining communication is always helpful. It reminds the student that others have an investment in the final product and are monitoring her progress. It also makes it easier for the student to approach the advisor should she run into a concern in the mid-dissertation. It is not exactly a partnership since the student must undertake original research, but it should be a supportive relationship in which the student feels confident that the advisor is paying attention to its development and can be consulted as issues—good or bad—arise. Maintaining a presence in a graduate student's career can be as simple as passing along relevant articles or books that cross an advisor's desk or asking the student to grab a cup of coffee every so often. These kinds of actions help prevent a sense of isolation and the inevitable stall that occurs for most PhD candidates.

There are few natural deadlines or other benchmarks for students writing dissertations. This can be a dramatic change for students who have been motivated by class deadlines and syllabus requirements through college and graduate school coursework. The advisor can be helpful in this regard by setting expectations. Depending on the student, these might be firm deadlines for chapter drafts and data analysis, regularly meetings to maintain accountability, or other ways of creating structure in a relatively unstructured environment.

The transition from coursework to dissertation is also easier if students have been prepared to think about the dissertation early in their graduate careers. Advisors should encourage students to be contemplating dissertation ideas in seminars and to move toward a dissertation prospectus soon after passing qualifying exams. One way to do this is to give ample feedback on seminar papers and to indulge graduate students in conversations about potential research ideas from the very first day of graduate school. The shift from student to researcher will be less abrupt and should result in a smoother transition to the dissertation stage.

Barry C. Burden
Professor of Political Science
University of Wisconsin
CGS UMI award winner, 2000

Passionate Engagement in Research

The transition from incoming graduate student to accomplished researcher does not occur at the hooding ceremony with the award of the doctorate. Instead it is a gradual process of learning that should start as early as possible. The first thing that must change is the attitude about studies. Although there are certain course requirements that must be satisfied, the most important aspect of graduate school is to become engaged in research. How can one make that transition? I have a few suggestions, based on my own experience supervising students:

1. You do not need to take a course to learn a subject. Researchers must continue to learn, especially as they get into new areas. This is accomplished by reading papers and books, and talking to colleagues.

2. You can learn a lot from your PhD advisor, but you can learn even more from fellow graduate students.

3. Make a real effort to attend seminars and colloquia. You can always find an excuse not to go. Some talks are bad and others are excellent, and most are just average. However I try to learn something from every seminar that I attend. Just in case, make sure to bring a pencil and paper so if the talk is really awful you can still get something done.

4. Research is a full-time activity and must be a passion. Follow your interests and you will excel in those areas.

5. Although research is a full-time activity, everyone needs balance in life.

Mark Raizen
Sid W. Richardson Foundation Regents Chair and Professor of Physics
Center for Nonlinear Dynamics and Department of Physics
University of Texas at Austin
Advisor to Daniel Steck, CGS UMI award winner, 2002

The Importance of Breadth

Graduate training in History is very personalized, so advice that would be good for one program might not be good at all for another. Here are three generic pieces of advice that I think would be valid wherever you study.

1. Always remember that (with rare exceptions) your goal is not just to get a degree; it is also to get a job. An excellent dissertation is a great start, but (however much you may want to) don't concentrate on your dissertation specialty to the exclusion of all else. Most programs also have "field requirements" that may seem designed to do nothing but slow you down. But they are there to prepare you to offer something other than your specialty when you go on the market. Look on them as an opportunity, rather than a burden. The same goes for teaching assistantships, which in our discipline is a major source of graduate funding. These are opportunities to think about how you would teach courses that may be only distantly related to your specialized interests. Demonstrated teaching ability, in our discipline, means a lot.

2. As you put together your doctoral committee, think of what each faculty member might contribute to your dissertation. Your advisor is, of course, the central person, but we're not a cottage industry any more. Think of your dissertation as a Saab, and your committee as the team of mechanics helping you assemble it. If you choose other members of the committee with different skills and interests, you will wind up writing a much richer and more multi-faceted dissertation.

3. A different kind of advice: I always tell my students to remember, when they are giving papers, that the ear is stupider than the eye. I mean by this that the ear, listening to a paper, cannot take in the kind of complexities that the eye can when reading. Don't just read a good seminar paper; rewrite your paper for oral delivery: shorter sentences, looser sentence structure, and more verbal cues about where the argument has been and where you are going with it.

Hal Drake
Professor of History
University of California, Santa Barbara
Advisor to Thomas Sizgorich, CGS UMI award winner, 2005

Collaboration and Professional Development

My primary discipline is molecular evolution/bioinformatics. Bioinformatics is still very much an emerging field, which may contribute to the large variation in outcomes for graduate students. The following thoughts are based on my own experience as a graduate student in Laura Landweber's lab at Princeton, the experience of other students in the PhD programs at Princeton, and my own students here at Boulder.

One major problem in this field is that its highly interdisciplinary nature can lead to students becoming involved with tasks that are extremely time consuming but will contribute only a small piece to a project that will be published as a paper with many authors. This makes the student's own contribution difficult to identify later when it is time to write the thesis or apply for jobs. I think it's important for advisors to guide each student towards a project that will be identifiably his or her own, but at the same time to encourage applications of the techniques learned for that project in other, collaborative work. One thing I really benefited from at Princeton was my advisor's encouragement to collaborate with people who, initially, had very different perspectives on the problems I was addressing, but to combine this encouragement with an emphasis on the discrete publications that would make up the thesis.

A second problem, which I think is more general, is the fear, uncertainty and doubt that many students have about both the publication process and the process of producing the actual thesis. Early involvement in all aspects of the publication process, including reading papers by other people in the lab who are available to answer questions, participating in peer review, exploring different journals' instructions to authors and editorial processes, writing drafts of responses to reviewers, etc., is very important. In particular, thinking about the audience for each piece of writing is crucial to its success, and the audience is very different for the journal article, the response to reviewers, the reviews, etc. I think that early exposure to the publication process definitely helped me both with subsequent publications as an independent investigator and with putting the thesis together.

Finally, I think it's easy for students to become too isolated in focusing on their own projects. Promoting attendance at national and international meetings, and participation in graduate student symposia, is key to helping students calibrate the likely significance of different directions in which they could take their research, and how close they might be to finishing. Again, I consider myself fortunate to have been able to present at a relatively large number of meetings. Although I found these presentations very stressful initially, they helped immensely with later presentations, and with teaching.

Beyond these issues, I think it's really important for the PI to hire good people so that there are high expectations within the research group, to promote an internal culture of collaboration rather than competition, and to provide advice about technical aspects of the project, appropriate scope of the project, and career development issues in a timely fashion as needed. My interactions with Steve Freeland, one of Laura's postdocs who is now at UMBC, were especially valuable in these regards. In general, though, Laura was certainly able to attract an excellent group of people to her lab, providing a very exciting milieu for interdisciplinary research.

Rob Knight
Assistant Professor
University of Colorado, Boulder
CGS UMI award winner, 2001

Dissertation Completion

The lack of fixed deadlines on dissertations is hard for graduate students who have come to depend over the years on the structure imposed by deadlines for exams and term papers. Furthermore, advanced graduate students are generally called upon to teach their own independent classes, and the resultant deadlines for the classes they teach make it even harder for them to make dissertation progress.

A secondary problem is that graduate students are often unrealistic in setting the scope of their dissertation. The dissertation is best seen as a means to the end of obtaining and keeping an academic position, rather than as a document that must be perfect. Dissertation advisors occasionally are fortunate enough to have a graduate student who can see how to carve out a reasonable-sized problem and write an excellent dissertation on it, but all too often graduate students impose higher expectations on themselves than faculty actually would require.

I've seen several useful approaches to deal with dissertation completion issues. One is for students to present chapters of their dissertation at conferences. Presenting the three main substantive chapters of the dissertation at different conferences can provide the deadline structure that would otherwise be lacking. Another approach is a student support group that meets every week or two for students to set their own goals as to how much they will finish by the group's next meeting and then having to report back to the group the next time. A decade ago, some of our dissertation students formed a support group they called "Dissertations Anonymous," which they used to share their completion issues with peers, gripe about their advisors, and realize that difficulty in dissertation completion is a common problem rather than due to their personal inadequacies. Our department has recently established three-quarter dissertation workshops in each subfield for students who have just passed comprehensive exams, so that the students meet collectively with a faculty member who works them through the steps involved in problem formulation and writing a dissertation prospectus. The common threads to these efforts are creating some structure and working to keep the objective of completing the dissertation as primary.

Herbert Weisberg
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Advisor to Barry C. Burden, CGS UMI award winner, 2000

Words of Wisdom

My experience as an advisor to Dr. Li Yu can be adequately expressed by adding a few pronouns to the translation of Chapter 17 of the Daodejing, a poetic philosophy whose origins stretch back well over two millennia. So, if "The Old One" will pardon the intrusion into his way, I would say that…*

At my best, she doesn't know I exist.
Next best, she likes and praises me.
After that, she fears me.
At worst, she reviles me.
When trust is insufficient in the matter,
There is no trust at all there.
Hesitant, I put a high value on my words.
When the work is complete and achievements in place,
They all say
"I did it myself."

When working with such a student on a topic I am intensely interested in, my challenge is to refrain from saying too much while saying enough. To keep her belief in the value of the study while not imposing what I think the conclusions should be. Then to enjoy reading her work and relish the conversations, where all good ideas eventually reside.

*（太上不知有之。其次┌而┌之。其次畏之。其次侮之。信不足焉有不信焉。悠兮其┌言。功成事遂1 百姓皆┌：「我自然」。 道德┌十七章）

Galal Walker
Professor of East Asian Languages and Literatures
Ohio State University
Advisor to Li Yu, CGS UMI award winner, 2003

A CHECKLIST FOR GOOD SUPERVISORY PRACTICE

The lack of a planned, disciplined, and well-supervised approach to research, coupled with the temptations to undertake other research activities or employment, can frustrate the timely completion of the PhD program. This publication has discussed some of the practices which, if generally adopted, should lead to greater numbers of students completing their PhDs or other advanced degrees expeditiously. The checklist below includes the main issues addressed in this document that should be considered by both supervisors and their students. They are presented in question format to facilitate structured reflection by departments, supervisors, and students.

1. Is there a departmental document easily available to students, prospective students and supervisors that describes the department's expectations on good supervisory practice?

2. Is there a published "framework" document provided and publicized to students that provides information about:

    - The anticipated length and structure of formal coursework?
    - The method of assessing this coursework and its relation to the rest of the graduate program?
    - Requirements concerning lab rotations or expected teaching sequences?
    - Expectations regarding financial awards, if any?
    - A clear description of the examination(s) for admission to candidacy that evaluate(s) the student's potential for independent work?
    - A general timetable for submission of any formal written work (progress reports, drafts of a research prospectus, etc.)?
    - An overall multi-year plan of study, including independent research, which articulates the date by which the degree should be completed?

3. What steps does the department or program take to try and make a good match between a supervisor and the prospective student take?

4. Does the student present a report during the first two years of doctoral study or earlier on any program which people other than the supervisor assess?

5. Do the supervisor and the student see each other often enough?

6. Are there regular occasions when both the student's progress and their background knowledge of the subject are assessed?

7. Are there regular department/program expectations or guidelines regarding faculty responsibilities?

8. Is the assessment procedure seen as satisfactory by both supervisor and student?

9. Are there occasions when the student has to make a public presentation and do students and supervisors find these presentations useful?

10. How is the topic of research refined in the first two years of a PhD or earlier in the course of a Master's degree?

11. When is a long-term program of research laid out and a critical path defined?

12. What mechanisms/guidelines are available to graduate students?

13. Does the supervisor periodically check the student's record keeping seeing whether it is systematic?

RESOURCES AND FURTHER READING

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Websites

The Carnegie Initiative on the Doctorate (www.carnegiefoundation.org)

Council of Graduate Schools (www.cgsnet.org)

GradShare (www.gradshare.com)

The PhD Completion Project (www.phdcompletion.org)

Preparing Future Faculty (www.preparing-faculty.org)

The Project for Scholarly Integrity (www.scholarlyintegrity.org)

The Responsive PhD (http://www.woodrow.org/responsivephd/index.php)

Re-envisioning the PhD (http://www.grad.washington.edu/envision/)

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