

THE PERCEIVED IMPORTANCE OF DEVELOPMENTAL RELATIONSHIPS ON WOMEN UNDERGRADUATES' PURSUIT OF SCIENCE

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Using a survey of women science majors, we tested the assumption that women mentors and other women guides help women students pursue the sciences. The survey explicitly distinguished among three types of guides: mentors (who provide psychosocial support), sponsors (who provide instrumental support), and role models (who act as examples) encountered before and during college. We found that over 90% of the women had a guide of one type or another, that mentors were most influential to women's pursuit of science, and that guides during college were more influential than guides prior to college. Participants reported having more female than male guides overall, but that some of the most influential guides were men.

The American scientific and educational community seems to have adopted a belief in the efficacy of mentoring, especially for women (Collins, Chrisler, & Quina, 1998; Dryburgh, 2000; Sebrechts, 1999). Mentoring is thought to be an especially important tool for increasing the participation of women and people of color in the sciences (Beans, 1999). Many scientists believe that women students need women role models and mentors to pursue careers

in science (One-on-one: Mentoring in psychology, 1999). Such a belief was, for example, the engine for a program funded by the National Science Foundation that was specifically designed for well-established women researchers to spend a year at a research university where women are under-represented on the faculty (e.g., California Institute of Technology). Interactions with senior women scientists were thought to help sustain the interest of women students in their science curriculum.

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Surprisingly, there is only sparse empirical evidence to support the belief that young women need older women guides to succeed in science. The central goal of our study is to test the assumption that the persistence of women in science throughout high school and college depends, even partially, on the presence of older female guides. Our study also adds to the existing literature by empirically delineating different types of developmental relationships in which an older guide helps a younger person and by differentiating between different measures of a guide's importance. Earlier research, both in business and in education, usually included together different types of developmental relationships (Crosby, 1999). This earlier research, furthermore, rarely distinguished between measures of frequency or prevalence and measures of influence.

Definition and Benefits of Developmental Relationships

What is popularly called mentoring is one aspect of what scholars have called "developmental relationships." In 1985, Kram published *Mentoring at Work* and inaugurated scholarship on developmental relationships. Today the field

defines a developmental relationship as “one that provides needed support for the enhancement of an individual’s career development and organizational experience” and as a “relationship in which the parties have knowledge of one another and from which both may potentially benefit” (Thomas, 1990, p. 480).

Kram (1985) and others have proposed that protégés benefit from being in developmental relationships in a number of ways, including enhanced self-esteem and increased accomplishments. A large empirical literature has now demonstrated the benefits of developmental relationships for protégés in both business and educational settings (Crosby, 1999). Other research has documented how youth benefit when they participate in developmental relationships with adults (Freedman, 1993; Rhodes, 2002).

Types of Developmental Relationships

Kram (1985) differentiated between two distinct types of guidance: instrumental or practical help and socioemotional or psychosocial help. Instrumental help includes coaching, exposure, and opportunities for challenging assignments. Psychosocial help centers on empathy and personal counseling. Subsequent researchers (e.g., Tepper, Shaffer, & Tepper, 1996) confirmed psychometrically that it is essential to distinguish between practical and emotional guidance. David Thomas (1990) applied the label “sponsor” to the guide who gives practical help and “mentor” to one who gives emotional help. Bucking accepted wisdom, Thomas pointed out the benefits of sponsorship, relative to mentoring, when junior women and people of color are seeking guidance. Keeping emotions out of the equation, Thomas found, can help to neutralize the advantage of White male protégés, with whom White male mentors may be most at ease and trusting.

Closely following Thomas’s lead, Crosby (1999) has drawn a sharp distinction between mentors, sponsors, and role models. A good mentor, according to Crosby (1999), provides psychosocial help to the protégé whether or not the guide is willing and able to provide practical help. Thus, for example, a marginalized woman professor can still help her protégés feel competent and hopeful even if she cannot provide them with access to material resources. In contrast, a good sponsor provides practical help, even if she or he is unable or unwilling to take an interest in the feelings and emotions of the protégé. Finally, a role model is someone whom a junior person wishes to emulate, but a role model may not even know of the existence of the junior person. Crosby (1999) acknowledges that one person can fill two or three of the guidance roles, sequentially or simultaneously.

One important question that has received little empirical attention to date concerns women’s experiences with the different types of developmental relationships, including mentoring, sponsorship, and role modeling. Specifically, do women students utilize and benefit equally from guides who

are mentors, sponsors, and role models? This question is at the heart of our study.

Gender and Developmental Relationships

Another critical question is whether women derive more benefit from female guides than from male guides. Are female guides more important for women than male guides? If one assesses importance in terms of prevalence, do women protégés rely disproportionately on female guides? If one assesses importance in terms of influence, are women protégés disproportionately influenced by female guides?

In the workplace, where the vast majority of quantitative studies on mentoring have been conducted, it does not appear that female guides are particularly important for women protégés. Researchers have found only one effect for the gender of the protégé: Women protégés tend to be in cross-gender dyads. In all other respects—including access to mentors and measured benefit from having a mentor—women and men appear to be indistinguishable (O’Neill, Horton, & Crosby, 1999). More to the point, women protégés in a business setting derive equal benefit from male and female guides.

Some research does suggest, however, that the gender of the guide may affect the type of developmental support offered. For example, in a study of 1,150 employees in a financial services company, McGuire (1999) found that both women and men received more instrumental help from senior males and more socioemotional help from senior females. Perhaps women have less access to power than men in organizations or perhaps they operate differently from men in similar positions.

The evidence is mixed for women in higher education. Some early data would seem to suggest the importance of women guides for women students. Goldstein (1979) found that women graduate students published more if they had a female advisor than a male advisor while the inverse held for men graduate students. A classic study of young women at a liberal arts college also found a strong preference for same-sex role models (Basow & Howe, 1985). Moreover, Ensher and Murphy (1997) studied the experiences of 104 high school summer interns who were placed with adult volunteers in a large media organization. They found that matching genders increased the mentors’ liking of the protégés and the protégés’ sense of support.

Other investigators have found few gender effects. Campbell and Campbell (2000) analyzed questionnaires received from approximately 200 faculty and 200 students and found access to and contentment with mentoring were unrelated to gender. Similarly, during graduate or professional school, neither the gender of the student nor the gender of the professor has been found to influence the positive outcomes that students derive from having a mentor, sponsor, or role model (Clark, Harden, & Johnson, 2000; Green & Bauer, 1995; Kelly & Schweitzer, 1997; Tenenbaum, Crosby, & Gliner, 2001). In contemporary studies of

graduate school, moreover, the benefits of developmental relationships that accrue to students do not seem to depend on a match between the gender of the guide and the gender of the protégé (Kelly & Schweitzer, 1997; Tenenbaum et al., 2001).

Present Study

The main aim of the present study is to test the assumption that women guides are especially important to young women majoring in the natural sciences, an area where women are traditionally underrepresented. To conduct our test, we asked women undergraduates majoring in science about the guides who have influenced their interest in science. To ensure that the participants were heavily involved in their major, we limited the survey to women in their junior and senior years of college. If the truism about same-sex guides is valid, we should find that women science majors identify more female guides than male guides and that they attribute greater influence on pursuit of science to female guides than to male guides.

Recognizing that the experience of higher education may vary according to the institution that one attends, we obtained our data from women attending two women's colleges and, for contrast, one small coeducational college in the same geographic region. All three institutions pride themselves on preparing women for careers in the sciences and the women's colleges boast of the role models they provide for women students. All three colleges in our sample are private and elite. Our sampling strategy intentionally drew from small, liberal arts colleges to maximize the likelihood of finding students who had experienced developmental relationships and for whom individual guides might supply different types of guidance.

Not only did our study look at the importance of female (as opposed to male) guides, it also sought to determine which types of guides (role models, mentors, and sponsors) are beneficial to young women in science. It may be the case, for example, that women students are particularly likely to identify female mentors, who give psychosocial help, and role models, but show no gender differentiation concerning sponsors, who give instrumental help. In both the scholarly literature (e.g., Conway, 1989) and popular accounts (e.g., Hartman, 1995), writers tend to stress the value for women of the emotional connection that forms between mentors and protégés; but it is also possible that women benefit from practical help as much as from emotional help (Tenenbaum et al., 2001).

Another factor we investigated is the timing of the developmental relationship. High school has been identified as a critical period for women in science (Cross, 2001; National Science Foundation, 1997), with several studies showing that college women are excluded from science majors because they did not take the requisite math and science courses in high school (Seymour & Hewitt, 1997). Yet, it is during college that many students become serious about

their interests in science. Perhaps the difference between those who persist in scientific majors through their junior and senior years and those who drop from science rests in the ability of the former to find helpful sponsors and mentors (Packard, Walsh, & Seidenberg, 2004). Our study contributes to the literature on women and mentoring by looking at the relative frequency of different guides before and during college.

METHOD

Participants and Procedure

Our respondents were women natural science majors in their junior or senior year of college at Mount Holyoke College, Smith College, and Williams College. We obtained lists of science majors from contact persons at these colleges. We then distributed questionnaires to the students' campus mailboxes. Students were offered an incentive (a chance to win \$200 or an airline ticket in a lottery) to participate in the study. Questionnaires were returned via campus mail to the contact person at each institution. There were 207 total participants in the study, constituting a 44% overall survey response rate. Seventy-nine women responded from Mount Holyoke College (38% response rate), 77 women responded from Smith College (44%), and 51 women responded from Williams College (52% response rate).

Seventy percent of participants were European American and 23% were women of color (including 12% Asian American or Pacific Islander, 5% Latina, 5% African American, and 1% identified as "other"). Most participants were 21–22 years old (66%) or 19–20 years old (31%). The mean grade point average of all participants was 3.45. The majority of students were biology majors (45%). The rest majored in chemistry (9%), biochemistry (9%), computer sciences (6%), geology (6%), physics (3%), neuroscience (4%), and "other" (2%). Ten percent of participants double-majored with one major in science or math and one outside science or math. Six percent double-majored with both majors in the sciences or math.

Questionnaire

Participants completed a questionnaire that asked them about their various experiences with developmental relationships. The questionnaire was divided into three major parts: (a) a section to assess their experience of role models, (b) a section asking about their experience with mentors, and (c) a section with questions about their experience with sponsors. Each section was subdivided to target developmental relationships before college and during college. Those who had more than one role model, mentor, or sponsor (before or during college) had the opportunity to report each relationship individually up to a limit of three in each category, with the most important one in the category named first. Thus, a student could name up to 18 individual guides. To make sure the student was focused on

specific people, rather than responding according to idealized stereotypes, we asked students to give the initials of the person whom they had in mind when answering the questions. Students were instructed that they could name the same person or different people in the functions of role model, mentor, and sponsor before and during college. Thus, for example, a student might name one individual as a role model and mentor before college and a role model during college.

To avoid confusion, the questionnaires provided explicit definitions of role models, mentors, and sponsors. Specifically, immediately prior to the questions about role models, a role model was defined as:

A senior person who inspires others. A role model is someone with whom one identifies emotionally and whom one wishes to emulate in some way. An individual looks up to and admires the role model. The role model may or may not be aware of the admiration he or she invokes and may not be aware that he or she is a role model for others. Furthermore, the role model may not feel any emotional attachment to the junior person and may not know him or her personally.

Immediately prior to the question about mentors, a mentor was defined as:

A senior person in an organization who takes a special interest in a more junior person's career. The mentor cares about the development of the junior person. Emotional attachment exists between the mentor and the junior person. The mentor may or may not be in a powerful position and may give instrumental help such as the sharing of information, giving practical advice, and showcasing the junior person.

Immediately prior to the questions about sponsors, the survey defined a sponsor as:

A senior person in an organization who helps a junior person. The sponsor is in a position of power, which allows him or her to give instrumental help such as sharing information with the junior person, giving practical advice, showcasing the junior person, and providing protection to the junior person. Unlike the mentor relationship, the sponsor and protégé do not have an emotional element to their relationship.

Students were asked to recollect their experiences before college (e.g., in high school) and to judge their current college experiences.

For each guide (role model, mentor, and sponsor) named, students were asked the gender of the guide and how much the senior person influenced their decision to pursue science ranging from 1 (*very little*) to 5 (*very much*). Thus, we gauged not only the quantity of guides of each type, but also the ascribed influence of guides of each type.

In a final section of the questionnaire, students completed demographic information including their age, ethnicity, gender, grade point average, major, and socioeconomic background. Students also were asked, "If you had several role models, mentors, and/or sponsors, which relationship was most influential in your decision to study the sciences?"

RESULTS

Our analytic plan involved three separate phases. First, we examined the data to see if women at the coeducational college differed from women at the women's colleges. There were no statistically significant differences among the women students at each of these institutions, so we combined the data from all the schools. Next, we looked at the students' responses about all the guides they reported, tabulating the number of role models, mentors, and sponsors before and during college. The final phase of analysis allowed for a deeper look at the ascribed influence of female and male guides who were named as the first (i.e., most important) role model, mentor, or sponsor before and during college.

Examination of Responses Overall

Prevalence of developmental relationships. To address the question about whether a majority of participants experienced developmental relationships, we calculated simple frequencies. Overall, 91% of participants indicated that they had at least one of the three types of guides either before or during college. Each student had the possibility of mentioning 18 guides. The average number of guides cited was 5.8 ($SD = 3.9$).

The most important guide. When asked, "If you had several role models, mentors, and/or sponsors, which relationship was most influential in your decision to study the sciences?," 42% of the entire sample of participants stated that mentors were most influential. Thirty-four percent of respondents reported that role models were most influential. Seven percent said the sponsor relationship was most influential to their decision to study science. Seventeen percent of respondents did not answer this question.

Proportion of women guides. Eighty-four percent of participants reported having at least one female guide and 75% had at least one male guide. To test the prediction that participants had more female guides than male guides, we tabulated the total number of female and male guides cited. The average number of female guides was 3.40 ($SD = 2.81$) and the average number of male guides was 2.39 ($SD = 2.13$). Participants thus reported having significantly more female guides than male guides, $t(206) = 4.63$, $p < .001$ (two-tailed).

Table 1

Percentages of Women Students Citing at Least One Role Model, Mentor, or Sponsor Before or During College ($N = 207$)

	<i>Role Model</i>	<i>Mentor</i>	<i>Sponsor</i>
Before College	73	64	23
During College	68	61	50

Examination of the First Named Guides

We conducted a set of analyses in which we limited our attention to the first named (i.e., most important) guide in each category. We examined the prevalence and ascribed importance of each type of guide, coded by gender.

Prevalence of different kinds of developmental relationships. To test our prediction that participants would be more likely to have had role models and mentors than sponsors, and to see if developmental relationships were more common before or during college, we tabulated the frequencies of each type of developmental relationship before and during college. Table 1 displays the data. Examination of the table shows that mentors and sponsors were equally frequent before and during college and that sponsors were less frequent than either role models or mentors, especially in the period before college, $\chi^2(1, N = 207) = 18.40, p < .001$.

Prevalence of women guides. To see if women students named women guides first (i.e., as most influential) more than men guides in the various types of relationships, we calculated the percentages of women who named a female or male guide in the first position in each category. For the 152 students who had a role model before college, 66% named a woman, as did 60% of the 140 students who had a role model during college. For the 132 students who had a

mentor before college, 54% named a woman, as did 62% of the 127 students who had a mentor during college. As for sponsors, 54% of the 48 students who had a sponsor before college named a woman, and 42% of the 102 students who had a sponsor during college named a woman.

To test these differences statistically, six separate chi-square analyses were conducted, using the Bonferroni approach to correct for multiple tests. Participants were significantly more likely to cite a female than a male as the role model prior to college, $\chi^2(1, N = 152) = 16.45, p < .001$, with a Bonferroni-adjusted p -value of .001. They were also more likely to cite a female than a male mentor during college, $\chi^2(1, N = 127) = 8.00, p < .005$, with a Bonferroni-adjusted p -value of .03. In all other cases, there was no significant difference in frequency of female and male guides.

Gender of guide and ascribed influence. The next set of analyses examined the amount of influence that women science students ascribed to the various developmental relationships with male or female guides. Here we conducted a $2 \times 2 \times 3$ analysis of variance (ANOVA). Gender of guide, timing of the developmental relationship (before and during college), and type of guide were the independent variables, and ascribed influence on pursuit of science ranging from 1 (*very little*) to 5 (*very much*) was the dependent variable. The means for this analysis are displayed in Table 2. A significant main effect emerged for type of guide, $F(2, 689) = 3.57, p < .05$. Pairwise comparisons suggested that role models (overall $M = 3.65, SD = 1.34$) were not perceived to be significantly different from mentors (overall $M = 3.59, SD = 1.42$). Nor were mentors significantly different from sponsors (overall $M = 3.40, SD = 1.47$). The ascribed influence of role models did, however, significantly exceed the ascribed influence of sponsors. There was also a significant main effect for timing of the developmental relationship, $F(1, 689) = 17.86, p < .001$, indicating that guides during college were rated as significantly more influential to participants' pursuit of science than guides prior to

Table 2

Ascribed Influence of Female and Male Guides on Pursuit of Science

<i>Type of Guide</i>	<i>Mean Ascribed Influence</i>		<i>Standard Deviation</i>		<i>Samples Size</i>	
	<i>Female Guides</i>	<i>Male Guides</i>	<i>Female Guides</i>	<i>Male Guides</i>	<i>Female Guides</i>	<i>Male Guides</i>
Role model						
Before college	3.42	3.67	1.44	1.19	101	51
During college	3.63	4.09	1.45	.98	84	56
Mentor						
Before college	3.17	3.48	1.55	1.43	71	61
During college	3.78	4.04	1.36	1.15	79	48
Sponsor						
Before college	2.85	3.23	1.51	1.66	26	22
During college	3.64	3.53	1.45	1.34	43	59

Note. Significant main effects emerged for type of guide, timing of the developmental relationship, and gender of guide.

college. Lastly, the analysis revealed a main effect for gender of guide, $F(1, 689) = 5.21, p < .05$, which indicated that male guides were rated as significantly more influential to participants' pursuit of science than were female guides.

DISCUSSION

In our study of women students at three New England colleges, we find strong support for the view that developmental relationships are important for women's pursuit of science when importance is indexed either by the prevalence of developmental relationships or by their ascribed influence on the students. We find that having one or more developmental guide is a common occurrence for women science majors in our sample. Participants, furthermore, have more role models and mentors than sponsors and consider mentors to be the most influential relationship for their decision to study science. Contrary to the common assumption, the gender of the guide was important only some of the time. In only two (role models before college and mentors during college) of the six types of relationships in our study were female guides more prevalent than male guides. Male guides, furthermore, were ascribed more influence than female guides.

There are several possible explanations for the relative importance of role models and mentors in the present study. It may be that women science majors gravitate most to psychosocial help. Still underrepresented in the sciences, women students may feel a strong need for socioemotional support (Murrell & Tangri, 1999). Also, gender stereotypes may lead guides to offer more psychosocial support, rather than instrumental support, to women. Additionally, it is possible that women guides may feel less comfortable functioning as sponsors than they do as role models or mentors, so women students may receive more psychosocial help than sponsorship if they seek out female guides. Such a pattern has been found in studies of mentoring at work (McGuire, 1999) and is consistent with the literature on differential attention to girls and boys in school (Sadker & Sadker, 1994).

The relative lack of sponsor relationships reported by the participants does not mean that sponsors are unimportant to women. Fifty percent of the women students did report the presence of a sponsor during college and 23% had a sponsor before college. Given that the instrumental help offered by sponsors can be more influential to advancement in one's field than the other developmental relationships, it is important to find ways for women students to experience this type of guidance.

It is also critical to consider the developmental context in which role model, mentor, and sponsor relationships take place. The finding that developmental relationships in college are more influential in the pursuit of science than guides prior to college is telling. Possibly, as the pressure and work load of a science major increases, particularly as students go further into their major, they may need more support from a guide. Women science majors in their junior

and senior years also may be looking forward to graduate school and could become more aware of their marginalized status within their profession. These realizations, in addition to their need for help with their future career aspirations (e.g., in the form of letters of recommendation), may lead women science students to ascribe more influence to guide relationships at that developmental time rather than during high school.

Although our results offer empirical support for some popular beliefs about gender and developmental relationships, they also challenge other commonly held assumptions. Contrary to the view popularized by Tidball (1980), we found that women guides were not uniformly significantly more prevalent than male guides. We also found that women students ascribed more influence on their pursuit of science to their male guides than to their female guides. We can offer a few possible explanations for this finding. For one, gender stereotypes may be in operation (O'Neill & Blake-Beard, 2002). That is, if women science students see mostly men as leaders in their fields of study, they may be more awed and thus more influenced by male guides than by female guides. Alternately, it may be that men have greater access to power and benefits than do women in science, so that they can bring more opportunities to their students (women or men) than can women guides. Finally, it is possible that the men who take time to guide a young woman are especially devoted to the developmental relationship and thus make especially influential sponsors, mentors, and role models.

We should also acknowledge an epistemological issue: the problem of women who are missing from our study because they are missing from the sciences. It may well be that some women who might be attracted to the sciences if they seemed more welcoming to women are discouraged by the overly male character of the enterprise. Such women fail to become science majors and are thus not in our sample. But among such women, the presence of a female guide might be very influential indeed.

A major limitation of the study is that it involves students at three elite East Coast liberal arts colleges where the student bodies are ethnically rather homogeneous. We intentionally selected the sites to increase the likelihood of students having several different types of developmental relationships, but we cannot know how well the findings would generalize to other settings. Women may need more guidance at large institutions, or the relative importance of role models, mentors, and sponsors may be different for women at highly selective science-oriented institutions than at liberal arts colleges. Perhaps in other settings, women students would not find as many guides during college as they did in our sample.

A second limitation of the study concerns our response rate. Although the rate of response was well within the conventional guidelines (Keeter, Miller, Kohut, Groves, & Presser, 2000), one might wonder about the other half of the women who did not return the surveys. Were they perhaps

uninterested in a study of developmental relationships because they lacked experiences with mentors, sponsors, and role models? Were they involved in mentoring relationships that were negative or did not meet their expectations? More information on the sample of women who did not respond may be as instructive as the information we collected from respondents.

A third limitation concerns the self-report nature of the data. Not only might sex-role stereotypes influence students' answers, it is also possible that the students are not fully aware of the forces that operate to make developmental relationships possible. Further research is needed to disentangle whether women are choosing not to have sponsors or sponsors are choosing not to guide women, in addition to why women science students ascribe more influence on pursuit of science to male than to female guides. A longitudinal study of women in high school and college is needed to assess the extent to which their experiences of guides in science affect their long-term attrition rates (cf. Farmer, 1997). Also informative would be an in-depth qualitative study of women science majors, asking respondents to discuss their experiences so that researchers could look for connections between women's circumstances and their choices in the realm of developmental relationships.

Future research might also follow women at various points in their education and careers in science. It is possible, for example, that sponsors may become increasingly important during and after graduate school. If mentors and role models are especially important to young women as they decide to pursue a career in science, sponsors may be critical for the retention of women in science.

Future research could also investigate the role of race. Some research suggests that power afforded to gender and race in organizations can play a large role in developmental relationships. For example, Dreher and Cox (1996) found that MBA graduates who had established mentoring relationships with White men attained higher salaries than those who had mentors with other demographic characteristics. In fact, those who had a White male mentor earned a salary of \$16,840 more than other students. Women MBA students were less likely than men to form mentoring relationships with White men (Dreher & Cox, 1996). Such findings point to the myriad of factors that intersect with gender to impact the benefits received from developmental relationships and could be informative in the context of science students.

Despite its limitations, our study yielded important findings, and there are several practical implications of these results. If we are serious about increasing the number of women who pursue education and careers in science, more effort is needed to provide women science students with developmental relationships. Contrary to some warnings (Leslie, McClure, & Oaxaca, 1998; Leslie & Oaxaca, 1997), our study suggests that it is not too late to establish developmental relationships in college. Perhaps the rigors of

college-level science and math courses make guidance especially valuable to students.

To increase the number of women in the sciences, our study suggests that it is as important for women science students to have male and female guides. Many educators assume that students need to form developmental relationships with older members of only their own gender (Conway, 1989; Erkut & Mokros, 1984). Our findings challenge that assumption. Therefore, male professors, in addition to female professors, should be encouraged to mentor and sponsor female students in the sciences.

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