

Chapter 10

Development of a Horizontal Peer Mentoring Network for Senior Women Chemists and Physicists at Liberal Arts Colleges

Kerry Karukstis,^{*,1} Bridget Gourley,² Miriam Rossi,³ Laura Wright,⁴
and Anne-Barrie Hunter⁵

¹Department of Chemistry, Harvey Mudd College, 301 Platt Blvd.,
Claremont, CA 91711

²Department of Chemistry, DePauw University, 602 S. College Ave.,
Greencastle, IN 46135,

³Department of Chemistry, Vassar College, 124 Raymond Ave., Box 748,
Poughkeepsie, NY 12604

⁴Department of Chemistry, Furman University, 3300 Poinsett Highway,
Greenville, SC 29613

⁵Ethnography & Evaluation Research, University of Colorado, Boulder,
580 UCB, Boulder, CO 80309

*Kerry_Karukstis@hmc.edu

Our research project focuses on the distinctive environments of undergraduate liberal arts institutions and the challenges faced by senior women faculty on these campuses to attain leadership roles and professional recognition. The project involves the formation of five-member alliances of senior women faculty members at different institutions for the purpose of “horizontal mentoring.” Three of the alliances are comprised of full professors of chemistry, the fourth involves full professors of physics. We have formed these alliances to test a “horizontal mentoring strategy” that aims to enhance the leadership, visibility, and recognition of participating faculty members. Alliance members participate in discussions, workshops, and activities focused on career and leadership development through periodic gatherings of alliance members at various locations across the country and through electronic communication via online collaboration tools. The alliances are

networked to augment the peer-support structure with a larger cohort of senior women scientists. Outreach activities on home campuses extend the impact of the career development expertise attained by project participants. This NSF-ADVANCE-PAID project is also working to identify and create resources that address career development issues for senior women at liberal arts institutions and disseminate best practices on horizontal mentoring strategies for academic women. We have explored how our institutional structure and culture can profoundly influence the career challenges of academic women and how our mentoring strategy can operate particularly effectively for women from liberal arts colleges.

The Value of Mentoring for Senior Women STEM Faculty Members

The underrepresentation of women in almost all physical science and engineering fields is a well-documented statistic (1). One strategic effort to broaden the participation of women in the technical workforce is to increase the advancement of women faculty in science and engineering fields at academic institutions of higher learning. The presence of senior women faculty in the highest ranks of academic leadership enables female students to self-identify as potential scientists and engineers, thus having a powerful influence on their choice of career. Yet the percentage of women in senior faculty positions in science and engineering is discouragingly low. For example, only 1.5% of those faculty members in universities and four-year colleges holding doctorates in the physical sciences are female full professors with 20 years or more experience beyond their doctorate (2). In contrast, the corresponding figure for male full professors with the same level of experience and doctoral field is 21.8%.

Analysis of the disproportional presence of senior women scientists and engineers at colleges and universities is a complex and multifaceted process. Numerous variables have been examined for their impact on advancement in academia. Compelling evidence exists to support the hypothesis that both formal and informal mentoring practices that provide access to information and resources are effective in promoting career advancement, especially for women (3, 4). Such associations provide opportunities to improve the status, effectiveness, and visibility of a faculty member via introductions to new colleagues, knowledge of information about the organizational system, and awareness of innovative projects and new challenges (5–8). Some of the specific benefits accorded to mentees compared with their colleagues with no mentoring support include enhanced socialization to institutional and professional organizations; greater productivity measured in terms of research, grants, and publications; and increased recognition from colleagues and authorities in the field (9–11). Given these favorable outcomes, higher education institutions, many funded through NSF-ADVANCE Institutional Transformation Awards (12), have established mentoring programs

to improve the campus climate for women faculty and facilitate their retention and promotion.

While mentoring is traditionally viewed as essential early in one's career, the changing responsibilities of faculty members as they advance in the professoriate suggest that mentoring relationships would also facilitate career advancement for senior faculty seeking new challenges and leadership roles and desiring greater professional visibility and recognition. Endowed professorships, department chair positions, membership on tenure and advancement committees, or roles as associate deans or chairs of the faculty are common leadership opportunities for senior faculty. In addition, as a consequence of particular expertise acquired throughout a career, senior faculty might also consider other leadership activities both at their institution and at a national level, including directors of interdisciplinary programs, offices in professional organizations, chairs of national disciplinary and professional conferences, or roles as principal investigators on multi-institutional collaborative grants. All of these career ambitions for senior faculty reflect goals of institutional and national leadership in the profession and are challenging aspirations. The coaching and advice of experienced mentors would be valued resources to assist a faculty member in achieving these goals.

Just as in the case of prospective women scientists, senior women faculty often prefer mentors who are like themselves because they perceive such female role models to have experienced professional and personal difficulties and challenges similar to their own (13–15). Yet, as there are few women faculty in high-ranking positions, cross-gender mentoring is likely to be the only “traditional mentoring” option available for senior women faculty in science and engineering. To remedy the lack of access to experienced female mentors, alternative models of mentoring must be found and research conducted to better understand the benefits of these different forms of mentoring in academe.

Critical Needs for Senior Women Chemistry Faculty at Liberal Arts Institutions

The ambition of senior women chemists at liberal arts institutions to attain the highest leadership positions at their institutions as well as in national professional organizations is a challenging goal. Private, residential liberal arts colleges are typically characterized by strong faculty governance, strong expectations of service, an emphasis on teaching with small classes and low student-faculty ratios, and small departments with few colleagues in one's area of specialization. These settings provide both unique career growth opportunities and challenges for women faculty members. Using local resources to identify female career mentors in the discipline is a limited option. Indeed, the dearth of senior women faculty in chemistry is even more acute at B.S.- and B.A.-granting institutions than at Ph.D.-granting universities. The Women Chemists 2000 publication of the American Chemical Society (16) reported only 932 female full professors of chemistry at baccalaureate institutions compared with 1696 at PhD-granting institutions. With 2.3 times as many baccalaureate institutions than Ph.D.-granting institutions in the United States (647 vs. 283, as reported in the most recent

version of *The Chronicle of Higher Education Almanac* (17)), the scarcity and consequential isolation of senior women chemists at such undergraduate institutions is profound. Alternative modes of mentoring are a necessity if a strong support system is to be established along gender-specific lines to improve the climate for senior women chemists at private liberal arts institutions and to facilitate their advancement to leadership positions.

Formation of Our Inaugural Horizontal Peer Mentoring Alliance

Peer mentoring is one particular form of mentoring that would seem ideally suited to senior women chemists situated at geographically distinct liberal arts institutions. The more egalitarian atmosphere of a peer mentor group with members of similar professional rank is a welcoming venue to share career information and provide support and feedback. Studies have shown that peer mentor groups can be particularly empowering as each member is serving as both a giver and receiver of information (18–21). The varied career experiences and achievements of a cohort of women faculty who have reached the senior ranks at their institutions provide a rich resource to utilize for guidance and recommendations.

In 2004 five senior women chemists (four are authors of this chapter) were successful in receiving funding for an interinstitutional initiative supported by a Mellon Foundation faculty development award to a cohort of eight liberal arts colleges (22). In this project, “Advancing the Careers of Senior Women Chemistry Faculty through a Horizontal Peer Network”, we established a networking peer support group for the purpose of exploring and defining future career aspirations. By meeting together to discuss career goals and establish steps for achieving these aims, the group sought to provide each other with support, advice, ideas, and contacts. We represented the only senior women chemists at our institutions and in the eight-institution cluster (23) and, in some cases, the only female chemists at any rank in our departments. In most instances we were the first women faculty hired in our departments with few, if any, female role models in our institutions as we progressed through tenure and promotion to full professor. Thus peer mentoring involving external mentors was a logical approach for our group of women faculty.

To determine the essential components for a successful horizontal peer mentoring approach, we examined the factors that lead to successful and sustained transformations in organizations. We surmised that face-to-face meetings of our small number of participants from distinct but similar institutions over a sustained period of time were central to the success of our initiative. There is ample evidence that, for organizations to initiate and sustain change, members must have a shared vision, use a systems approach that recognizes the interrelationships among participants, and learn as a team particularly through personal commitments made to each other (24). Furthermore, faculty participation from multiple institutions in discourse and activities focused on faculty development can lead to more creative approaches and certainly mitigates the sense of professional isolation in pursuing new initiatives. The collaborative team model can invoke a stronger

commitment to the goals and a greater appreciation of the dedication of colleagues to the long-range objectives. Research further indicates that successful faculty professional development requires mechanisms that are iterative, systemic, and involve ongoing interactions and interventions (25, 26). The multi-day gatherings for our horizontal mentoring alliance allowed for the personal interactions that are necessary to foster the formation of a support network. With a support network in place and with opportunities to meet regularly, the most lasting career development is likely to occur (27, 28).

Our horizontal peer alliance corresponded electronically for several months prior to our first face-to-face meeting to explore common professional objectives and establish priorities for the first meeting. Electronic communication continued between meetings to continue conversations on issues raised at gatherings, share new information and advice as new professional challenges and achievements occurred, and design the agenda of future gatherings. Prior to the first meeting the group also began the compilation of an annotated bibliography of journal articles and books on career development issues for senior academicians. Reviews of these publications were shared at gatherings and through electronic communications. To facilitate the discussion, members of the group selected several texts to read in common, depending on the particular professional interests of the individuals.

Four meetings of the mentoring group were held from 2004 to 2006 with Mellon funding, with partial gatherings at two professional conferences. At the first meeting, members formulated short-range individual career goals to address over the subsequent months. The group also decided at that meeting to seek the guidance of a career development consultant to enhance their leadership and self-presentation skills. The second meeting was held with an experienced career development and executive coach for women academic physicians and scientists. We addressed a broad range of issues in our coaching sessions including effective communication and relationship-building strategies, self-presentation and self-promotion techniques, and values-based goal-setting. At the third meeting we considered avenues for extending this network to other senior women in chemistry at liberal arts colleges similar to our own institutions and for assisting junior women faculty at our own institutions in their career development. A fourth meeting focused on assessing the impact of this career enhancement project.

Assessment efforts demonstrated this mentoring strategy to be a resounding success. One participant articulated the personal impact of the project on her career as follows: "This grant provided me with the means to meet with and discuss my situation with four other successful and talented women who each had to face their own set of personal hurdles in their career paths. I have been inspired by them and have come to rely on their expertise and decision-making skills to help me in making choices and decisions. ... My confidence and self-esteem have soared." Another expressed the value of the experience for both herself and her institution: "The horizontal mentoring network that we have set up will continue to be of great value to me. I know that if I need advice from someone more removed from my setting I now have four individuals, each with different talents, who I can contact for guidance. Knowing the value of this mentoring has reinforced my willingness to provide guidance for junior colleagues as they progress through their careers.... In addition I now realize that the senior women in science at [my institution] need

to spend more time together. Each of us is fairly isolated in our own department. Having experienced the utility of a mentoring network first hand I now know that we need the equivalent of this to happen on my home campus. ”

An NSF-ADVANCE-PAID Project To Expand the Horizontal Peer Network

Given the success of our initial peer mentoring group, we applied and received funding from the NSF ADVANCE PAID (Partnerships for Adaptation and Implementation) program in 2006 to continue our mentoring approach. Our project established a network of four five-member “horizontal” mentoring alliances of senior women scientists at private liberal arts institutions – three alliances were composed of chemists at the full professor rank and the fourth was composed of physicists at the full professor rank. A significant amount of research occurred to survey the composition of chemistry and physics departments at over 200 liberal arts colleges around the country. The members of the alliances were selected on the basis of their existence as the lone senior female faculty member in their department and often for their presence as the singular female faculty member in their department. Geographical diversity was a key objective in three of the alliances in an effort to bring together women whose institutions might not already be participating in a regional consortium. We did recognize, however, that travel times could hinder meeting during the academic year, so a more regional association of alliance members was sought in one alliance to test the impact of reducing that constraint. No effort was made to match women in similar subdisciplines of chemistry or physics. With one alliance the selection of women who had fairly recently attained full professor status was the aim. We also deliberately chose women from twenty different institutions to maximize the impact of campus outreach efforts.

Each alliance was free to determine their own meeting times and locations. Some alliances chose to meet on each other’s campus to benefit from learning about each institution. Other alliances held gatherings in conjunction with professional society conferences in order to minimize travel. Still others, when time was tight during the academic year, chose hub cities and even airport hotels for convenient air travel and maximum time for interaction. At the first gathering of each alliance, in addition to getting to know one another, each alliance participant shared her individual short- and long-range career goals and the alliance decided on areas of career development to address as a group (e.g., leadership, self-presentation and self-promotion skills, dealing with difficult colleagues, effective communication and relationship-building strategies, etc.). Funds were available for external consultants to provide guidance in these areas and for the purchase of reference books as additional resources. Each alliance chose its own means of electronic communication and/or teleconferencing to stay connected between gatherings and to further promote the sharing of advice, ideas, and contacts. Significant numbers of the members of the chemistry alliances gathered for dinner at national meetings of the American Chemical Society to create an expanded network of colleagues and share news about the activities

of each alliance. Finally, a variety of outreach activities on home campuses extended the impact of the career development expertise attained by project participants. These outreach activities included, for example, book discussion groups on faculty development topics for the women science faculty on a given campus; sponsorship of a consultant visit to conduct a strategic career planning workshop for the women science faculty with individual career planning meetings and sessions on negotiation and brainstorming on critical career issues; and a visit to campus of an external speaker to provide professional development for all science faculty (male and female) in the form of information about significant contemporary interdisciplinary research questions and career paths and internship opportunities for students. As a culminating event of the project, a summit meeting was held in Washington, D.C. for all project participants and more than thirty additional senior chemistry and physics female faculty members at liberal arts colleges to identify and create resources that address career development issues for senior women at liberal arts institutions and disseminate best practices on horizontal mentoring strategies for academic women.

The Efficacy of the Horizontal Peer Mentoring Approach

Our project to establish horizontal peer networks of senior women chemists and physicists at private liberal arts institutions has the following distinguishing features to insure effectiveness:

- an approach focused on senior women chemists or physicists who are employed in the distinctive environment of a private liberal arts campus,
- a structure that enables multi-day gatherings that foster the personal interactions necessary to form a committed cohort of faculty to serve as peer mentors,
- mechanisms for regular follow-up to maintain the support network and mitigate professional isolation, and
- professional development activities tailored to the specific needs of the participants and designed to enable these senior women scientists to serve as effective leaders of institutional change on their own campuses and in their professional associations.

Our project evaluator (and an author of this chapter) conducted an ethnographic study using qualitative research methods, and her results show this form of peer mentoring to be particularly effective. Our summative evaluation is still in progress, but formative evaluation involving interviews with project participants explored early outcomes of participation in the initiative and revealed many benefits of the mentoring approach. Alliance members were asked their views about the efficacy and relevancy of the structural model (i.e., a horizontal mentoring alliance) in practice, their thoughts about barriers and supports to using this model, its sustainability, and where it might be usefully replicable.

Participants overwhelmingly agree that the alliances promote the sharing of ideas, experiences, and expertise. Furthermore, the composition of the alliances

with members from different institutions was valued in that it provided a different perspective from an outsider's point of view and an opportunity to be open and honest without fear of competition or reprisal. Nearly 75% of participants agreed that being part of a horizontal mentoring alliance had given them more confidence to "speak up for myself," ask for what they wanted from their departments, accept due recognition for their professional work and contributions and permission to focus more time and attention on their professional goals. Three-quarters of participants also noted that, aside from strong professional support, they had developed friendships with other alliance members that would last beyond the life of the grant and that a benefit of participating was simply in talking and socializing with other women having similar career paths and interests. The career development focus of alliance meetings, network gatherings, and horizontal mentoring activities also contributed to many major professional developments for the project participants. A key aspect of the initiative is the articulation of short- and long-range career goals by each participant and the formulation of action plans to attain the stated professional goals. An extensive array of enhanced leadership and career opportunities have resulted including endowed professorships, institutional awards for teaching and service, invited lectureships, and offices in professional organizations. Participants also noted a range of additional benefits that included the transfer of gains back to their own institutions in terms of a renewed effort to mentor women and in terms of interactions with deans and other institutional administrators who were actively interested in the horizontal mentoring alliance initiative and were interested in seeking ways to support women science faculty. Coding of the interview data also revealed comments focused on the alliance meetings, the topic of mentoring, geographical issues associated with career development and alliance functioning, professional development issues associated with differences between R1 and liberal arts college settings, replicability and sustainability of the horizontal mentoring alliance, career satisfaction, comments on whom the horizontal mentoring alliance best serves, as well as additional gender, departmental, and institutional issues. These comments helped to structure subsequent alliance gatherings and develop communication among the alliances. Overall, baseline outcomes from the external evaluation demonstrated that the rationales underlying the development of the Horizontal Mentoring Alliance initiative were accurate. In practice, the mentoring model that was implemented was found to be highly effective in addressing issues particular to senior women faculty members in the sciences at liberal arts colleges, and thus, successful in achieving project goals of reducing members' isolation, increasing their access to professional networks and advice, and in promoting their career advancement. It is notable that qualitative findings from participant interviews align with the varied research and discussions in the literature concerning women science faculty and academe. The strong benefits to alliance members, their colleagues and institutions suggest that effective mentoring is needed and beneficial at all levels of one's academic career. As a model, horizontal mentoring might well be adopted by others seeking to effectively promote women science faculty members' advancement in academe.

Conclusion

The formation of these horizontal mentoring alliances has had significant direct impact on the career development of the twenty senior women participants and additionally developed a cohort of leaders of institutional change at the participants' home institutions. Participants cite a range of personal benefits from involvement in this initiative including opportunities to network with senior women science faculty in liberal arts institutions; time to engage in career development discussions aimed at enhancing leadership, visibility, and recognition on campus and in the broader academic community; and occasions to develop mentoring paradigms that can be used with students, junior female faculty colleagues, and other senior female faculty colleagues. This horizontal mentoring strategy has also enabled participants to realize numerous individual gains that have impacted both their professional and personal lives. It is our belief that, for senior women faculty seeking new avenues of career development resources, a horizontal mentoring approach might indeed offer a viable mechanism.

This material is based upon work supported by the National Science Foundation under Grants NSF-HRD-0618940, 0619027, 0619052, and 0619150. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

1. ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers Program Solicitation; NSF 05-584; National Science Foundation: Arlington, VA, 2005.
2. Science and Engineering (S&E) doctoral holders employed in universities and 4-year colleges, by broad occupation, sex, years since doctorate, and faculty rank: 2002, Table H-22. NSF 09-305. National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients. <http://www.nsf.gov/statistics/wmpd/pdf/tabh-22.pdf> (accessed August 19, 2010).
3. Ragins, B.; Cotton, J. Mentor functions and outcomes: A comparison of men and women in formal and informal mentoring relationships. *J. Appl. Psychol.* **1999**, *84*, 529–550.
4. Ambrose, S. *Journeys of Women in Science and Engineering*; Temple University Press: Philadelphia, PA, 1997.
5. Kanter, R. *Men and Women of the Corporation*; Basic Books, New York, 1977.
6. Burke, R. Mentors in organizations. *Group Organ. Stud.: Int. J.* **1984**, *9*, 353–372.
7. Ragins, B.; Cotton, J. Mentor functions and outcomes: A comparison of men and women in formal and informal mentoring relationships. *J. Appl. Psychol.* **1999**, *84*, 529–550.

8. Cawyer, C.; Simonds, C.; Davis, S. Mentoring to facilitate socialization: The case of the new faculty member. *Int. J. Qual. Stud. Educ.* **2002**, *15*, 225–242.
9. Boice, R. Lessons Learned about Mentoring. In *New Directions for Teaching and Learning*, No. 50; Sorcinelli, M., Austin, A., Eds.; Jossey Bass: San Francisco, 1992; pp 51–61.
10. Luna, G.; Cullen, D. L. Empowering the Faculty: Mentoring Redirected and Renewed. ASHE-ERIC Higher Education Reports No. 3; 1995.
11. Madison, J.; Huston, C. Faculty-faculty mentoring relationships: An American and Australian perspective. *NASPA J.* **1996**, *33*, 316–330.
12. ADVANCE Portal. <http://www.portal.advance.vt.edu/> (accessed August 2010).
13. Packard, B. A ‘Composite Mentor’ Invention for Women in Science, American Educational Research Association Annual Meeting, Montreal, 1999.
14. Chesler, N. C.; Chesler, M. A. Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community. *J. Eng. Educ.* **2002**, *91*, 49–56.
15. Simeone, A. *Academic Women: Working towards Equality*; Bergin & Garvey Publishers, Inc.: Boston, 1987; p 101.
16. Women Chemists 2000. American Chemical Society. http://www.chemistry.org/portal/resources/ACS/ACSContent/careers/empres/WCC_contents.pdf (accessed January 5, 2006).
17. 2005 Carnegie Classification of Institutions of Higher Education. The Chronicle of Higher Education Almanac. <http://chronicle.com/article/2005-Carnegie-Classification/47991/> (accessed August 19, 2010).
18. Shapiro, E.; Haseltine, F.; Rowe, M. Moving up: Role models, mentors, and the ‘Patron System’. *Sloan Manage. Rev.* **1978**, *5*, 51–58.
19. Clark, S.; Corcoran, M. Perspectives on the professional socialization of women faculty: A case of accumulative disadvantage? *J. Higher Educ.* **1986**, *57*, 399–414.
20. Johnsrud, L. K. Mentor relationships: Those that help and those that hinder. *New Direc. Higher Educ.* **1990**, *18*, 57–66.
21. Chesler, N. C.; Single, P. B.; Mikic, B. On belay: Peer-mentoring and adventure education for women faculty in engineering. *J. Eng. Educ.* **2003**, *92*, 257–262.
22. Andrew W. Mellon Foundation Grant for Faculty Career Enhancement. List of Awards. Interinstitutional Initiatives, December 2003. <http://www.depauw.edu/admin/acadaffairs/facdev/careerenhanceclusterawards2003.asp> (accessed January 3, 2006).
23. The eight-institution Mellon cluster consisted of Denison University, DePauw University, Furman University, Harvey Mudd College, Middlebury College, Rhodes College, Scripps College, and Vassar College.
24. Senge, P. M.; Kleiner, A.; Roberts, C.; Ross, R. B.; Smith, B. J. *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*; Doubleday: New York, 1994.

25. Guskey, T. *Evaluating Professional Development*; Corwin Press: Thousand Oaks, CA, 2000; pp 14–30.
26. Collins, A.; Brown, J.; Newman, S. Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing, and Mathematics. In *Knowing, Learning, and Instruction: Essays in Honor of Robert Klatzer*; Resnick, L., Ed.; Lawrence Erlbaum: Hillsdale, NJ, 1989.
27. Sunal, D. W.; Hodges, J.; Sunal, C. S.; Whitaker, K. W.; Freeman, L. M.; Edwards, L.; Johnston, R. A.; Odell, M. Teaching science in higher education: Faculty professional development and barriers to change. *Sch. Sci. Math.* **2001**, *101*, 246–257.
28. Herr, K. Exploring excellence in teaching: It can be done! *J. Staff, Program, Organ. Dev.* **1988**, *6*, 17–20.