The Transition to Independent Research: Who Makes It, Who Doesn't, and Why

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The main purpose of doctoral training is "to prepare a student for a lifetime of intellectual inquiry that manifests itself in creative scholarship and research" (Council of Graduate Schools, 1977, cited in Bargar & Duncan, 1982, p. 1). Successful completion of the dissertation "marks the transition from student to independent scholar" (Council of Graduate Schools, 1995, p. 9). However, graduate faculty acknowledge that the transition from course-taker to independent scholar/researcher is hard for many students and that they cannot predict who will successfully make the transition and complete the doctorate based only on students' undergraduate records or even their performance in their first year of graduate school (Lovitts, 2001, 2003).

Many graduate students also feel unprepared to make this transition. Golde and Dore (2001) found that 35% of third-year graduate students did not believe that their graduate coursework laid a good foundation for doing independent research.[1] The percentages were significantly higher in the sciences (biological sciences, 40%; physical sciences 42%) than in other fields (social sciences 31%; humanities, 29%; other disciplines, 25%) (Golde, February 2002, personal communication). Further, numer-

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ous studies estimate that 15–25% of graduate students who advance to candidacy never complete the PhD (Benkin, 1984; Bowen & Rudenstine, 1992; Moore, 1985; Nerad & Cerny, 1991).

This article addresses two important questions about the transition to independent research: (1) What facilitates or impedes graduate students' ability to make the transition, where "impede" is defined as leaving the program without completing the dissertation, making slow progress toward the degree, or completing an undistinguished dissertation (i.e., acceptable but not high quality)?; and (2) Given doctoral education's emphasis on creative research and scholarship and the production of a dissertation that makes an original and significant contribution to knowledge (Lovitts, 2003, 2007; Tinkler & Jackson, 2000; Winter, Griffiths, & Green, 2000), what leads some students to produce distinguished research and scholarship, where distinguished is defined as high quality and original/creative/innovative? I explored these questions from two perspectives: theoretical and practical. The theoretical perspective derives primarily from theory and research on creativity. It is discussed in detail in Lovitts (2005) and is outlined briefly below. The practical perspective derives from focus group discussions with high-PhD-productive faculty on the "critical transition" and is guided by the theoretical perspective. It constitutes the body of this article.

Theoretical Perspective

Creativity is acknowledged to be a factor in the successful completion of the PhD (Enright & Gitomer, 1989). It is also inherent in and integral to graduate education because graduate education is about producing the knowledge workers who ensure the ultimate success and survival of all the major institutions of society by preserving, creating, and developing the ideas, information, and technology necessary for them to persist and advance. Indeed, the concept of creativity is frequently invoked in discussions of the goals and end products of graduate education—"the production of creative scholars" and the completion of a dissertation that makes "an original contribution to knowledge." Similarly, off-hand remarks often appear in the literature on creativity about how graduate education and dissertation research and writing exemplify the processes being discussed (e.g., Amabile, 1996; Sternberg, 1997a).

Contemporary work on creativity has focused on creativity as a social phenomenon that takes place within a social context and involves a sociocultural judgment of the novelty, appropriateness, quality, and importance of a product (Amabile, 1996; Csikszentmihaly, 1996; Sternberg, 1997a; Sternberg & Lubart, 1995). According to Sternberg and Lubart

(1995) and Amabile (1996), three components comprised of six personal and social resources are needed for creative work: domain-relevant skills (intelligence and knowledge); creativity relevant processes (thinking styles and personality); and task motivation (motivation and environment). (More will be said about these resources in the following sections.) Lovitts (2005) contends that these same resources also contribute to degree completion. According to the model depicted in Figure 1, different completion and creative performance outcomes (center ring) are influenced by five individual resources that students bring to and develop during their graduate education (second ring). These resources are embedded in, interact with, and are influenced by factors in the microenvironment (third ring), which are in turn embedded in, interact with, and influenced by factors in the macroenvironment (fourth ring).

The details about the resources for creativity and degree completion outlined above structure and guide the analysis of responses from faculty who participated in focus groups about the transition to independent research. This analysis is presented in the Practical Perspective section. Before turning to that section, I discuss the study's methods.

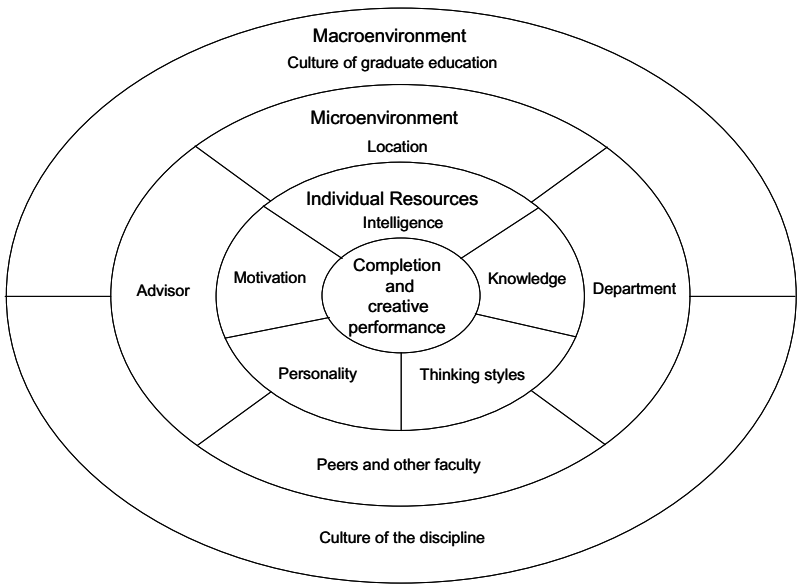

FIG. 1. A model of factors influencing degree completion and creative performance

Methods

The practical perspective on the critical transition was obtained through a series of hour-long, tape-recorded, department-based focus groups with faculty from seven departments (sciences: biology, engineering/electrical and computer engineering, physics/physics and astronomy; social sciences: economics, psychology; and humanities: English, history) at each of two Doctoral/Research Extensive universities, one public, one private. Both universities were ranked among the 25 most educationally effective research universities in the United States (National Research Council, 1994). All of the targeted programs were ranked in the top 50.

The faculty who participated in the focus groups were high-PhD-productive faculty. For the purpose of the focus groups, they were defined as faculty who had advised many doctoral students and who had sat on many dissertation committees both inside and outside the department. The director of graduate study in each department at the public university (hereafter Public University) provided me with a list of eligible faculty. I contacted these faculty via e-mail and invited them to participate in a focus group. The department chairs or a staff member designated by the chair coordinated the focus groups at the private university (hereafter Private University). Six of these chairs participated in their department's focus group. In all, 55 faculty participated in the focus groups: Five focus groups had five participants, four had four, four had three, and one had two.

Three focus groups were conducted in fall 2002; 11 were conducted in fall 2003. Prior to the start of the focus group session, the faculty were asked to provide the some background information: number of years they had been a professor (all faculty appointments), number of dissertations they had advised, and number of dissertation committees on which they had served both inside and outside the department. Many faculty did not know exactly how many dissertations they had advised, and most did not know on how many dissertation committees they had served. Consequently, they were asked to estimate. When the faculty provided a range (e.g., 25–30), the average of that range rounded to the nearest whole number was used. Overall, the average focus group participant had been a professor for 25 years, had advised 15 dissertations, and had served on 36 dissertation committees. It should be noted that Lovitts (2001) found that high-PhD-productive faculty have different attitudes and beliefs about graduate students and graduate education and interact with graduate students differently than their low-PhD-productive counterparts. Consequently, the comments of the focus group faculty do not necessarily reflect the attitudes, opinions, and experiences of all faculty.

During the focus groups, the faculty were asked a variety of questions related to the transition to independent research, including factors that facilitate or impede the transition. In particular, they were asked to talk about a student or students who had difficulty making the transition to independent research or who did not make it at all and to address why it was hard for those students. The focus group faculty were also asked to talk about a student or students who made the transition to independent research with relative ease.

When the focus group tapes were transcribed, no effort was made to link respondents individually with their responses. Thus, while each participant's utterances were transcribed separately, the identity of the speaker is not recoverable from the transcript, nor is the speaker's gender. Consequently, because the majority (41) of the focus groups participants were male, the respondent will be referred to as "he," unless I remembered the gender of the person being quoted or checked the tape. On the few occasions where a focus group dialogue is presented in the text below, the speakers are given pseudonyms to make the dialogue easier to read.

Transcripts of the focus group discussions were edited so that all potentially identifying information such as names, locations, specialty areas, and the like was altered, taken to a higher level of generality, or deleted entirely. Finally, for the sake of readability, common but distracting components of speech such as "ah," "um," "you know," "I mean," "I think," and "sort of" were deleted from the quotations that appear in the text unless they were particularly meaningful. False sentence starts were also frequently deleted, as was the word "and" when it linked sentences, as it often does in spoken language. In most instances, ellipses are not used to indicate these deletions.

The edited transcripts were coded by question or relevance of the response to a particular question and entered into N6, a qualitative data analysis software program. The data were then sorted by question and discipline and indexed to corresponding nodes. After each node report was printed, the data were further reduced through a winnowing process, so that only essential information related to the question remained and categories and patterns could emerge.

Between the time the first three focus groups were conducted in fall 2002 and the time I started to conduct the remaining 11 in fall 2003, I had developed a theoretical perspective on the transition to independent research (Lovitts, 2005), which, as noted earlier, derives from Sternberg and Lubart's (1995) and Amabile's (1996) work on creativity. The correspondence between the six personal and social resources needed for creative work and the focus group faculty's descriptions of students who

made the transition to independent research with relative ease and of those who had difficulty with the transition or did not make it at all was so striking that I used this framework to analyze the data pertaining to these focus group questions. Using *in vivo* coding, I sent those data to relevant nodes created for each of the six theoretical constructs and their subconstructs. The node reports for the theoretical constructs and subconstructs underwent further reduction and winnowing until only essential information remained and patterns emerged.

Practical Perspective

This section presents the results of the focus group discussions on the transition to independent research. It is organized by each of the six major theoretical constructs and their subconstructs: intelligence (analytical, practical, creative), knowledge (formal and informal), thinking styles, personality (various traits), motivation (intrinsic and extrinsic), environment (macro, micro). These constructs will be defined in greater detail in the sections in which they are discussed. Focus group participants' comments are presented by disciplinary affiliation. Although disciplinary differences are highlighted, where relevant, in most instances the comments made by faculty across disciplines were very similar.

Intelligence

Intelligence is necessary for participating in advanced education and for producing creative work because of its role in acquiring subject matter knowledge and skills and using them heuristically in one's work. Theories of intelligence (Gardner, 1983; Sternberg, 1985, 1988, 1997a; Sternberg & Lubart, 1995) contend that people have multiple types of intelligence. According to Sternberg's theory of triarchic or successful intelligence, individuals have three types of intelligence—analytical, creative, and practical—that they draw on in different degrees at different times in different situations.

Analytical Intelligence. Analytical intelligence is the ability to recognize and solve problems, judge the quality of ideas, and then allocate resources to address the problem or develop the idea. Analytical intelligence is necessary for acquiring subject matter knowledge and skills and performing well in coursework. Indeed, it is the type of intelligence that educational institutions recognize when they designate someone as bright and that gatekeeping admissions tests to higher education such as the GRE measure (Sternberg, 1997a; Sternberg & Lubart, 1995).

In describing students who made the transition to independent research with relative ease, the faculty made few remarks about analytical

intelligence other than to note that students need sufficient intelligence to acquire the tools of the trade. For instance, a biologist said, "You don't need to be the brightest person on the planet, but you need to be smart enough to put things together." Similarly, the economists at Private University said that economics was not a particularly difficult subject to master: "You need analytic ability, which means to organize your thoughts. You need tools like mathematics." The economists went on to discuss a study of factors that predicted the quality of the dissertation, which their department had done some years earlier. The factor that ruled the largest was the quantitative GRE score. However, they noted that its influence was not overwhelmingly significant—it accounted for a very small proportion of the variance.

According to the focus group participants, students who had difficulty with the transition to independent research were not lacking in analytical intelligence. They were typically described as being very bright in conventional terms—that is, people who had high IQs, who were "gung-ho" undergraduates, who had straight-A averages in college and in graduate school, and who were overachievers in coursework. But, as one biologist noted, "Someone who is used to getting an A in a course, which . . . is basically doing everything you are told to do, may be a little less able to assess what do I need to know when no one is telling them what to do."

Students who did not make the transition at all were described as not being that bright, as being the ones who fail in coursework or who cannot pass their qualifying exams. One engineer who had a nativist view of intelligence said that "some students are very dumb, very stupid." He defined "stupid" as being incapable of engaging in logical or analogical thinking.

Practical Intelligence. Sternberg (1997a; Sternberg & Lubart, 1995) defines practical intelligence as the ability to solve problems and use ideas and their analyses in effective ways, present them effectively to an audience, and react properly to criticism so that the ideas gain acceptance. By contrast, the focus group participants' discussion of practical intelligence had a more everyday connotation. It focused more on simple common sense and having a pragmatic, independent approach to one's work.

Students who make the transition to independent research with ease possess a high degree of practical intelligence. They were described as people who are very efficient, who can work to task, and who set and meet goals and standards for themselves. The physicists described them as students who are meticulous, who can figure out problems, who document and break down their work, and who spot their own mistakes. One physicist gave an example of a colleague whose undergraduate

and graduate records were not distinguished but who has done very well in his career because he had a lot of practical intelligence:

> This person has done very well because he is an operator. He is not a brilliant person. He arranges in this, and arranges in that, and he gets big support from here and there. All these entrepreneurial characteristics, which can be very important, aren't measured by the coursework.

The economists noted that students who transitioned easily had to "understand something about the real world," whereas the historians noted that students who did well were adept at finding things in documents and archives that others had missed. They gave an example of a student who is

> not just engaged with those previous books or a previous historiography. . . . So he's in a big conversation and he knows that. He's not afraid of that conversation. In a sense he's the perfect student because he's not afraid of it, but he also has very specific documents that he's going to work with. He knows exactly what the documents are. He has already done a lot of the analysis of the documents. So he is both very practical in his approach and very ambitious in his approach, a perfect combination.

Students who had difficulty making the transition to independent research were often described as lacking in practical intelligence—that is, as people who cannot or will not think or work or make decisions on their own. They were described as being very dependent, as students who "knock on your door every week because they need some direction," who say, "I can't make progress on my dissertation unless I talk to you for an hour." When given a task or a goal, they do not know what to do. They cannot figure out the next step and are unwilling to "play around" and try things. Rather, these students prefer to "be given each and every step." While some may ultimately complete their dissertations, they "never do really strong independent research."

Respondents gave the following examples of analytically intelligent students in laboratory-based disciplines who lacked practical intelligence:

> *Psychology*: One [student] . . . came here with outstanding theories and grades. Got an NSF predoctoral fellowship, but could not problem solve, so . . . practical things in the lab were a constant barrier. And to everyone's frustration, she seemed so promising, but she never got the data, and, ultimately, other people had to solve her problems for her. She did finish, but it was a struggle.
>
> *Biology*: She got into the lab work and a project and realized, "Oh my God, I have to work on this by myself and I don't know exactly what I'm supposed to do." She hated it. She was really good if you said, "Do A, B, and C." She would do it. But if you asked her, "What do you suppose follows 'A'?" She hated it. And she dropped out.

The historians described two opposite practical intelligence problems common among graduate students in their discipline. One is students who have a very grand concept of what they want to do but no notion of how to implement it. They do not know what the documentation is going to be or how they are going to get data. The other is students who become absolutely immersed in the data but cannot get anything out of them.

Creative Intelligence. Creative intelligence is the ability to formulate good problems and good ideas (Sternberg, 1997a; Sternberg & Lubart, 1995). It involves insight and imagination, and this is what the independent stage of doctoral education is about.

In describing students who made the transition with relative ease, the focus group faculty distinguished between students who had "pure intellectually ability," who learned course material easily and could spit it back knowledgeably, and those who exhibited creative ability. The latter were described as having "this intangible creativity," as being "idea generators, idea factories" and as having "ideas all over the place." They are students who enjoy the contest of ideas and who get emotionally and intellectually involved in seminars, debates, and the discussion of any subject. They are interested in answering questions, willing to be critical, willing think about what they hear or read, and willing to look at problems in different ways. They also actively seek feedback on their ideas, can distinguish between good and bad ideas, and can roll with the punches and pick another question when they "hit the wall." The faculty indicated that the ability to find ideas on one's own was a "very powerful predictor" not just of a quality dissertation but of future ability to produce research. An economist gave an example of a student with average analytical intelligence and high creative intelligence. The student had done "okay" but "nothing special" in his coursework. Then one day he walked into the economist's office and said, "You know . . . I think [this concept I taught him] can solve this problem in international economics." The economist did not "even know this thing that was a puzzle with international economics existed," and the international economics people "didn't know much about [this concept]." He observed:

> So, to some extent, I think it's about, What is the idea? There were two ideas, but one was [this concept], one was a particular way of thinking about [another concept]. And rather than conceiving of [this concept] as this mathematical formula that people had to learn in this class . . . —he wasn't that good at learning mathematical formulas, so he did okay on the coursework—but he understood the ideas and he was able to put them together.

By contrast, students who have difficulty with the transition to independent research often do not know what an interesting question or

idea is, and they have a hard time conceptualizing a problem for their dissertations. One biologist said, "The tough part is getting students from doing what they're told to being able to come up with their own questions." An economist expressed amazement "at the inability of students to know what's a good idea and to know what's not."

The economics faculty at both universities engaged in the most extensive discussion of the issue. Smith and Keynes are at Private University, Friedman is at Public University:

> *Smith*: I think there is something to what I'm going to call "creative instincts." I think we do see students who do very well in their coursework, all A's. . . . really struggle to come up with an idea for a dissertation. They just have trouble going beyond what they mean and figuring out. . . .
>
> *Keynes*: There are people who can do very well in the classes and just don't seem be able to come up with any ideas. . . . There's a noticeable difference among some students. They have the ability to learn material and spit it back in exams or whatever, but the ability to actually find an idea, a little problem. . . .
>
> *Friedman*: There are basic reasons like they're not creative or they don't have the energy to be creative. . . . They don't know what's an interesting question; they don't know what's an interesting way to attack the question.

Knowledge

Knowledge (formal and informal) is a prerequisite for making an original contribution. Possessing a large store of formal knowledge is necessary but not sufficient for making an original contribution; possessing informal knowledge about the system (the domain, the field, and their interaction) is thought to be equally, if not more, important (Sternberg & Lubart, 1995). Indeed, there is consensus among Nobel laureates—"the scientific elite"—that the least important aspect of their scientific training was acquiring formal knowledge from their advisors (Zuckerman, 1977).

Formal Knowledge. The coursework stage of graduate education focuses on the acquisition of formal knowledge and domain-relevant skills—facts, principles, concepts, theories, paradigms, attitudes, and opinions toward various issues in the domain; techniques and methods of solving problems; and aesthetic criteria for judging others' contributions (Amabile, 1988, 1996; Sternberg & Lubart, 1995). Graduate students are required to demonstrate that they have acquired a broad and deep knowledge of the domain on qualifying or comprehensive exams before being admitted to the dissertation or independent stage of their education. Yet, passing these exams does not guarantee that graduate students have a sophisticated or deep understanding of the knowledge base of their discipline or specialty area(s) (Bargar & Duncan, 1982). They are not yet experts.

The literature on expert/novice differences shows not only that experts have a larger store of knowledge than novices but also that their knowledge is organized differently (Sternberg, 1985, and references contained therein). Experts store knowledge in wide categories according to general principles and approach problems with general performance scripts, whereas novices store knowledge as specific, narrowly applicable collections of facts and approach problems with specific response algorithms (Amabile, 1988, 1996). Indeed, a consistent finding in the expert/novice and creativity literatures is that it takes at least 10 years to move from novice to expert in any domain (Feldman, 1999) and to develop the technical expertise necessary to make a creative contribution (Policastro & Gardner, 1999), roughly the number of years students devote to undergraduate and graduate study of their discipline.

Formal knowledge came up in only two focus groups (biology and engineering) and only in response to the question about students who have difficulty with the transition. The comments suggest that these students' knowledge bases are not yet organized in the same way as those of experts. The engineers discussed formal knowledge in terms of possessing a global perspective and noted the frustration that surrounds its development.

> *Marconi*: I think another thing is that people have to maintain knowledge and maintain a global perspective of an area. Students take courses. They get their A, and then they may forget it the next week or something like that. Even as I'm teaching my graduate class right now, people have forgotten what they learned the semester before, which is very surprising to me. . . . [O]ne of the key aspects is you can't forget it. It has to be with you. You have to maintain this global perspective because . . . you have to be able to put it together with the other intuitive things.

> *Sarnoff*: Let me comment on this global perspective. . . . The little speech I give my students is that you're going to come in here and you're not going to understand anything. *And* you're going to have no perspective. And you're not going to understand how it comes together. But hang around. Work on stuff. Work on various projects. Hang around the students, talk to me, and at some point all these disparate little components are going to gel. They're all going to crystallize. And it's going to happen over a pretty short time. . . . There is a period where the real meaning isn't absolutely clear. So I tell them right up front, "You are going to be frustrated. Take it on faith from me that there is going to be a point down the line where all of these things . . . have meaning. And at that point you can really call yourself a researcher . . . [be]cause then you know better what a correct move and an incorrect move is in pursuing a research objective. You['ve] now attached your intuition to a broader perspective." And that's very empowering when you're deciding on a research direction.

In the biology focus group, formal knowledge was implicated in students' difficulties in coming up with their own research questions. The

faculty located the problem in the need "to know the entire field," about which they commented, "The literature is huge and it's nebulous."

Informal Knowledge. Informal knowledge is tacit knowledge that is "caught" (inferred) rather than "taught." Unlike formal knowledge, which draws on analytical intelligence and is about *knowing that*, informal knowledge draws on practical intelligence and is about *knowing how*. It is procedural in nature and it helps people achieve the goals they value (Sternberg & Lubart, 1995). Studies of the difference between more and less creative scientists (Kasperson, 1978, cited in Sternberg & Lubart, 1995) show that more creative scientists rely more on informal sources of knowledge than less creative scientists. While both groups read books and journal articles, the more creative scientists place greater emphasis on talking to and interacting with people at conventions, professional meetings, and in scientific societies. They are also more likely to talk to people in fields other than their own.

Students who make the transition with relative ease possess or are good at acquiring informal knowledge about doing research and about being an academic or professional in the discipline. In some cases, those who enter graduate school with a lot of informal knowledge are children of academics. More commonly, they acquire knowledge of the academic profession through a process of tacit socialization by doing research as undergraduates and working in an environment with graduate students, so, as a psychologist said, they knew "what they were getting into and what was expected. . . . [T]hey didn't have to figure that out their first year." Others acquire informal knowledge though participation in a "predoc" program or from preprofessional work between college and graduate school. According to a historian, these students "really hit the ground running." They "know exactly what to expect. They know how to work on their own. And they come here and this is just a passing phase."

Students who come from small colleges where faculty are not actively engaged in research were said to have greater difficulty with the transition. Unlike students who come from research-oriented institutions, who have had opportunity to see "from day one, grad students and postdocs and faculty struggling to be academics," students from small colleges are less "apt to understand the differences in the culture." When students from small colleges who have "never even seen the model . . . arrive [at research universities], they're completely shocked."

Students who engage in a lot of informal knowledge acquisition behaviors are particularly successful. For example, an economist said:

> We had one student who did very well as a graduate student. She was very energetic when faculty members were coming around. We have a weekly

> seminar series in a bunch of different fields, so the place is populated by visitors. She would always want to talk with other people [be]cause she was trying to get ideas and trying to get feedback and trying to sharpen her skills. She was energetic at finding out information about her work and things that are going to improve her work, and so she was seeking that out.

Thinking Styles

Thinking styles are how one capitalizes on and directs one's intelligence(s). In contrast to ability or intelligence, which signify how well a person can do something, thinking styles signify how a person prefers to use the abilities he or she has (Sternberg, 1997b; Sternberg & Lubart, 1995). For instance, some people prefer to come up with new ideas and initiatives (creative/legislative style), some prefer to execute and implement ideas (executive style), while others prefer to judge or evaluate ideas (judicial style) (Sternberg, 1997b). Different thinking styles may predominate in different disciplines, though people with all three styles can be found within each discipline.

Because people with different thinking styles like to use their abilities in different ways, people with different thinking styles will do better on some tasks or in some situations or environments than in others. When a person's thinking styles match well with those required for successful performance on a task or in the environment or setting they are in, they thrive; when they do not match well, they suffer (Sternberg & Lubart, 1995). This helps explain why two graduate students of equal intellectual ability may perform so differently in the dependent (coursework) and independent (research) stages of graduate education.

Faculty in four focus groups across the disciplinary spectrum made remarks that suggest that the difficulty some students have with the transition to independent research is related to their thinking styles: They do not think in a way that is congruent with the tasks of independent research or becoming a professional in their discipline. A few comments illustrate the point:

> *Psychology*: In another area they might have been fine . . . they don't have that turn of mind.
>
> *Economics*: [T]he most difficult transition is to go from a consumer to a producer [of knowledge], and some people just don't have the capacity to think in that manner. . . . [S]ome people's minds are just not wired for that.
>
> *History*: [T]here are some students . . . [whose] brains just may not function in a way that allows. . . . they may be a great someone else, but not a great historian. . . . I really do think that there are wrinkles in your brain that allow you to do some things but not others.

A physics professor provided an example of an experimental student who was not doing well in laboratory work and who "wound up doing

what's usually viewed as much harder—theory—very well." He commented, "There are really different sets of skills for different fields." These "skills" may also be defined as styles of thought.

Personality

While no particular set of personality traits or characteristics is essential for making an original contribution (Csikszentmihalyi, 1996) and completing the PhD, certain traits are associated with creative performance and degree completion. The following set of characteristics show up frequently in summaries of empirical research on traits of creative people (Amabile, 1996; Sternberg & Lubart, 1995): high degree of self-discipline in matters concerning work, ability to delay gratification, perseverance in the face of frustration, independence of judgment, tolerance of ambiguity, a willingness to take risks, and a high level of self-initiated task-oriented striving for excellence. In addition, the traits of persistence, curiosity, energy, and intellectual honesty are characteristics that have been found in people who are good problem solvers (Amabile, 1988).

Five personality traits came out in discussions of students who made the transition with relative ease: patience, willingness to work hard, initiative, persistence, and intellectual curiosity; and five came out in discussions of students who had difficulty with the transition: willingness to work hard, ability to deal with frustration, fear of failure, tolerance of ambiguity, and ability to delay gratification.

Patience and Willingness to Work Hard. In the case of students who made the transition with relative ease, patience and a willingness to work hard were noted without discussion. By contrast, students who had difficulty with the transition either did not work hard enough or were unwilling to work hard. One engineer provided an example of a student who took longer to complete his degree than most of his other students because of his "9-to-5" approach to his research. This engineer noted that a 9-to-5 approach to research is problematic because research is "something you have to be thinking about all the time, so that you can have some inspiration, so that you try different things."

Initiative and Persistence. Initiative was characterized as being proactive, a bit aggressive, and self-motivated and having a desire to be involved. Persistence was associated with "stick-to-it-ness." Indeed, one economist said, "[I]f the question is what characteristics lead a student to finish a dissertation, that's a rather different question from what characteristics lead a student to become a productive scholar with good research subsequent[ly]. You certainly need persistence to do the former, but you need creativity as well as persistence to do the latter."

Intellectual Curiosity. Intellectual curiosity was identified as the single most important characteristic for ease in the transition and for high-quality performance. It was defined concretely as "intrinsic interest," having an "active, engaged mind," and being "interested" and "open to new ideas." It exhibited itself abstractly as "a fire," "a spark," and "a light in the eye." The essence of the meaning of intellectual curiosity is best captured in the following exchange between two biologists:

> *Darwin*: What is infallible, I think, and you don't often see it, is a demonstration of their intellectual curiosity. This is something that fascinates them.
>
> *Huxley*: That's it!
>
> *Darwin*: This is something that they would do not matter what.
>
> *Huxley*: Freely.
>
> *Darwin*: For no pay. This is fun!
>
> *Huxley*: Yep!
>
> *Darwin*: . . . [I]f they . . . hear a seminar that excites them, they have to go up and talk to the person afterwards. That, to me, that person needs to be in graduate school. And undoubtedly they will do well because that's what it's really about.
>
> *Huxley*: That's really a good point. That's something that we should have on our evaluation sheet [for admission to the program]. *Intellectual curiosity!* It's more important than research experience because people can go [work in a lab], but what does that tell you? But intellectual curiosity is the essence of being a successful graduate student, and if they have that, then the next thing is persistence.

Traits Associated with Difficulty in Making the Transition to Independent Research. In their discussions of students who had difficulty with the transition, the ability to deal with frustration, fear of failure, tolerance of ambiguity, and ability to delay gratification were closely related to each other. The discussion of these traits focused more on situations that called for them to be exhibited than on students' personalities per se.

The science and social science faculty noted that one of the most important things about empirical research is that it is frustrating: "Most of the time you fail." They provided numerous examples of students who encountered failure in one form or another for the first time or who became paralyzed by the fear of failure. The following exchange in an engineering focus group is particularly noteworthy because it reinforces the situational, "learned" aspect of this problem and just how different the requirements of the independent phase of doctoral education are from the coursework phase of graduate education and from undergraduate education.

> *Marconi*: That's an important point about the transition that students have to make. In their coursework they are often given assignments to do a problem, where it's a closed problem. You know that there's an answer and it's just a matter of figuring out what that answer is. And you know that it can't take too long otherwise it wouldn't have been assigned to you.
>
> *Sarnoff*: And if you read the right paragraph of the right section it will tell you how to solve the problem.
>
> *Marconi*: Research, like David said, most of the time you fail. You think you're going to do something and it doesn't work. So, then, you have to figure [out], what else can I do? And that's a completely different talent than what is taught in schools all over the world, I suspect, because I certainly haven't noticed that our foreign students are any better at making this adaptation than domestic students.

The economics and psychology faculty provided examples of students whose fear of failure or quest for perfection inhibited their ability to make progress.

> *Economics*: The research process is essentially a series of decisions. . . . All [students] are most familiar with working with data, and you always have to make decisions. How do you deal with this? or How do you deal with this observation? How do you select a sample? The shear number of decisions is relatively high and some students are just paralyzed by that many decisions. They're afraid to make a decision because they don't like to be wrong, and, as a result, they don't make any. . . . I've seen that with a number of students. They just turn things over in their head. . . . They're so unsure of themselves or [unsure] that they're doing the right thing that they're not moving forward. They're just really spinning in their tracks.
>
> *Psychology*: I cosupervised a student . . . who was really spectacular in the lab and was very clever, but he just couldn't design the perfect experiment. And because he couldn't design the perfect experiment, he was never willing to run the imperfect experiment, and he ended up leaving our program.

Indeed, Sternberg notes that "In hundreds of ways in the course of their schooling [students] learn that it's not all right to make mistakes. As a result, they become afraid to err and thus to risk the kind of independent, if sometimes flawed, thinking that can lead to the development of creative intelligence" (1997a, p. 202).

Like the sciences and social sciences where students must repeat and revise experiments that fail or revise and rerun problematic computer programs and datasets, doctoral students in English and other humanities disciplines have to take their product—essays—through multiple drafts and be able to handle the frustration of being told that a draft they thought was done needed to be reconceptualized and revised again.

The discussion about the formation of a global perspective in the formal knowledge section is also a discussion about the ambiguity of

research, the need to tolerate that ambiguity, and how frustrating ambiguity is. One engineer highlighted the importance of academic integration with peers and one's advisor for seeing the big picture and for overcoming the frustration that is inherent in ambiguous situations and in situations where one "fails" repeatedly.

> You're talking about a period of frustration which can last about a year or more. It's very important during that time that there is interaction. I think that advisors or other students, somebody that they can interact with very regularly [is very important], because there are a lot of little frustrating things. . . . I found some students who are ready to drop out of our PhD program because they were getting nowhere. In those cases, when I became their advisor and spent [a] significant amount of time helping them get over the threshold or assigned them to somebody else who spent time, [saw] them on a daily basis, after a few months you could see, all of a sudden, they regained self-confidence and became fairly good researchers. But there is a period of frustration. You need to go through a period of frustration. But also you have to be able to get that information and someone has to hold their hand and help them get over that period**.**

In all fields, doing research and writing a dissertation involves an element of delayed gratification, as dissertations take months, often years, to complete. The pats on the back and other forms of positive reinforcement are few and far between. A physicist embeds the problem of delayed gratification in the differences between undergraduate and graduate education and the field's failure to provide students with a realistic view of the nature of research until they are well into their graduate programs:

> One other thing that happens in physics, and I suspect that happens in other disciplines as well, but maybe physics is worse than most, what we do with undergraduates is very different, really different than what we do with research characteristically. So there is a certain element of delayed gratification. "Now we really, really are going to do physics." A lot of students come in with a very unrealistic view of what doing physics is like. In the back of their mind, some of them [think] they are going to be Einstein. They are going to sit in their office for maybe twenty minutes and say "Ah, eureka!" . . . and then they are going to write something down and they will win a Nobel Prize. . . . Then they come in and somebody says, "I'd like you to evaluate these fifty Feynman diagrams and sum them together to get this one percent correction for something that we already know." It's not that romantic vision that they somehow held in mind. This is just a mismatch between that somewhat unformed but basically romantic view of science and the rather pedestrian thing that we spend most of the time doing. I think that kills off some people.

Indeed, another physicist said, "We spend most of the time stuck. This is true in the lab and it's true doing theory. I want to solve this equation,

and you try this and it doesn't work. You try that [and] it doesn't work. You can easily spend on some projects, ninety-five percent of your time in fruitless activity."

Self-esteem and Self-confidence. In addition to the characteristics and traits most commonly found in the literature on creativity and problem solving, the faculty indicated that students who lacked or lost self-esteem and self-confidence also had difficulty making the transition. As suggested above, loss of self-esteem and self-confidence is sometimes a function of being in an ambiguous situation or experiencing a series of failures. The faculty also noted that students who were sensitive to criticism had difficulty with the transition.

What is perhaps most interesting about the above discussion of characteristics and traits is the general absence of personality-related remarks from the English and history faculty. This may be because humanities students do not encounter the same daily frustrations and failures as science and social science students, or it may be because during the independent stage humanities students are more likely to work in isolation and, consequently, their advisors do not see the daily struggles. Another thing that is interesting about the above discussion is the science faculty's remarks about students' lack of understanding of the nature of research and how frustrating they find research. Yet, in response to another focus group question, the science and engineering faculty said that they only admit students to their graduate programs who have had prior research experience (Lovitts, 2003). Clearly, something is very different about the nature of the two research experiences.

Motivation

Motivation—the nature and strength of a person's desire to engage in an activity (Sternberg & Lubart, 1995)—is a key factor that mediates between what a person *can* do and what a person *will* do (Amabile, 1996). Not only can it spell the difference between more and less successful creative performance (Amabile, 1988, 1996), but it can also spell the difference between doctoral degree completion and noncompletion. While most doctoral students have the ability to complete their degrees and make even the most modest contribution to knowledge, their motivation during the independent stage—in particular, their interest in and enthusiasm for their research topics/problems—is an important determinant of whether they will actually finish their research and their dissertations and of the nature and quality of the contribution they make.

Researchers who study motivation typically distinguish between two types of motivation: intrinsic and extrinsic. Intrinsic motivation derives from the task itself and a person's positive reaction to or enjoyment of

the task. It is commonly experienced or expressed as interest, involvement, curiosity, or satisfaction (Amabile, 1996). When intrinsic motivation is high, people will spend more time and energy exploring different aspects of a problem and acquiring more knowledge and information that may be relevant to it. A high level of intrinsic motivation also makes people more willing to take risks and notice aspects of the task or problem that may not otherwise be obvious.

Extrinsic motivation derives from sources outside the task itself, such as grades and other forms of expected evaluation, contracted-for rewards like money or gifts, external directives, and other factors not inherent in the task itself (Amabile, 1996). Numerous studies have shown that extrinsic motivation undermines intrinsic motivation and creativity, in part because extrinsic motivators cause people to focus on the goal/reward rather than on the task itself. Consequently, extrinsically motivated people tend to take the fastest, shortest route to the goal so that they can receive the reward, whereas creative performance is typically time intensive and its own reward; the task and the goal are one (Sternberg & Lubart, 1995).

The faculty's remarks are about intrinsic motivation and fall into two distinct categories. The first category is motivation for the PhD. The faculty felt that completing the PhD was a "matter of drive," of having "an irrational desire to get your PhD," "a hunger," "a fire." An engineer felt that the source of motivation was self-motivation: "you have to motivate yourself" in order "to spend enough time doing research for [the PhD]." One group of economists provided an example of how motivation for the PhD can sustain students through any difficulty they may be having and lead to completion:

> *Veblen*: Some people . . . really, really want a PhD. We advised one student a couple of years ago. She was really, really driven. She was very focused and she had a really difficult time moving from student to researcher.
>
> *Macaulay*: They had a lot of discussions about whether or not she should be getting a PhD in economics.
>
> *Veblen*: But this was her goal and this is what she wanted to do, and so she worked hard at it. . . . A lot of the time it's just this [being] willing to sort of . . .
>
> *Cairnes*: Stick it out. It has to be . . .
>
> *Macaulay*: . . . And it's the students who . . . aren't driven [who don't complete].

The second category is about students' interest in or enthusiasm for the field or their research project. According to one English professor, "what gets people through is passion. You just really have got to have a passionate commitment to the work, to your project, to finding a project

that you feel really passionate about. . . . [I]f you don't love it, it won't get done." Indeed, students who do not have a strong interest in ideas or in their project not only have a harder time with the transition but also produce lesser quality dissertations. This lack of interest is often attributable to having been assigned a research topic or project:

> *Economics*: There are lots of people who can do math and understand the engineering formulas and learn all sorts of techniques, but if they don't have any kind of fundamental interest in the contest of ideas and persuading people of one viewpoint or another, they tend to not produce very inspired research.
>
> *History*: I will not [assign topics]. I learned this when I first came here from watching one of my colleagues who always assigned topics. All of these people always produced these really incredibly boring papers. I began instantly to say, "That's a requirement. You have to work out your own topic." So I'll help them define it, but they're the ones who have got to live with it. They're the ones who've got to be enthusiastic about it.

Environment

The environment can be divided into two components, a macroenvironment and a microenvironment. The macroenvironment is the larger cultural context in which graduate students live and work. This cultural context includes the culture of graduate education writ large and the culture of the discipline. These contexts shape the norms, values, and beliefs that guide action and interaction and teaching and training in universities and departments. The microenvironment is the immediate setting—university, department, laboratory—in which a graduate student works and the interactions with advisors, faculty, and peers that take place in that setting, as well as the material resources provided by the setting.

Macroenvironment. Most of the comments about the environment were made in the discussions about students who had difficulty with the transition. Factors in the macroenvironment that affect students' ability to succeed and do high-quality work were discussed in only two focus groups (English and history). In both cases the remarks had to do with what was "hot" at the time a student was in a graduate school and how a student's interests or research fit with the prevailing paradigm. The following comment illustrates how the element of luck may also come into play:

> *English*: I also think that there is a little caprice involved in who ends up not going on and who ends up going on . . . that has a lot to do with what sorts of paradigms are reigning in the field and at what point you entered into this field, and at what a point you do your dissertation, with whom, and . . . whether it is seen as cutting edge or not. So I do feel that it is highly variable.

Microenvironment. By far, most of the comments about the environment had to do with support structures and interactions in the microenviroment. Comments about support structures came primarily from faculty in the humanities, disciplines in which students are often completely on their own during the independent stage: "You have no structure and that's the problem, not having structure." The economics faculty at Public University contrasted the social support provided by their department with the lack of support found in other departments:

> In some other departments . . . students are, just after their coursework, are left on their own and told to come back when you have an idea. . . . [They] are really left on their own to develop their own ideas. And, so, when students fail, it's either that they don't know how to seek out advice, [or] they don't know how to seek out topics or advice from faculty.

With respect to interactions, the faculty discussed ways in which being engaged in the life of the department and interacting with peers not only helped students make the transition but also helped them produce higher quality dissertations, as the following exchange between two historians shows:

> *Kearns*: Often you'll get a case where the professors are kind of fuddie duddies, but the students have enough of a community that they know what's going on . . .
>
> *Boorstein*: Especially these days, because fields are changing very rapidly. So very often the students have better communications. They have a broader communication among professors than professors have among themselves, and their own group generates a lot of knowledge that not necessarily one professor has.
>
> *Kearns*: . . . [What] is really crucial for graduate student success is having a cohort and having a good cohort—I mean really strong relations with that cohort. It just makes a world of difference. I have seen good students do great work, [and] I have seen mediocre students do good work as a result of having that kind of support and interchange.

However, the focus group faculty identified the advisor as single the most important microenvironmental factor in success or failure. Indeed, the advisor was the only environmental factor that came up in the discussions of students who made the transition with relative ease. These students were said to succeed because they "are the ones who hear what their mentors [say]" or because the student managed to find an advisor who was willing to give them an idea and see them through.

In their discussions of students who had difficulty with the transition, the focus group faculty talked about the advisor's responsibility for students' lack of success: "I think advisor negligence is a large part [of it] because there are no professional incentives to be nice to your disserta-

tion students. It's hard work and you're not rewarded for it." Another faculty member said, "People [who] are at the deep end [are] left to drown, especially the ones who can't swim very well."

In contrast to their negligent colleagues, the focus group faculty, who were high-PhD-productive faculty who tend to be systematically different than their low-PhD-productive counterparts (see Lovitts, 2001), noted the degree of personal responsibility they take for their own students' success. Comments from two biologists are worth presenting:

> *Mendel*: I think what I learned is that if I can't get my students to make it to the point where they can put up testable hypotheses no matter, then I'm not doing my job.
>
> *Crick*: I view it as part of my mentoring responsibility to see when a student has hit one of those walls, and if temperamentally they're just not going to be able to move forward, to find a way to help them out of it. But not expect them to be so independent that they can solve all of their own problems. But to work with them so they can have a graceful and productive exit from one of those situations and keep things from getting so bad. Keep students from falling into a trap where they're not working too long. Careful monitoring of their work to make sure things are really functioning so that they can continue to be reinforced.

A biologist and an economist talked about how they and some of their colleagues actively modeled or coached the behaviors necessary to do high-quality work and succeed. These faculty helped students through difficult periods by identifying problems, sharing drafts of proposals and papers, having students coauthor papers and write small proposals. By contrast, a psychologist attributed success or failure to students' ability to assimilate behaviors that were modeled more passively.

> A lot of it is this idea of socialization. It's kind of interesting. All the graduate students see faculty members at work. They see more advanced graduate students at work. They see postdocs in the department at work. Some of them figure out what it is, what it means to do that, and others can't relate to it. They see the same stimulus, but it doesn't sink in sometimes. . . . Basically they are smart. They are hard workers. They are interested. And then somehow or other they are able assimilate what it is that is important. But it is impossible to directly teach somebody that. You show them all the same thing, and some of them just don't get it.

The English faculty also focused on the differences among advisors and provided an interesting explanation for how good advisors help students navigate the complexity of their projects.

> These of my colleagues [the other focus group participants] are really good coaches, but there are some who aren't. Many students need someone to listen to them talking, repeat back what they're saying in a way that will enable

> them to transform it so that [their project] is a project that is workable for the professional field. Janet Emig says that's how all writing works. It's a version of language acquisition where the mother repeats words that raises the level of difficulty and translates for the child. So that process sometimes isn't there for some students.

The faculty also discussed the nature of advising styles. One English professor exonerated students, saying, "I am not at all sure that I feel that some of the students who don't go on lack independence. Sometimes it is quite to the contrary and that, again, has to do with styles in mentoring." Here is one group of economists' discussion of these styles:

> *Smith*: Not being too hokey about it, but mentally just caring about the students to push them through, you know, wanting to do a good job.
>
> *Mill*: "Speak with me. Let's work on this," as opposed to just saying, "You come see me when you see me."
>
> *Smith*: In some cases, you are probably just putting in some time and spending some thought. I think also that being a sympathetic person and trying to help their morale, because I think a lot of students are teetering on the edge of not being competent enough to do it.

In general, the faculty across focus groups said that most students managed to get the PhD even if they did not genuinely make the transition to independent research because their advisor took "mercy" on them and adjusted his or her standards and expectations or because the students found a less demanding advisor. Three responses from different disciplines are presented below to illustrate the extent of this "confidential" aspect of doctoral education.

> *Engineer*: One of the strange things—and this is confidential—is that the standard, the requirements for what it takes . . . vary drastically from one advisor to another. There's always amounts of differences in the requirements, and, therefore, if a student finds that one advisor is too demanding there exist other advisors who will be much less demanding or, maybe . . . they help the students more.
>
> *Psychology*: There is also a category [of students] that finishes without really ever passing the independent criteria. . . . They finish, but their advisor, when it is finished, says, "Gee, I can still write a dissertation." You feel like in the end you did it for them. You know that's coming. We're not that hard. We don't ship people out really if they get through their comprehensive. . . . If they get there, if they're willing to have their hand held, we'll hold their hand to get them through. . . . There are a lot of people like, some get to finish who by some very reasonable but more exacting standard wouldn't finish.
>
> *English*: I think it is entirely justified for us and for students to have different expectations for what a PhD does for them. . . . I think one of the reasons why some PhD students in this department do not succeed is that some of our colleagues, present company excluded, measure all of them by exactly

> the same standard, which I think is a great mistake. There are people in this PhD program who will become professionals. There are people who will go out and teach in junior colleges or community colleges or even in very good public or private high schools and be completely okay with that. If we are only talking about people who will be like us, that's a relatively small percentage of *any* PhD program. . . . I think that distinction is very, very important.

Conclusions

A critical question in doctoral education is why students who succeed in the coursework (dependent) phase of their graduate education have different fates in the independent research phase of their education. The analysis of the focus group discussions reveals three distinct fates. One fate is an easy transition to independent research and the production of a high-quality dissertation that makes an original contribution to knowledge (distinguished completers). A second fate is a difficult transition to independent research and the production of an acceptable dissertation that makes a small but not particularly interesting or important contribution to knowledge (undistinguished completers). The third fate is a difficult transition to independent research and the failure to complete a dissertation at all (noncompleters). While other fates may be possible, such as an easy transition and the production of a bland or undistinguished dissertation, and a difficult transition and the production of a good to distinguished dissertation, the focus group faculty did not discuss them.

The analyses of the focus group discussions also reveal systematic differences between students who met with or achieved the three fates they identified. These differences align well with the theoretical constructs and subconstructs guiding this research—the personal and social resources necessary for the conceptualization and completion of creative work (a dissertation).

The distinguished completers can best be characterized as students who possess high levels of practical and creative intelligence—they are independent and practical in their approach to their research, are good problem solvers, and are bubbling with ideas. However, some may be somewhat lower in analytical intelligence and may not necessarily shine during the coursework phase of their graduate education. The absence of comments about their formal knowledge suggests that it is unproblematic for them, that they are able to acquire the necessary knowledge and organize it as experts do. Distinguished completers often enter their doctoral programs with good informal or tacit knowledge about graduate education and the profession, and they engage in a lot of tacit knowledge acquisition behaviors. Their thinking styles are congruent with the tasks

of independent research in their field or discipline. They display intense intellectual curiosity, are willing to work hard, take the initiative, and have the power to persevere in the face of apparent failure. They are motivated by a strong intrinsic interest in their research and are passionately committed to their projects. They also have good advisors and are willing and able to seek out and take advice from them.

The undistinguished completers can best be characterized as students who often exhibit a high degree of analytic intelligence during the coursework phase of their education but who have lower levels of practical and creative intelligence—they will not or cannot think, work, make decisions, or solve practical problems on their own, and they have difficulty coming up with good problems or interesting ideas. Their formal knowledge bases are not yet organized in the same way as those of experts, and this is a source of frustration for them. They also do not appear to engage in many informal or tacit knowledge acquisition behaviors. Their thinking styles are not congruent with the tasks of independent research in their field or discipline, though they may go on to be successful in fields or professions that require styles of thought more congruent with their own. Undistinguished completers often do not work hard enough, and, at least in the sciences and social sciences, they have difficulty dealing with frustration, fear failure, have a low tolerance for ambiguity, and have difficulty delaying gratification. They may also lack or have lost their self-esteem or self-confidence. Undistinguished completers are often not intrinsically interested in their research project, in many cases because the topic or problem was given to them, and they may be more motivated by the idea of the PhD than by their research. Undistinguished completers often make it through because they had a lot of positive interaction with their advisor and/or peers or because their advisor adjusted his or her standards and expectations downward for them.

The focus groups often did not address or blurred the distinction between students who had difficulty with the transition (undistinguished completers) and those who did not make it at all (noncompleters). However, it is reasonable to assume that in most cases noncompleters have fewer of the personal and social resources that contribute to completion of a distinguished, creative work/dissertation than do undistinguished completers. The focus group faculty did note that noncompleters were often lacking in analytic intelligence, often failing in coursework or on their qualifying exams and thus never making it to the independent phase. However, several objective studies have found no differences between completers' and noncompleters' undergraduate or graduate GPAs (Belt 1976; Benkin, 1984; Berelson, 1960; Lovitts, 2001; Tinto, 1993;

Tucker, 1964), though none of these studies assess GPA by stage of departure (i.e., dependent or independent phase). Of those students who do make the transition to the independent phase but fail to complete, the focus group implicated factors in the microenvironment as the key cause, the advisor in particular. These students often do not receive adequate advising either because they do not know how to seek out advice from their advisor or, more commonly, because their advisor does not mentor them properly and push them through.

The above categorization of students by distinction and completion status raises questions about distinguished and undistinguished noncompleters. Undistinguished noncompleters are essentially the noncompleters described above. But what about distinguished noncompleters? Is that category even possible? I argue that it is and that it has implications for graduate education. I believe that there are two types of distinguished noncompleters, or, perhaps more correctly, noncompleters who have the potential to do distinguished work. These are the highly creative students who either leave their programs because they cannot actualize their creativity or because they were never admitted to a doctoral program in the first place. With respect to the first group, Lovitts (2001) found that many noncompleters felt "positively stifled" during the dependent, coursework phase of their graduate programs. Two comments from noncompleters in that study are worth repeating:

> *Boyd*: I felt like the whole process of being there was calcifying that part of me that I drew on to do other more creative kind of work.
>
> *Hugh*: [W]hat I saw happening is that all of the kind of creativity that I thought was so important seemed to be blanched out of the work we were required to do. We weren't really encouraged to use any kind of creativity in our presentation of papers, for example. (Lovitts, 2001, p. 115)

With respect to the second group, they are often screened out of doctoral programs by low undergraduate GPAs and tests like the GRE that focus primarily on analytical skills and thinking styles that are necessary to perform well in coursework but not on the skills and thinking styles that matter most for becoming an independent, creative researcher and for performing well in PhD-level professions (Sternberg, 1997a; Sternberg & Williams, 1997). Indeed, in a study of college students, Sternberg (1997a) not only found that it is possible to test for creative and practical intelligence, but, in doing so, he also identified gifted students who would not be so identified using conventional measures of ability. Further, the college students who tested high on creative and practical intelligence were much more diverse with respect to race and ethnicity and socioeconomic class than students who tested high on analytical intelli-

gence only. Overall, these findings raise questions about the criteria by which students are admitted to doctoral programs as well as about the types of experiences that highly creative students have while they are in college and graduate school.

Caveats and Implications

A few caveats are in order. First, this analysis is based exclusively on remarks made by faculty. A full understanding of factors that facilitate or impede students' ability to make the transition to independent research requires an assessment of and input from the students themselves. Second, no single characteristic determines whether an individual will or will not transition and complete or the manner in which he or she will transition. Different characteristics can and do combine in different ways to yield a successful outcome. This issue is ripe for further investigation. Third, while the faculty highlighted differences between students who had difficulty with the transition and who made the transition with relative ease, they also pointed to factors in the environment that influenced the outcome, such as the type of undergraduate institution the student came from, the paradigms prevailing in their field, the role of the cohort or peer group, and the type of advisor with whom the student worked. Thus, while individual characteristics play a role, they also interact with situation and circumstance, often powerfully so.

Indeed, according to Amabile "social variables represent one of the most promising avenues for influencing creative behavior" (1996, p. xv) and the "social environments influencing creativity can be changed easily and have an immediately observable effects on performance" (p. xvi). Similarly, Lovitts (2001) argues that the social environment plays a major role in students' attrition and retention decisions. Thus, to the extent that the individual resources and their subcomponents (i.e., analytical, practical, and creative intelligence; formal and informal knowledge; different styles of thought; certain personality traits; and intrinsic motivation) are influenced by the social environment, these findings suggest that the transition to independent research and the quality of students' performance can be enhanced by changing variables in the micro- and macroenviroments.

Variables in the macroenvironment that might be changed are the educational system's overvaluation of analytical intelligence and other norms in graduate education that promote intellectual conformity. Similarly, at the microenvironmental level, norms, values, and behaviors of those who train graduate students might be changed to increase students' integration in their programs and to better enhance and support

the development of the subcomponents identified as most critical to success: practical and creative intelligence, informal knowledge, perseverance in the face of frustration/failure, tolerance of ambiguity, self-direction, a willingness to take risks, and intrinsic motivation.

In addition, to the extent that creative and practical intelligence appear to be more important than analytical intelligence in the transition to independent, creative research/scholarship, universities may need to review the criteria they use to admit students to their doctoral programs. Above a certain threshold of demonstrated academic ability (e.g., undergraduate GPA and GRE scores), they might consider focusing more on measures or predictors of practical and creative ability and less on measures of analytical ability. Indeed, Sternberg (2007) has developed new forms of assessments that measure practical and creative intelligence and other relevant skills and has been experimenting with these assessments in the undergraduate admissions process at Tufts University. Similarly, the Educational Testing Service recently developed a Personal Potential Index for graduate school admission that allows undergraduate professors to rate prospective graduate students on six noncognitive skills (knowledge and creativity, communication skills, teamwork, resilience, planning and organization, and ethics and integrity) (Jaschik, 2007). By focusing on skills and abilities relevant to success in the independent phase of graduate education, graduate programs may discover that they are admitting—and graduating—a more diverse student body that produces more creative and innovative work in graduate school and beyond.

Note

[1]The figure in Golde and Dore (2001) is incorrect and has been updated in the tables at www.phd-survey.org.

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