

ARTICLE

The Intentional Mentor: Effective Mentorship of Undergraduate Science Students

Julio J. Ramirez

Department of Psychology and Neuroscience Program, Davidson College, Davidson, NC 28035.

Promoting quality mentorship of undergraduate science students has recently emerged as an important strategy for successfully recruiting and retaining students in the sciences. Although numerous faculty members are naturally gifted mentors, most faculty are inserted into a mentorship role with little, if any, training. Successfully mentoring undergraduate science students requires a myriad of skills that can be honed with forethought and practice. In this essay, the value of mentoring, the developmental profile of young adult students, and the

traits of a good mentor are explored. The Triangular Model proposed by W. Brad Johnson provides a theoretical framework for the development of effective mentorship. Fifteen tips gleaned from the literature and the author's personal experience are provided to help improve mentoring skills of faculty working with undergraduate science students.

Key Words: Mentee; Mentor; Mentoring; Protégé; Role Model; Science Education; Undergraduate Student

Over the last twenty years, the scientific community in the United States has come to the realization that educating the next generation of scientists will require more than simply lecturing to them in classrooms and depositing them into laboratories with a to-do list. National lamentations and debates about dwindling and leaky pipelines have renewed the scientific community's commitment to ensuring that science students are well educated, properly trained, and inspired to make the great discoveries of the future. A key element that has emerged in this national dialogue is the importance of mentorship, as illustrated in the National Academies publication in 1997 of *Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*. Many studies of mentoring have since revealed that personal, one-on-one interactions with their faculty are essential ingredients in nurturing the nascent interest students might have in a scientific career. Indeed, establishing personal and enriching relationships may be particularly important for sustaining interest in scientific careers among students from underrepresented groups in the sciences. Against a backdrop of insightful theoretical efforts providing a coherent framework guiding mentoring activities, the goal of this essay is to explore approaches that have been effective in promoting healthy mentoring relationships in college.

Before we embark on this exploration, a brief digression into the origin of the term mentor might be instructive. Mentor is derived from a proper noun, the name of a character appearing in Homer's *Odyssey*. When Odysseus (aka Ulysses) was called to fight the Trojan War, he left his infant son Telemachus in the care of a wise friend, Mentor. Odysseus asked Mentor to protect and guide Telemachus during his absence, which lasted until Telemachus himself was a young man of about twenty. The goddess Athena appeared to the twenty year old Telemachus in the form of Mentor to encourage him to find his father Odysseus, who had been wandering futilely for ten years, and return him home to Ithaca. Reflecting on

this series of events, one can interpret this dual nature of Mentor, both male and female, as indicative of the integration of qualities necessary for properly providing counsel, support, wisdom, and guidance to the next generation.

ADVISING VS MENTORING

As we consider the role of the mentor, care should be taken to distinguish an academic or research adviser from a mentor. Depending on the institution, academic advisers are typically appointed to their role and students may or may not have a choice of the adviser with whom they work. Academic advisers have the responsibility of guiding their student advisees through an institution's academic program. Academic advisers should be intimately familiar with the academic rules and regulations of an institution to ensure that students are well informed about their paths to their diplomas. At the very minimum, academic advisers are checking off the boxes that reveal their advisees are making progress towards fulfilling their graduation requirements. At a deeper level, research advisers may be intensely involved in their students' research activity and may not necessarily serve their students as an academic adviser. Research advisers' responsibility is to facilitate their students' education in the research enterprise – guiding students from the formulation of research questions through design and analysis stages and finally to the interpretation of the findings as well as their integration into the greater body of knowledge providing the context for the research. Whereas academic advisers may not benefit personally from advising students, research advisers may in fact benefit tremendously from students conducting research that advances the research program of the research adviser. In a relationship between a research adviser and an advisee, reciprocity begins to emerge as a fundamental aspect of the relationship, but a deeper and enduring relationship is not a predestined outcome. The relationship may have a quid pro quo feel to it, in fact.

A mentor in contrast has a significant investment in his/her students' personal development, which extends well beyond a concern for the adequate attainment of degree requirements or the completion of a research thesis. An academic or research adviser may evolve into a mentor for a student, but the mentoring relationship becomes more clearly characterized by the intertwining of professional and personal features. The relationship is reciprocal and the development of a life-long friendship would not be unusual.

The remainder of this essay is focused on the characteristics that define a mentor, the attributes that make a mentor effective, and tips for successful mentoring. To help us form a more crystallized view of what mentoring involves, I have found the definition provided in the excellent and comprehensive book *On Being a Mentor: A Guide for Higher Education Faculty* by W. Brad Johnson at the U. S. Naval Academy to be most useful: "Mentoring is a personal and reciprocal relationship in which a more experienced (usually older) faculty member acts as a guide, role model, teacher, and sponsor of a less experienced (usually younger) student or faculty member. A mentor provides the protégé with knowledge, advice, counsel, challenge, and support in the protégé's pursuit of becoming a full member of a particular profession." The term protégé is derived from the French *protéger* meaning to protect. The Merriam-Webster Dictionary defines protégé as "one who is protected or trained or whose career is furthered by a person of experience, prominence, or influence." In recent years, the term mentee has become a popular synonym for protégé. Because mentee avoids the gender designation of protégé(e), we will use mentee in the remainder of this essay.

ADVANTAGES OF MENTORING

The investment of time and energy required from both the mentor and the mentee to establish and build a meaningful relationship raises an important question: Is it worth the effort? For some, an ineffectual, marginal, or failing mentorship would certainly not be worth the effort and indeed could be toxic for a budding scientist. The evidence gleaned from numerous studies suggests on the contrary that engagement in a mentoring relationship is fertile soil from which numerous personal and professional benefits may be harvested. Students report being happier with their chosen majors, they persist to graduation, and they achieve greater academic heights. Importantly, students report that a mentoring relationship introduced them to career paths and advanced study that they may not have otherwise contemplated pursuing. Overall, student mentees appear to attain higher levels of personal well-being, confidence, and belief in their own abilities to succeed. Objective assessments of career attainments suggest that mentorship is predictive of future distinction in a mentee's career. Faculty mentors report tremendous intrinsic satisfaction in preparing the next generation of scholars and problem-solvers. Benefits from the mentoring relationship also accrue for the mentors in external ways: trustworthy mentors attract good students and develop reputations for producing excellent students. As their

mentees graduate, excel, and become established, the professional network of mentors may expand dramatically as well. Finally, mentees who are eager to learn, experiment, and test the boundaries of knowledge are likely to motivate their mentors to remain current in their fields of expertise. Thus, for both the mentors and the mentees the rewards both intrinsically and extrinsically are numerous and ultimately appear to be well worth the effort.

DISTINCTIVE ELEMENTS OF MENTORSHIP

Although there are numerous aspects of relationships that may define a mentorship, here we will focus on several elements that are particularly salient for developing a healthy and productive mentoring relationship. In agreeing to mentor a student, the faculty member is implicitly accepting the responsibility of helping to promote the personal growth and psychosocial development of the mentee. Oftentimes, the developmental trajectory that the mentor is hoping to facilitate will involve encouraging students to move from a state of dependence, wherein they are neophytes in the scientific enterprise, to a state of independence, characterized by confidence, deep knowledge, and well-developed skills in conducting scientific work. A theme that appears frequently in the literature suggests that the full development of a mentoring relationship requires reciprocity – a thoughtful exchange of ideas, openness to personal and professional experiences, and mutual respect. In order to attain this reciprocity, the mentor must provide a safe haven for the students to explore their dreams. The mentor's task is, of course, to provide an informed sounding board for the student, but also to enable the student to think expansively about the future, to dream the big dreams. More pragmatically, as mentors stimulate the professional growth of their mentees, mentors must ensure that their students are developing a skill set that will advance their performance in the classroom, the laboratory, the field, or on the job. Perhaps of greatest importance to mentees who are first-generation college students, good mentoring requires that the mentees are properly introduced to the culture of the professional world – items ranging from punctuality to conversational style to proper dress could be arenas where mentors can help their students become accustomed to the requirements of the professional world. Of course, the Academy is not known for a plethora of black tie events (with the notable exception of Stockholm festivities), but t-shirts and jeans are likely not going to impress interviewers for entrance to a graduate program or for a job. Finally, providing career opportunities to the mentee is an essential aspect of a healthy mentorship. The opportunities appear in the form of introductions to the mentor's network, which may include job, graduate school, or fellowship prospects. Mentors who actively seek out opportunities for their mentees are likely to discover that providing their students with access to the next phase of their professional growth is exceptionally rewarding.

DEVELOPMENTAL PROFILE OF THE UNDERGRADUATE MENTEE

In 1969, Arthur Chickering in *Education and Identity*

(revised in 1993 with Linda Reisser) published a prominent model for understanding the undergraduate psyche. In the seven vector theory of identity development, Chickering suggests that young adults (specifically, undergraduate students) undergo psychological development that emphasizes developing competence, managing emotions, becoming autonomous, developing mature interpersonal relationships, establishing identity, developing purpose, and developing integrity.

A key aspect of psychological maturation that occurs between the first year of college and graduation is the development of competence. According to seven vector theory, competence may occur in three areas: intellectual, physical/manual, and interpersonal. Clearly, as science students transition from introductory courses in the sciences to the advanced courses that may ultimately lead to senior theses, they are demonstrating greater competence in the intellectual arena. Importantly, during this same time frame students may gain more refined control over their bodies. For an athlete, the control may mean developing exceptional command of a racquet or basketball; for a budding scientist, the control may mean developing exquisite manual dexterity to thread a cannula into a rat femoral artery. Undergraduate students are simultaneously developing competence in the interpersonal arena. Learning how to maneuver through interactions with others, from understanding the transactional nature of relationships to the nuances involved in effective leadership, is a significant piece of developing competence for a college student. Indeed, the importance of this interpersonal competence is emphasized in several other vectors proposed in the model, which will be discussed shortly.

The ability to manage one's emotions throughout the college years and thereafter is the second vector of the model. Clearly, the tidal experience of emotions in early adolescence has not completely subsided by college. Oftentimes the mentor may be most influential for a young adult who is in the throes of an emotional maelstrom by simply modeling how an emotionally balanced adult behaves. Occasionally, the mentor may be required to be more direct in advising about acceptable emotional behavior or to suggest seeking professional support.

The third vector in the model focuses on autonomous behavior, which involves helping a student transition from a state of dependence and constant reassurance to a state of independence and self-direction. Although it is very appropriate for a student who has just been introduced to a mentor's research program to require frequent sessions guiding the mentee in the project, a mentor's job to some extent is to become superfluous as the mentee becomes equipped to solve problems arising in the research project, though the mentee should have enough humility to know when to ask the mentor for guidance. Even as the mentee develops a sense of autonomy, it is essential that the mentor maintain regular contact to continue building and nurturing the relationship.

Developing mature interpersonal relationships is the fourth vector described in the model. Here, students are on the path of broadening their tolerance of and

appreciation for cultural differences that are encountered because of increasing diversity of the population. As American institutions of higher education become more reflective of the Nation's changing demographics, students will be immersed in a mix of social circumstances that challenge their previous interpersonal approaches and that hopefully lead to more mature interpersonal relationships.

The fifth vector in the model is a particularly salient feature of a personality theory: the establishment of a personal identity. Young adults in college have especially malleable personas; indeed, many are experimenting with the multiple facets of self that ultimately comprise who they are currently and who they are becoming. Some students may be struggling with their gender or sexual identity; a number of students from minority groups may be struggling to understand their racial or ethnic identity. As students integrate these personality elements into a coherent whole, they are deeply influenced by the role models they engage and the feedback that they receive from their role models. For many mentees, and this may be especially the case for students from underrepresented groups in the sciences and first-generation college students, the undergraduate years are crucial for helping them ascertain their place in the broader cultural or historical context that helps these students define who they are. Thus, the mentor has an important task of guiding their mentees by word and deed as the mentees struggle with the establishment of their personal identities throughout the college years.

The model's sixth vector is focused on the development of purpose in a college student's life. Not surprisingly, many undergraduate students are steeped in a search for meaning and purpose. The exploration of new ideas, ways of being in the world, and interpersonal relationships all may help students crystallize purpose in their lives. A supportive mentor may significantly facilitate this quest for purpose. As students work toward synthesizing their vocational and personal interests in the context of their family aspirations, a mentor's knowledge of professional opportunities and attitude in balancing family and work may be crucial in helping students identify and embrace a purposive life.

The seventh and final vector appearing in the model addresses the development of integrity. As students develop along the dimensions involved in the other six vectors of this model, they are also moving psychologically into a space that integrates their efforts into a coherent whole characterized by humanizing and personalizing values. The model proposes that students developing humanizing values begin to develop moral reasoning skills that are less absolutist and more relativistic in nature. Students also are simultaneously personalizing values indicating that they are affirming their core values while concurrently respecting others' opinions, though they may disagree with them. Developing integrity to a large extent is reflected in the appearance of congruence between students' personal beliefs and their overt behaviors. As Chickering and Reisser (1993) make clear in the model, the development of integrity is inchoate in young adults and will continue throughout their lifetimes. A mentor may be particularly instrumental in helping students appreciate

whether the values they espouse indeed align with the behaviors they exhibit. A mentor's personal integrity is likely to be his or her students' most important inspiration to develop integrity in their own lives.

THE INTENTIONAL MENTOR

Historically, the Academy's approach to mentoring was simply sink or swim. A student was matched with a research advisor and both were often left to their own devices as to how or whether a mentoring relationship would evolve. Although the apprenticeship model has been a part of science education for centuries, clearly articulated instruction in mentoring for faculty is a recent innovation. The approach promoted in this essay can best be described as intentional mentoring. The intentional mentor approaches a mentoring relationship with the kind of forethought and planning that would go into designing an experiment. Just as a scientist would become familiar with the nuances of a problem under investigation, the intentional mentor becomes deeply familiar with the prospective mentee. Development of the mentoring relationship is taken seriously and involves creating an atmosphere of trust, support, and openness to dreams about the future.

Research and theoretical work by W. Brad Johnson is especially instructive as we contemplate the traits characterizing a competent mentor. Johnson's "Triangular Model of Mentor Competence" proposes three fundamental dimensions that define mentoring proficiency: Virtues, Abilities, and Competencies.



Figure 1. Triangular Model of Mentor Competence. (Modified from Johnson, 2003).

As Figure 1 illustrates, virtues form the base of the triangle; these are the qualities in an individual typically regarded by society as admirable traits that suggest moral and behavioral uprightness. The model proposes that the mentor should have integrity, i.e., the mentor should act in accordance with ethical principles indicative of an honest and upfront individual. A competent mentor should also be caring, exhibiting genuine concern for the mentee, and prudent, demonstrating sound judgment and wisdom. At the base of the triangle in parentheses, I have added "patience" to the Triangular Model. Guiding young persons as they wind their way through the complexities of the academic life will require mentors to sit back patiently and allow their students to err and learn from their mistakes.

Abilities constitute three categories of assets: cognitive, emotional, and relational. As Johnson describes in his model, these assets are not necessarily trainable; they are

capacities individuals may or may not have as part of their psychological disposition. By virtue of attaining faculty status, a mentor is likely to have the intellectual skills necessary to provide a mentee with the instruction necessary to make progress in the laboratory or classroom. It is also likely that a faculty member will embrace the complexity of the problems encountered in the mentor's research and career, which will be useful as the mentor guides mentees through their efforts to attain a diploma. The command of emotional and relational elements may be less certain across prospective mentors. As role models in the position to provide counsel to college students, mentors should be well-balanced emotionally and well-adjusted psychologically. Indeed, given the vicissitudes of life, there may be times when a mentor may decide to take a respite from mentoring to regain perspective and tranquility in his or her own life. As to relational elements, the capacity to establish intimate relationships and to communicate clearly with mentees is essential for nurturing mentees. The reciprocal nature of a mentoring relationship requires openness to relate in deeply personal as well as professional ways.

According to Johnson, competencies, the third side of the triangular model, essentially comprise the fundamental skill set and knowledge that a mentor brings to the mentorship. As opposed to virtues and abilities, mentoring competencies can be readily modified and enhanced through conscious effort. Indeed, it is this aspect of the model in which the intentional mentor can make significant gains in a mentoring relationship.

The ten competencies highlighted in the model include: 1) developing an awareness of mentees' state of psychological development (e.g., as described above in Chickering's Seven Vector Theory); 2) having an understanding of the status of the mentoring relationship (e.g., whether it is just being established or is ready to progress to an amicable separation); 3) clearly articulating for the mentee the details defining the nature of the mentorship (this competency will be revisited later in this essay); 4) appreciating the three primary mentor functions offered to mentees – career guidance, psychosocial support, and role-modeling; 5) maintaining a set of boundaries in the relationship that protect the mentee from coercive behavior that may sometimes evolve from power imbalances or from overly personal involvement that may compromise professional judgment; 6) acknowledging when a mentoring relationship has become dysfunctional and implementing strategies to correct the problems or to separate amicably; 7) developing skills in cross-gender relationships, which include developing an awareness for the obstacles and concerns a mentee of the opposite gender may be confronting; 8) developing skills in cross-race or cross-ethnicity mentoring – similar to the cross-gender skill set, this competency involves developing sensitivities to cultural differences that may exist between the mentor and mentee as well as trying to understand the obstacles encountered by mentees who are members of minority groups, particularly those underrepresented in the sciences; 9) respecting mentees as autonomous young adults who are entitled to discover and create their own

paths with the mentor's support, rather than simply viewing them as the prospective clones of the mentor; 10) remaining vigilant about the benefits that the mentor can bring to the mentee thereby ensuring that mentees do indeed gain useful knowledge and skills to advance their careers.

Particularly effective mentors are likely to share four distinct approaches: an altruistic orientation, an upbeat attitude, a sense of humility, and consistency. Mentors should have an altruistic orientation in their dealings with both their mentees and colleagues. Erik Erikson (1959, 1980; Johnson, 2007) describes in his theory of psychosocial development a 7th stage of development characterized by a deep caring for the next generation, which he calls "generativity." This stage emerges between the ages of 35 and 65, a period coinciding with the establishment and flourishing of an academic's career. The intentional mentor is affirming the mentoring relationship by exhibiting empathy and concern for the mentee. It is also important to recognize that the mentor's behavior towards others serves as a model for good professional and collegial behavior, which the mentee may emulate. In many respects, the intentional mentor is an excellent cheerleader. Maintaining an upbeat and positive attitude is key in helping many a mentee through stressful times. Providing the positive regard and respect to the mentee throughout the course of the relationship will help build trust in the mentoring relationship and improve undergraduate mentees' confidence as they progress towards graduation. A healthy mentoring relationship is founded on openness and accessibility to the mentor. Having a sense of humor about one's foibles and a sense of humility may balance the power structure in the mentoring relationship so a mentee may be more relaxed with the mentor, which is important for maintaining open communication. Finally, mentors must align their behavior with their principles; in other words, a mentor's words and deeds should be congruent. Living by the expression "Do as I say, not as I do!" is a surefire way to undermine a mentoring relationship as mentees will rapidly detect hypocrisy.

CORE MENTORING GOALS

A mentor's job to a large extent is to inspire, encourage, and empower his or her students. Mentors' efforts in the classroom, the laboratory, and the field are meant to serve as springboards for mentees' own exploration of the world and to inspire them to seek answers to questions about the nature of the world around them. As they venture out to seek those answers, it is not unlikely that mentees will encounter obstacles and failures along the way. An intentional mentor recognizes that, much as a parent, the mentor needs to build an intellectual and emotional scaffold for the mentees as they lay their paths to discovery, in other words, to encourage them and to help them develop persistence in the face of intellectual adversity. A mentor inspires and encourages mentees, so they will grow in confidence and develop the scientific skills necessary to answer the questions about which they are passionate. Providing guidance that will enable mentees

to grow intellectually and emotionally as well as providing them with opportunities to develop their research and communication skills are essential to empowering a mentee. Their successes and their ability to cope with frustration and failure in the classroom or the laboratory will empower them and will assure them that they are capable young men and women, ready to venture further into uncharted scientific terrain.

THE MENTORSHIP STRUCTURE

When establishing a mentorship formally, both the mentor and mentee will benefit from having a clear set of parameters laid out to provide structure to the developing relationship. Both parties should come into the relationship with their expectations openly discussed. For the mentorship to develop fully, honesty is paramount. Both the mentor and the mentee must share their opinions openly and truthfully. Honesty is a necessary condition for developing trust, which is ultimately an essential thread in binding the fabric of the relationship. The mentor should rightfully expect that the mentee will embrace a good work ethic and show commitment to the mentorship, including showing up punctually for meetings. The mentee should be treated with respect and should be assured that the conversation held as part of the mentorship is confidential. Punctuality in attending scheduled meetings is as important for the mentee to rely on as it is for the mentor. The goals of the mentorship should be agreed on as early as possible. For an undergraduate student, these goals would include taking the necessary steps for completing research projects and to graduate, being introduced to the path to a successful career, and working towards a strong letter of recommendation based on the honest appraisal of the mentees' performance. Meetings should be regularly scheduled to develop and maintain a strong relationship. These meetings provide the forum for sharing dreams, learning how to maneuver in college and careers, and assessing the progress the mentee is making as well as the quality of the mentorship itself. Malcolm Campbell and Barbara Lom at Davidson College have a strategy for weekly e-mail contact in which the mentee is asked the following five questions: 1) How have you spent your time? 2) What do you know? 3) What don't you know? 4) How can you find out what you don't know? 5) What are your frustrations? In the event that weekly meetings are difficult to schedule, the Campbell and Lom approach at least ensures that communication with the mentee is frequent, regular, and informative. The method requires mentees to reflect on their activity and their knowledge base. The fifth question may serve as a good barometer for how mentees are doing psychologically. Finally, as in most human relationships, it is unlikely that a single mentor can adequately satisfy all the needs of mentees, thus mentees should be encouraged to develop a mentoring network wherein mentees may gather a variety of useful advice to help them progress to fruitful and enriching careers.

TIPS FOR THE INTENTIONAL MENTOR

Since the primary goal of this essay is to provide ways in which mentoring of undergraduate science students might

be enhanced, here we explore a variety of mentoring tips that have been discussed in the mentoring literature as well as from my personal experience.

Know thyself! First and foremost, take an inventory of your strengths and weaknesses as a mentor. Philip Clifford and Joan Lakoski recently published in *Science Careers* (<http://sciencecareers.sciencemag.org>) an 11-item inventory that nicely provides a snapshot of a mentor's skill set. Because these items are assessing particular skills, a mentor can conceivably attend to areas of weakness and improve upon them. A mentor should realistically determine how many mentees can be taken on and still provide the kind of attention that promotes the health and well being of the relationship. Spreading oneself too thin is neither good for the mentee nor the mentor.

Accept your position as a role model. Mentors should understand the professional standards of conduct that their professional societies as well as colleges and universities have established. These standards often include directives about the nature of the relationships between a faculty member and a student. Striking a balance between professional behavior and acceptable personal interaction is paramount so as not to threaten the health of the mentoring relationship. Mentors are bound to adhere to principles guiding responsible conduct of research to ensure the integrity of their investigative work and for the example that they are setting for their mentees.

Select mentee carefully. In choosing a mentee, the mentor would be well advised to consider the old quip: "It's not the IQ but the 'I Will' that counts." A highly motivated and hard-working mentee is likely to benefit tremendously from a mentorship, which will in turn reward the mentor for his or her investment in the mentee. A mentor would be wise to have a clear idea about whether a particular student and the mentor would work well together. A mentorship in which there may be discomfort or friction because of incompatibility will likely be ineffective. One scenario is to have a probation period in which the mentorship is explored and assessed as to its potential. Both the mentor and the mentee must be clear about the duration of the probation period and the benchmarks by which success might be measured. Although a shared gender or racial identity between the mentor and mentee may be of value, a caring, open, and inspiring mentor can be effective with mentees from a broad range of backgrounds.

Hone listening skills. In this day of calendar reminders, e-mail arrivals, text message buzzes on one's cell phone, a mentee may be easily forgotten in the middle of a mentoring session. When mentor and mentee are in a mentoring session, the mentor should be certain to attend to the needs of the student. Maintaining good eye contact and exhibiting body language conveying that one cares for the mentee is important. A seemingly disinterested mentor

will not inspire confidence in the mentee and will likely damage the development of trust in the relationship. Silencing phones, calendar, and e-mail prompts are strongly suggested for both the mentor and the mentee during the mentoring session.

Be accessible. Regular interactions with the mentee are essential to maintaining the health of the mentorship. Using e-calendars (such as those found on Google or Microsoft Outlook) are effective ways to ensure that meetings are regularly scheduled and evident to both the mentor and the mentee. Efforts to have informal interactions over coffee, lunch, and the like will help solidify the personal nature of the relationship. Often times the neutral setting of a coffee shop helps to reduce some of the nervousness that might be associated with meeting one's mentor.

Be wary of cloning! A mentor's role in the life of mentees is to facilitate their professional, intellectual, and emotional growth. Although satisfaction in a mentoring relationship may be particularly sweet when a student follows in the footsteps of the mentor, one should guard against encouraging the mentee along a path to satisfy one's own ego. Obtained through honest dialogue, a deep understanding of mentees and their dreams for the future should inform mentors' decisions in guiding their mentees as the mentees work to fulfill their dreams. Especially for college students, a mentor's role is to encourage the students to attain their goals, which may more immediately involve graduating, securing a job, or pursuing postgraduate education in whatever area has ignited their passion. This area of interest may or may not overlap with the mentor's career path. Mentors should enthusiastically support their mentees as they seek and embark on their paths to enriching and productive lives.

Stay informed. If the mentorship includes a student conducting research in one's laboratory, clearly remaining current in one's field of expertise is crucial to promoting a mentee's development as a nascent scientist. In addition, a mentor should be familiar with research or internship opportunities on- and off-campus that would enable further skill development and exposure to scientific problems for mentees (e.g., information may be found at Pathways to Science of the Institute for Broadening Participation [www.pathwaystoscience.org], at the National Science Foundation [http://www.nsf.gov/crssprgm/reu/reu_search.cfm] or at Faculty for Undergraduate Neuroscience [http://www.funfaculty.org/drupal/undergrad_internships_neuroscience]). Similarly, mentors should be familiar with graduate school and fellowship application processes as many undergraduates (particularly first generation students) have little understanding of the steps involved in attaining advanced degrees or of ways to secure funding for a graduate degree. Unfortunately, students may encounter obstacles and suffer psychological crises that mentors are not trained to help with; these conditions

underscore the importance of mentors' awareness of their institutions' counseling centers.

Socialize students to the profession. Regardless of the path that students ultimately take upon graduation, introducing students to the mores of the professional world will significantly improve their chances of succeeding in that environment. Helping mentees understand the importance of punctuality, bringing projects to fruition, submitting well-organized, well-written, and neat reports will aid a student's development as a young professional. Especially for students pursuing a scientific career, the sooner mentors can introduce their mentees to the nuts-and-bolts of manuscript preparation or making oral presentations the better. Introducing students to the hierarchical structure of professional settings (e.g., in the Academy) and the salaries they might expect upon completion of an advanced degree removes the mystery of career paths and for first generation students may help them persuade their families of the value of academic and professional pursuits.

Promote mentee among colleagues. One of the key responsibilities of an intentional mentor is to facilitate mentees' careers by networking on their behalf. For mentees who are undergraduates, the networking may be with colleagues in graduate programs who are seeking students or with colleagues who may be in need of technicians. Therefore, maintaining one's own network and making efforts to attend regional or national conferences will be important for a mentor to serve adequately as a mentee's agent. Acting on behalf of one's mentees in this capacity has the added advantage of keeping the mentor fresh in his or her career and well connected with the scientific community.

Directly train and teach the mentee. If the mentee is a member of the mentor's research team, the mentoring relationship will be significantly enhanced by direct interaction in the laboratory or field setting. Mentees benefit from direct exposure to their mentors conducting scientific work as part of a team. Role modeling and nurturing a mentoring relationship are well suited to the opportunities presented in conducting investigative work at the bench or in the field. For some students, working on projects together may be the most effective means by which to solidify a relationship.

Escalate the mentee's responsibilities over time. As the mentor works to promote the mentees' confidence, the intentional mentor gradually transitions the mentee from neophyte to expert. Particularly with undergraduates, it is important not to overwhelm the student at the outset. Allow the student to develop a sense of competence with smaller projects and then escalate the mentee's responsibilities for overseeing and executing a project as part of a mentor's research program or the mentee's independent project.

Clear expectations for performance. As mentioned above, at the outset of the mentoring relationship, the objectives for the mentorship should be clearly laid out. If the mentee is also part of the mentor's research team or is also an academic advisee, the mentor's expectations of the mentee for laboratory and classroom performance should be well defined. Setting the bar high may motivate many students to perform at levels that may surprise even them, but it is important that high standards not be equated with perfection. The pursuit of perfection may paralyze some mentees, whereas the pursuit of excellence may inspire them.

Provide honest, explicit feedback. The development of a healthy mentorship relies on the trust and honesty that is established between a mentor and a mentee. Although a mentor's job is to nurture the intellectual and psychosocial development of the mentee, this does not mean that the mentor should refrain from honestly appraising the performance of the mentee. Indeed, to do anything less than a forthright and honest appraisal would be a disservice to the mentee. Beginning these appraisals with positive comments are likely to be more effective in gaining the mentee's trust and attention than launching into a laundry list of flaws and failings. Maintaining a positive, though firm, tone throughout the discussion is likely to be most effective in promoting the growth of the mentee.

Promote time management skills. One of the most challenging aspects of entering college for many students is the management of time. For many of these students, being away from home for the first time is a liberating experience that may test their abilities to create structure in the course of their day. Mentors, through role modeling and direct conversation, may be instrumental in helping their mentees to organize their days more efficiently. Teaching mentees to use a paper or electronic calendar may be a small but very effective way of promoting their professional growth. Creating a clear schedule to attain the major goals a student has set for him- or herself is an important aspect of the mentorship. An overt set of benchmarks along the path to thesis completion or graduation, for example, will help mentees judge their progress and facilitate any course corrections along the way. Regular contact throughout the process is of course crucial to helping mentees accomplish their goals.

Offer personal support. Although this item appears last, it is by no means least. Agreeing to accept the responsibility of a mentorship is essentially a social contract in which the mentor agrees to look out for the welfare of the mentee. All the items discussed thus far reflect the nature of this contract. There may be times, however, when the needs of a mentee, psychologically or academically, may exceed what a mentor is prepared to support. A mentor should be aware of the counseling and academic support services that one's institution has to offer its students. Intentional mentors recognize that they are

part of a network of support and should never hesitate to use whatever services an institution or colleagues may offer to promote the intellectual, professional, and psychosocial development of the mentee.

FINAL REFLECTIONS

Unfortunately, the reward systems at many academic institutions have not yet incorporated mentoring as a key element in recognizing faculty contributions to the life of these institutions. In agreement with W. Brad Johnson's suggestion in 2003, as further research continues to underscore the importance of mentoring in the success of students, whether a member of the majority or minority, male or female, colleges and universities should embrace mentorship as an essential aspect of how the quality of a faculty member's contributions to an institution might be measured. Reassuringly, numerous scientific societies, such as the American Association for the Advancement of Science, the Society for Neuroscience and the Faculty for Undergraduate Neuroscience, acknowledge the importance of mentoring with awards highlighting outstanding mentoring of students. Indeed, even the White House has recognized the importance of mentoring to the intellectual life of the Nation with the 1996 creation of the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. To strengthen the scientific education of our students, colleges and universities should significantly invest in supporting programs that enhance the mentorship skills among their faculty.

In closing, mentorship is a unique gift that both the mentor and the mentee have the privilege and the joy of sharing. The hours and effort spent in nurturing a relationship with a mentee seem fleeting when the time arrives to send a mentee off to a job, graduate school, and the like. The investment often reaps much greater rewards than one could have ever anticipated. Enduring friendships, wonderful colleagues, moments of delight in reconnecting after months or years have passed are many of the unanticipated rewards that blossom in a healthy mentorship. As Winston Churchill so aptly put it "We make a living by what we get, we make a life by what we give." The life of an intentional mentor is indeed a rich one.

REFERENCES

- 2005 Awardees, Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. (2006) Mentoring for science, technology, engineering and mathematics workforce development and lifelong productivity: Success across the K through grey continuum. A White Paper.
- Allen TD, Eby LT, Poteet ML. (2004) Career benefits associated with mentoring for protégés: a meta-analysis. *J Appl Psychol* 89:127-36.
- American Association for the Advancement of Science (2011) Vision and change in undergraduate biology education: a call to action. Washington, DC: American Association for the Advancement of Science.
- BEST: Building Engineering & Science Talent. (2004) A bridge for all: higher education design principles to broaden participation in science, technology, engineering and mathematics. Retrieved from <http://www.bestworkforce.org/publications.htm>.
- Boyer Commission on Education of Undergraduates in the Research University (1998) Reinventing undergraduate education: a blueprint for America's research universities. New Jersey: Carnegie Foundation for the Advancement of Teaching.
- Campbell AM, Lom B (2006) A simple e-mail mechanism to enhance reflection, independence, and communication in young researchers. *CBE:Life Sci Ed* 5:318-322.
- Carrero-Martinez FA (2011) Rethink summer student research. *Science* 334:313.
- Chickering AW (1969) Education and identity. San Francisco, CA: Jossey-Bass.
- Chickering AW, Reisser L (1993) Education and identity. San Francisco, CA: Jossey-Bass.
- Clifford P, Lakoski J Top ten tips for mentors. Retrieved from <http://sciencecareers.sciencemag.org>, 8 October 2010.
- Council on Undergraduate Research. (2002) How to mentor undergraduate researchers. Washington, D.C.: Council on Undergraduate Research.
- Eby LT, McManus SE, Simon SA, Russell JEA (2000) The protégé's perspective regarding negative mentoring experiences: the development of a taxonomy. *J Vocat Behav* 57:1-21.
- Erikson, EH (1980) Identity and the life cycle. New York, NY: Norton (originally published in 1959).
- Gewin V (2005) Learning to mentor. *Nature* 436:436-437.
- Handelsman J, Pfund C, Lauffer SM, Pribbenow C (2005) Entering mentoring: a seminar to train a new generation of scientists. Madison, WI: Board of Regents of the University of Wisconsin System.
- Haynes L, Adams, SL, Boss JM (2008) Mentoring and networking: how to make it work. *Nat Immunol* 9:3-5.
- Johnson WB (2003) A framework for conceptualizing competence to mentor. *Ethics Behav* 13:127-151.
- Johnson WB (2007) On being a mentor: a guide for higher education faculty. New York, NY: Laurence Erlbaum Associates.
- Johnson WB, Ridley CR (2004) The elements of mentoring. New York, NY: Palgrave Macmillan.
- Kardash CM (2000) Evaluation of an undergraduate research experience: Perceptions of undergraduate interns and their faculty mentors. *J Educ Psychol* 92:191-201.
- Lopatto D. (2004) Survey of undergraduate research experiences (SURE): First findings. *CBE: Life Sci Ed* 3:270-7.
- Lee A, Dennis C, Campbell P (2007) Nature's guide for mentors. *Nature* 447:791-797.
- National Academy of Sciences (1997) Advisor, teacher, role model, friend: on being a mentor to students in science and engineering. Washington, DC: National Academy Press.
- National Academy of Sciences (2011) Expanding underrepresented minority participation: America's science and technology talent at the crossroads. Washington, DC: National Academies Press.
- Nagda BA, Gregerman SR, Jonides J, von Hippel W, Lerner JS (1998) Undergraduate student-faculty research partnerships affect student retention. *Rev Higher Ed* 22:55-72.
- National Research Council (2003) Bio 2010: Transforming undergraduate education for future research biologists. Washington, DC: National Academies Press.
- Powell K (2006) Mentoring mismatch. *Nature* 440:964-965.
- Russell SH, Hancock MP, McCullough J (2007) Benefits of undergraduate research experiences. *Science* 316:548-9.
- The Survival Skills & Ethics Program, the University of Pittsburgh, <http://www.skillsandethics.org>.
- Villarejo M, Barlow, AEL, Kogan, D, Veazey, BD, Sweeney, JK (2008) Encouraging minority undergraduates to choose science careers: career paths survey results. *CBE: Life Sci Ed* 7:394-409.

Acknowledgements

With gratitude for grant support from the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (National Science Foundation Grant No. DUE-0930153), the Howard Hughes Medical Institute (Grant No. 52005120 to Davidson College), and the National Science Foundation (Grant No. IOS-1048556). I am deeply grateful to my mentors who guided and inspired me throughout various phases of my career: Dr. Donald Stein, Dr. Oswald Steward, Dr. Gerald Schneider, Dr. Patricia Goldman-Rakic, Dr. Michael Zigmond, Dr. William Greenough, Dr. Sonal Jhaveri, Dr. Ronald Salafia, Dr. John (Jack) Boitano, Dr. Betsy Gardner, and Dr. Dorothea Braginsky.

Finally, I dedicate this work to my mother Doña Elia Rosa Cortés: De mis mentores aprendí sobre la ciencia; de mi madre, aprendí sobre la vida. Mi mayor deseo es vivir la mía tan plenamente y valerosa como mi madre vive la suya. (From my mentors, I learned about science; from my mother, I learned about life. My highest hope is to live my life as fully and as courageously as my mother lives hers.)

Address correspondence to: Dr. Julio J. Ramirez, Psychology Department and Neuroscience Program, Davidson College, Box 7017, Davidson, NC 28035. Email: juramirez@davidson.edu.