CENTER FOR Children & Technology

The Benefits of Online Mentoring
for High School Girls:

Telementoring Young Women in Science,
Engineering, and Computing Project

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Year 3 Evaluation

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Introduction

> *Any time that I had a problem I could send her an email, and I would come back the next day and there it was waiting for me! I wasn't sure what I wanted to do with my life, to go into engineering, or physics, or the arts. My telementor really helped me know that everyone feels this way.*
> — *Eleventh grader, Brooklyn, N.Y.*

Since 1988, EDC's Center for Children and Technology (CCT) has conducted several investigations into the relationship between gender and technology that shed light on the needs of young women who are working in or considering careers in engineering or computing (Bennett, 1993; 1996; Brunner, Hawkins, and Honey, 1988; Brunner, 1991; Hawkins, 1991; Hawkins et al., 1990; Honey, 1994; Honey et al., 1991; 1994). These studies point to the many tensions and conflicts that young women experience when contemplating or pursuing technical and scientific courses and careers. Girls in high school pre-engineering classes reveal their feelings of isolation and the challenges they encountered when they approached their technical or design work differently from their male peers (Bennett, 1993; 1996). There was no one to validate the difficulties they were experiencing, and there were no female mentors to share similar experiences and help them craft strategies for dealing with these issues. This, in turn, resulted in many of the students questioning their own abilities to succeed in engineering.

With funding from the National Science Foundation, the *Telementoring Young Women in Science, Engineering, and Computing* project was created to develop and test online mentoring environments in which high school girls could safely discuss their school experiences and feelings with practicing women professionals who had "made it" in science and technical fields. Central to the project's goals was the belief that ongoing electronic communication with successful women engineers and scientists could provide girls with validation and advice rarely found in traditional educational settings. Because young women do not have easy access to professionals, we speculated that telecommunications could be a particularly appropriate medium for providing this kind of support. Through online conversations and discussions, professionals could address many of the girls' apprehensions, tensions, and questions by providing expert knowledge, useful strategies for overcoming fears and obstacles, and sound career advice. We also speculated that this additional support could help sustain girls' interest in science and technical fields and broaden their awareness of different career options.

About the Telementoring *Program*

When we received funding for this project in 1994, the notion of using the Internet for online mentoring experiences was novel. We understood that it would take intensive work to understand how relationships between younger and older people might flourish in this medium where individuals do not have the benefit of meeting face to face. We conducted intensive formative research in Year 1 with girls enrolled in a junior-year mechanical engineering course in a New York City public high school. We also conducted formative studies with mentors recruited from a range of institutions.

The Year 1 formative research informed the development of the following chief components of the *Telementoring* program:

- **ONE-ON-ONE MENTORING RELATIONSHIPS:** At the heart of *Telementoring*, high school girls engaged in private discussions via email with women professionals to gain useful strategies for overcoming obstacles and fears, expert knowledge, and sound career advice.

- **PEER LOUNGES:** *Telementoring* participants were separated into mentor, student, or teacher clusters to engage in training and orientation experiences that helped prepare them for their work online and helped them get to know their peers. Each cluster was provided with its own mailing list, referred to as "lounges."

- **DISCUSSION FORUMS:** Large-group discussion forums addressed such topics as the balance of family and work, self-image and self-confidence, networking and professional contacts, career opportunities and options, and strategies for dealing with classroom issues. These focused discussions took place via group mailing lists and were moderated by experienced mentors.

- **PROJECT WEBSITE:** A World Wide Web site provided detailed information about the *Telementoring* project, as well as project-related materials, college and career information, and other information sources that had proven to be useful in supporting young women in science and technology.

- **GUIDES FOR PREPARATION AND IMPLEMENTATION:** Print-based implementation guides for teachers and orientation materials for students and mentors provided information to assist participants in joining and staying with *Telementoring*.

In the second year of the project (1995–96), we collaborated with the Department of Energy's *Adventures in Supercomputing* (AiS) program to pilot-test *Telementoring* in ten schools located in five states: Alabama, Colorado, Iowa, New Mexico, and Tennessee. The primary goal of the AiS program is to capture and cultivate the interests of diverse populations of high school students, particularly girls, in science, mathematics, and computing through project-based computational science courses. AiS provided a unique opportunity to work with a wide range of ethnically and economically diverse high schools equipped with the appropriate technologies (including access to the Internet and individual email accounts), making *Telementoring* possible.

In the third year of the program (1996–97), we continued to collaborate with the AiS program to implement the program more broadly and to conduct a more comprehensive evaluation of *Telementoring*. The primary goal of the Year 3 research was to evaluate what actually happened in online mentoring relationships and to assess the impact the program had on female participants' perceptions of science, engineering, and computing, and their inclinations to pursue studies in these fields.

About this Report

This report focuses on the heart of the *Telementoring* project — the individual online relationships between students and mentors during the final evaluation year. Because online mentoring via the Internet was relatively new, we were interested in investigating the types of relationships that could evolve in this medium and the ingredients necessary for creating satisfying relationships. In addition, we were interested in understanding the impact *Telementoring* had on students participating in the program. This meant examining the dynamics of *Telementoring* relationships from both the students' and the mentors' perspectives.

Our evaluation focused on collecting data from both mentors and their respective mentees to address four key questions:

- What took place in online relationships between female students and their Telementors?

- What were mentors' and students' perceptions of these relationships and of each other?

- What were the characteristics of good relationships and the factors that mediated these relationships?

- What impact did *Telementoring* have on students' career aspirations, perceptions of scientists, and career-seeking behaviors?

In the first section of this report, we explore the key participants in the project and the unique set of circumstances they brought to the *Telementoring* experience. The second section examines the nuts and bolts of relationships — how often mentors and students actually communicated, what they tended to discuss, and what types of learning experiences took place. The third section discusses students' and mentors' perceptions of the quality of their relationships and some of the intervening factors that mediated their satisfaction. The final section focuses on *Telementoring*'s impact on students' awareness of careers, their career aspirations, and their behaviors. Based on a myriad of findings, we suggest future directions for research and development.

About the Study: Research Plan and Methods

Research in previous years of the *Telementoring* project revealed that online relationships tend to vary in content, frequency, and scope, posing interesting questions as to how much communication is enough and what kinds of relationships could possibly take place between individuals online who never meet face to face. We used a broad range of methods to assess different aspects of online *Telementoring* relationships:

- **WEB-BASED APPLICATIONS**: To collect baseline information about participants prior to participation, all mentors and students were required to complete applications soliciting general demographic data, as well as more qualitative information about their life goals, career/academic aspirations and anxieties, and expectations of the program. These data enabled us to gain a sense of what participants brought to the *Telementoring* experience.

- **END-OF-YEAR EVALUATION SURVEYS**: Both mentors and students were required to complete end-of-year evaluation surveys that were designed to assess the content and scope of *Telementoring* relationships and to investigate students' and mentors' perceptions of their experiences. These surveys were emailed to both mentors and students participating in the program.

- **ONLINE CONVERSATION TRANSCRIPTS**: To have a better sense of how students and mentors discussed issues online, we collected online transcripts of email exchanges for 30 mentor-student pairs. The transcripts served as additional data to interpret students' and mentors' self-reports of conversations that took place.

- **PRE-POST ATTITUDINAL SURVEYS**: To better understand the impact of *Telementoring* on students' attitudes and behaviors after participation in the project, all *Telementoring* students were asked to complete pre- and post-attitudinal surveys on a private webpage mounted on the project website.[1]

- **IN-DEPTH INTERVIEWS**: To broaden our understanding of the project's impact, we conducted in-depth interviews with a subset of 40 students in 4 states. Interviews probed for what students explored in their relationships, as well as their perceptions of how *Telementoring* influenced their career aspirations and life goals.

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[1]In our original research design, we had included a control group of AiS students who were not participating in the *Telementoring* project. However, our research in Year 2 revealed that such comparisons were not fruitful since impact was much more subtle than broad survey measures could assess.

Due to scheduling and technical difficulties at the school level, the response rate for online end-of-year evaluation surveys and attitudinal surveys was lower than anticipated for students (only 30–50 percent of students completed and returned these measures). On the other hand, roughly 70 percent of the mentors completed online evaluation surveys. Despite these return rates, the combination of these data enabled us to gain a rich portrait of the nature of telementoring and the potential benefits it holds for students.

Who Were *Telementoring* Participants?

As in any online program, the success of the *Telementoring* program was largely dependent on the willingness of diverse groups of people to facilitate and participate in online exchanges. *Telementoring* involved three core groups of participants: teachers and their respective schools, female students ages 14–19, and professional women serving as online mentors. Each group brought diverse backgrounds and circumstances to the *Telementoring* experience. The descriptions of each group are based on information that students, teachers, and mentors provided in their applications to the program.
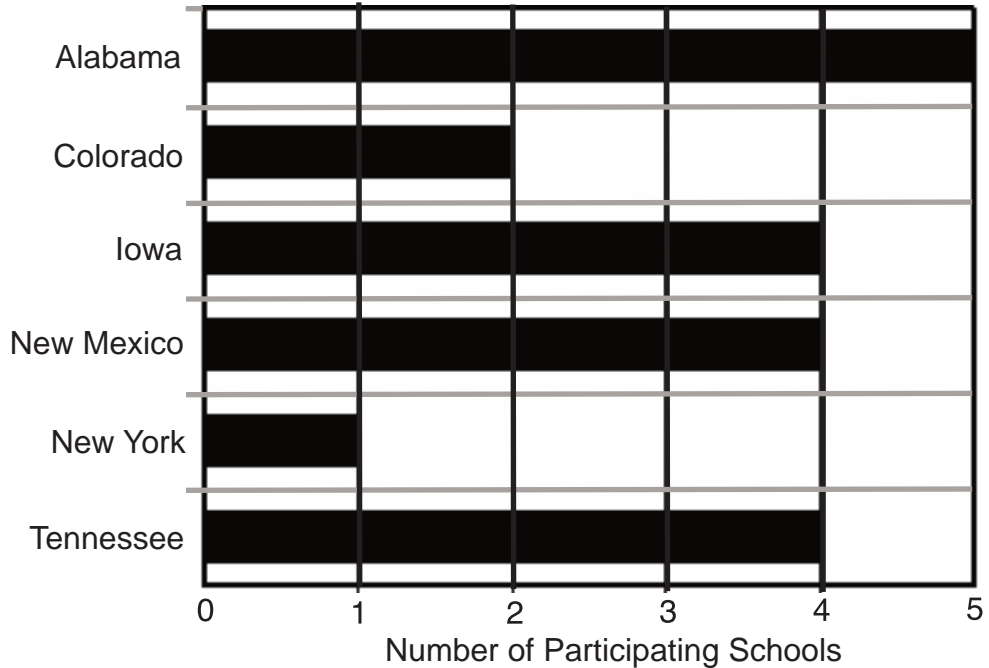
Participating Schools

PROFILES OF SCHOOLS

Participating schools were predominantly recruited through the Department of Energy's *Adventures in Supercomputing* (AiS) program — a project-based computational science program for high school students in Alabama, Colorado, Iowa, New Mexico, and Tennessee. Our collaboration with the AiS program was an attempt to build on an existing network of schools dedicated to promoting computational science skills and increasing the participation of young women and people of color in technical courses and careers. In addition, we continued to work with a mechanical engineering program at a specialized high school in Brooklyn, New York, that was also dedicated to this cause and that had served as a co-developer with CCT during the first year of the project.

While there was a great deal of interest in *Telementoring* outside of the AiS network of schools, we limited acceptance to AiS schools since they had an existing technical and administrative infrastructure for providing Internet connectivity, recruiting teachers, and disseminating information. Furthermore, AiS schools provided a population of students already in a science and technology pipeline — a population we were most interested in reaching, since *Telementoring* was designed as a program to *sustain* the interests of girls in science and technology. The schools were invited to apply through online announcements and through applications administered by AiS program coordinators in each state.

Overall, the *Telementoring* project recruited 20 high schools in 6 states (see Figure 1). The greatest number of schools were located in the Southeast and Midwest and the fewest schools in New York and the Southwest. Thirty-five percent of the schools that applied were located in a small city, followed by a third of the schools situated in large cities. The remaining schools were in rural, small town, or farming communities. Due to technical difficulties with its server, one school was unable to participate.

Figure 1: Number of Schools by State

State	Number of Participating Schools
Alabama	5
Colorado	2
Iowa	4
New Mexico	4
New York	1
Tennessee	4

Number of Participating Schools

School sites in the southern states of Alabama and Tennessee tended to be more rural in character and hence more isolated. Teachers in these states overwhelmingly remarked that they hoped the *Telementoring* program would provide their students with a greater vision of the world outside their small towns and an increased sense of the variety of people and career possibilities that exist. Young women in Alabama and Tennessee seemed to have access to far fewer opportunities (within their own communities) to explore a range of lifestyle and career choices. In other participating states, these opportunities were generally offered by universities, industries, and the diverse professional populations that tended to coalesce around these institutions.

CONDITIONS OF SCHOOL-BASED EMAIL ACCESS

All schools involved in the AiS program were equipped to provide basic email access to students participating in the *Telementoring* project. At the minimum, this was to include access during a regularly scheduled class period. Computer facilities within schools were generally open during lunch periods, study halls, and after school for students to read and respond to email. However, the particular circumstances of open-computer periods varied widely from site to site, and occasionally female students reported that they did not feel comfortable using the computers during open periods that were dominated by male users.

At least two of the schools (one in Iowa, another in Tennessee) experienced significant server malfunctions during the year; students at these sites were unable to access their email for months at a time. Participants at the New York site had email accounts at a free, public-access provider. These students also had considerable difficulty logging in to their accounts because the server's phone connections were often busy.

Approximately one-fourth (24 percent) of *Telementoring* students reported that they also had email access from home.

Student Participants

Students were largely recruited by teachers in our different school sites who hosted orientation sessions and distributed recruitment materials. Teachers generally recruited students from their computational science, physics, or mathematics courses. As a result of teachers' efforts, the *Telementoring* project recruited 216 students from 19 high schools in 6 states; 153 of these students were matched with mentors. The remaining students did not complete the appropriate consent forms required for participation.
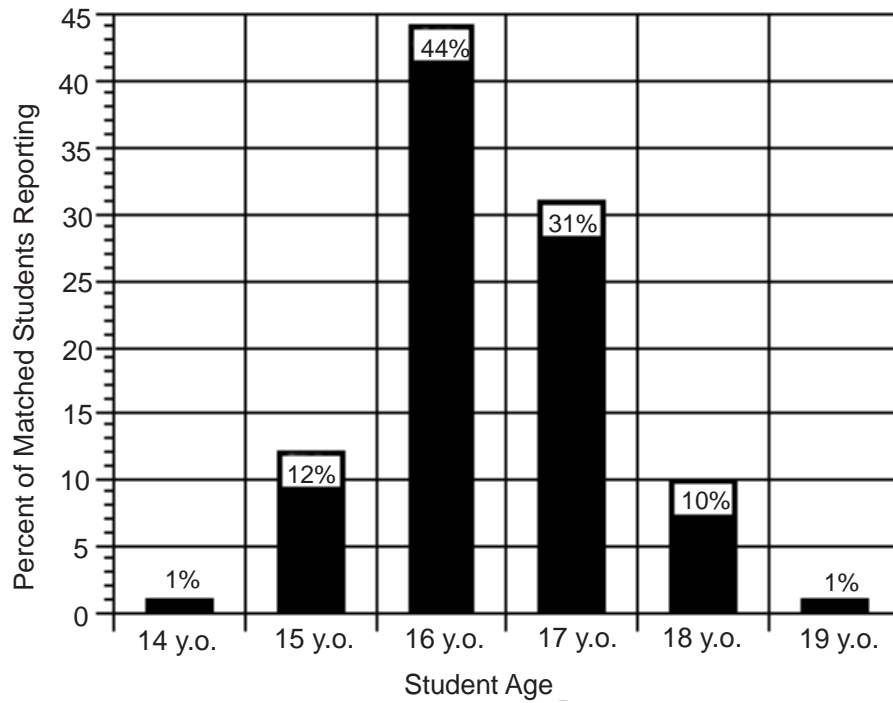
Telementoring participants were distributed across the six states, with the most students coming from Tennessee (29 percent), Alabama (21 percent), and Iowa (17 percent). Twelve percent of *Telementoring* participants lived in New Mexico, 12 percent in Colorado, and 9 percent in New York.

Figure 2: *Telementoring* Students by State (n=153)
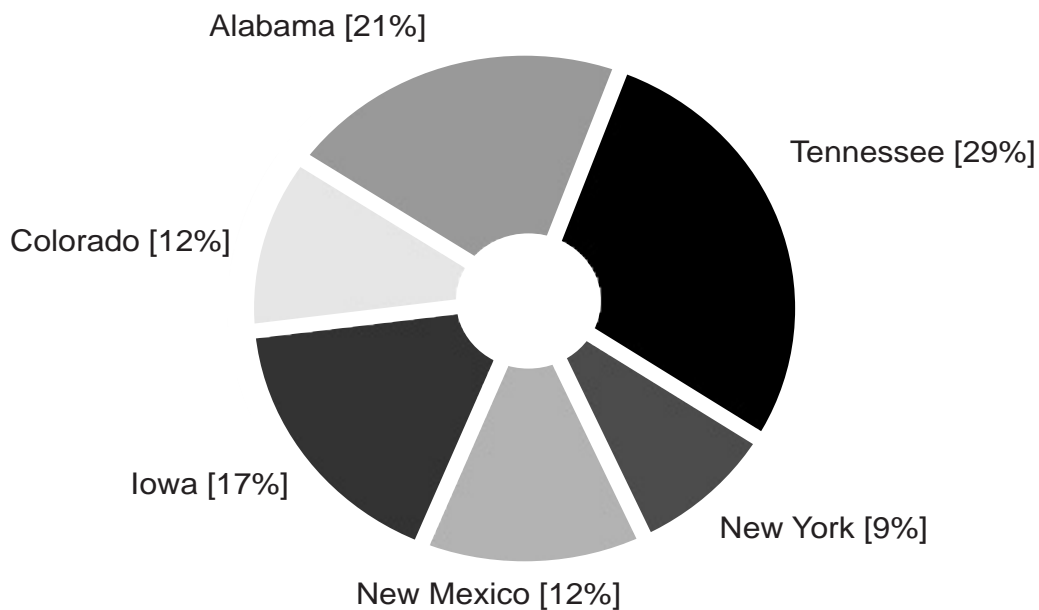
Students in the *Telementoring* program ranged in age from 14 to 19 years, spanning grades 9 through 12. The greatest number of participants were 16 years old and in their sophomore or junior year of high school. Roughly one-third of participating students were 17 years old. There were approximately equal numbers of 15 and 18 year olds involved in the program.

Figure 3: *Telementoring* Students by Age (n=152)

Telementoring participants were also relatively diverse in their racial and ethnic backgrounds. Fifty-six percent (56 percent) of *Telementoring* participants were Caucasian of non-Hispanic descent, 25 percent were Black/African American, 13 percent were Hispanic, and 6 percent were Asian or of Pacific Island descent.

Figure 4: *Telementoring* Students by Race (n=153)
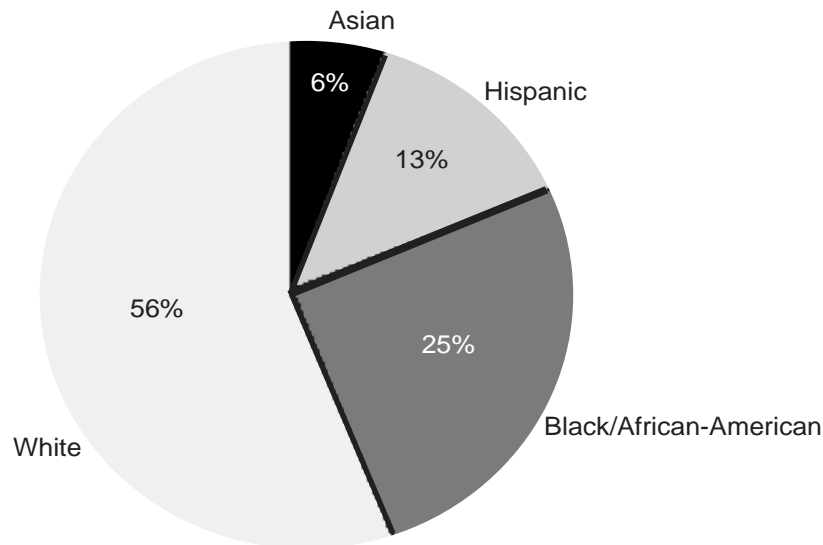
In addition, three young men and two students with hearing impairments were recruited during the course of the program. For reasons involving failed email connectivity, the young men (all from the same school) were never matched with Telementors. However, the students with hearing impairments were both matched with and involved in *Telementoring* relationships.

Mentor Participants

Mentors for the project were recruited through online announcements to a variety of mailing lists, as well as through in-person recruitment efforts. An announcement describing the project and inviting applications was posted to online mailing lists reaching a broad audience, including Black on Black Communications, Society of Hispanic Professional Engineers, Mexican American Engineering Society, Society for Black Engineers, AISESnet for American Indian Scientists, Systers, and Women In Science and Engineering Network (WISENET). In-person recruitment took place at the Women in Technology International Conference, the Supercomputing Conference, and the Telecommunications in Education Conferences during 1996 and 1997. In addition, our returning mentors passed on information to their colleagues about the project, and a substantial number of new mentors were informed about the project through informal networks.

Our recruitment of professional women was surprisingly successful. A total of 303 mentors had completed applications in Year 3, and 167 volunteered to be in our active pool of mentors in the fall of 1996. Of these mentors, 141 completed online trainings and were matched to students (some were assigned to more than one student). All mentors recruited were women.

Overall, our mentor pool was predominantly involved — and quite accomplished — in technically oriented careers. The majority of mentors reported their field of work as engineering (36 percent), with the largest number specializing in software engineering, electrical engineering, and computer engineering. Another 18 percent of mentors reported their field as computer programming or software development, and 11 percent indicated that they worked in the biomedical sciences. The remaining 36 percent of mentors worked in a range of fields, including physics and astronomy, mathematics, computational science, chemistry, earth science/geology/meteorology, social sciences, humanities, or business. Mentors indicating these categories represented less than 10 percent in each category.

The mentor pool was less racially and ethnically diverse than the student body, despite targeted efforts to recruit women of color. Of the mentors, 81 percent were white, 9 percent were Asian, 7 percent were Black/African American, 3 percent were Hispanic, and less than 1 percent were Native American.

Figure 5: Matched Mentors by Race (n=145)
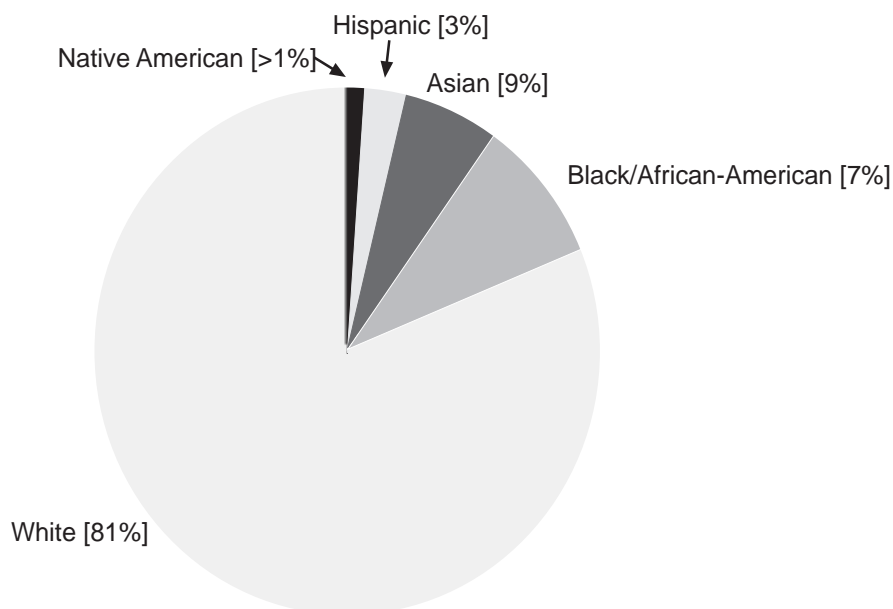
Of the mentors who reported their ages (n=147), 39 percent were between 30 and 40, 31 percent were under 30, and 26 percent were between 40 and 50. Mentors spanned the ages, with most in the 30- to 40-year-old age bracket. The fewest mentors (4 percent) were more than 50 years of age.

Figure 6: Matched Mentors by Age (n= 93)
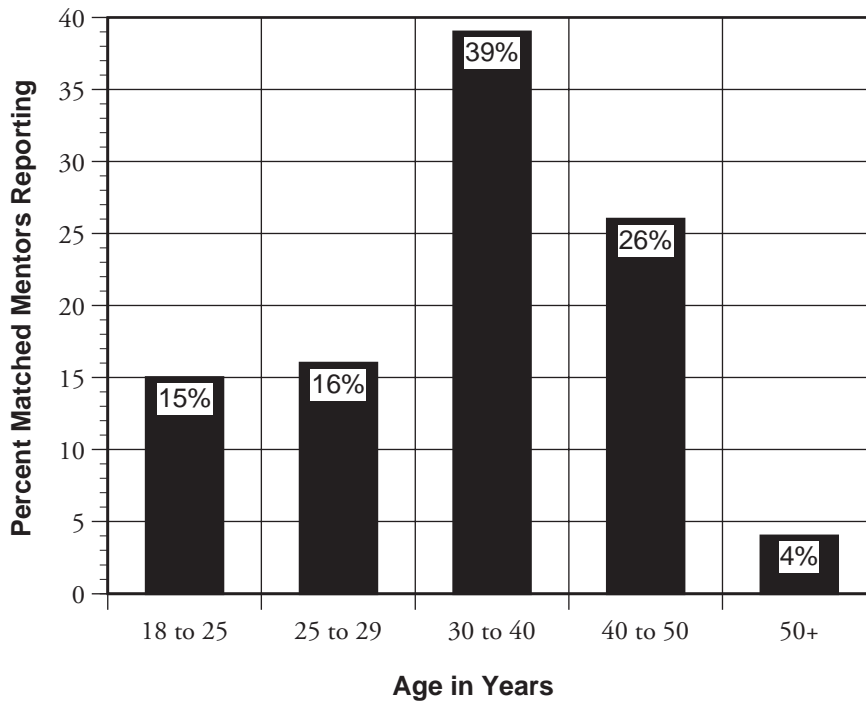
The Scope and Content of *Telementoring* Relationships

The first step to understanding the scope and content of *Telementoring* relationships was to determine how often the mentors and students communicated with one another and what they actually discussed in their online relationships. Because we viewed communication as largely motivated by the desire to build a relationship between two people (the mentor and the student), we documented both mentors' and students' perspectives on these issues through evaluation surveys and attitudinal surveys administered at the end of the academic year.

### Frequency of Communication

Based on previous research, we knew that frequent communication (e.g., email exchanges at least once a week) was essential to keep online conversations thriving. In both the end-of-year evaluation surveys and the attitudinal surveys, students and mentors were questioned about how often they communicated. Students were asked to select the most accurate description from six options: daily, once or twice a week, every couple of weeks, once a month, less than once a month, other. Mentors were asked to describe in an open-ended manner the frequency of their communication.

Of students (n=77) who responded to questions about the frequency of contact with their mentors on either the end-of-year evaluation survey or attitudinal survey, 46 percent indicated that they communicated with their mentors at least once a week, with 10 percent of these students noting that they "talked" daily. Twenty-six percent (26 percent) reported exchanging email with their mentors every couple of weeks, and 12 percent said they communicated about once a month. Thirteen percent (13 percent) communicated less than once a month, and 3 percent noted that they had begun corresponding regularly but had stopped doing so for a variety of reasons, including time demands.

Overall, mentors (n=86) reported similar communication patterns, but more mentors indicated instances where there was a drop-off in communication (15 percent as compared to 3 percent).

Additional qualitative data suggested that mentors and students differed in their notions of what constituted "enough" communication. Nearly a third of the mentors commented that they wanted to communicate more with their students, even in cases where they were communicating more than twice a week. Our interviews with students indicated that they did not necessarily need to communicate as

Figure 7: Frequency of Communication for Students (n=77)
and Mentors (n=86)
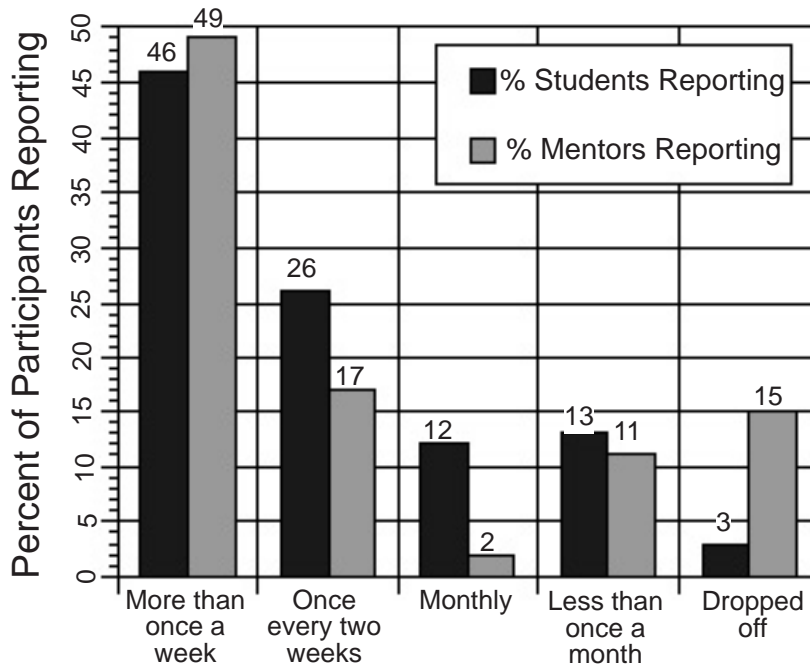
frequently to feel like they had a satisfying experience. Furthermore, students reported that communicating regularly was far more arduous for them, given frequent technical difficulties at the school level and limited access time during or after classes.

Topics Discussed in Telementoring Relationships

While it was clear that nearly three-quarters of the *Telementoring* participants were communicating regularly (i.e., at least once a week or every other week), we were interested in the kinds of topics that mentors and students addressed. Thus, we asked both students and mentors to note the topics they had discussed online during the course of their relationships.

STUDENTS

Overall, topics falling under the headings of "College" and "Careers" seemed to have received the most coverage in *Telementoring* exchanges. Of students responding to these questions (n=40), the greatest number (62 percent) indicated that they talked about college life and college courses with their mentors. Sixty percent (60 percent) of these young women also indicated that they had discussed career opportunities and their mentor's career.

Figure 8: Topics Discussed in *Telementoring* Relationships

Percent of Students Reporting (n=40)
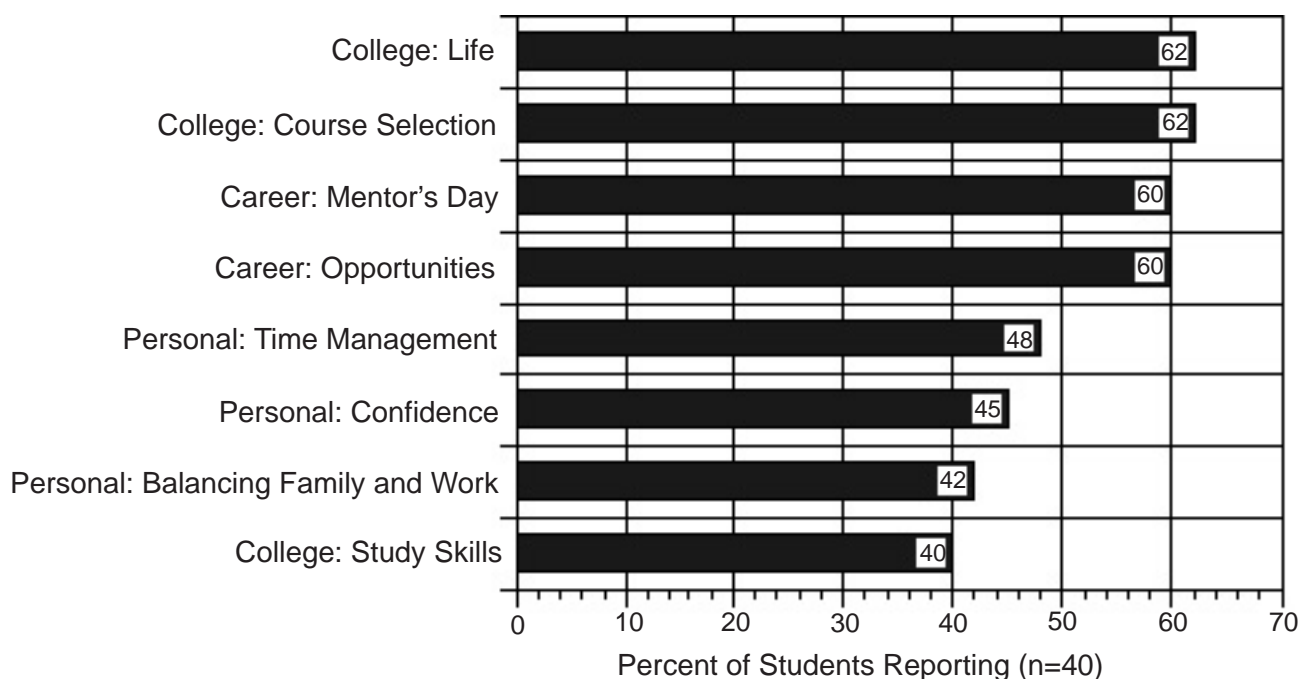
These topics were closely followed by "Personal Issues": 45 percent had talked about confidence issues, and 42 percent indicated that they had conversations about their families. Students also noted several pragmatic issues that they discussed with their mentors. About half of the participants (48 percent) noted that they had discussed time management strategies with their Telementors, and two-fifths (40 percent) of the young women discussed study skills that might be useful in college.

MENTORS

Mentors were also queried about the nature of their *Telementoring* conversations with students. They were asked, "What, if any, assistance (advice) did you provide in guiding your mentee in making transitions between high school, college, and work?"

Mentors' assessment of the advice they gave varied greatly. Less than one-quarter of the 93 mentors who responded to this open-ended question indicated that they encouraged their mentee to think about her future (including college) and to listen to her own desires. Fourteen percent cited specific college-related conversations (regarding financial aid, course selection, and general descriptions of college life and dilemmas) as having occurred in their exchanges with mentees, and 14 percent described other types of assistance they had provided (for instance, guidance about making definitive decisions, suggestions about family medical and financial conditions, and strategies for getting summer jobs). About a tenth of the mentors (8 percent) shared personal stories and experiences but did not necessarily categorize these as "advice." Approximately 3 percent of mentors reported that they worked on specific goals with their mentees, while another 3 percent suggested that their mentee was too young to be thinking about college or work goals.

More than one-quarter (27 percent) of the mentors indicated that they did not feel they had provided any guidance because they communicated only minimally with their mentees or they believed they hadn't explored substantive issues. Another 9 percent indicated that topics about academics and careers just never came up in their conversations.

These data suggest that mentors and students differed on what they considered worthwhile conversation. Mentors' comments on evaluation surveys revealed that several had high expectations for specific career-oriented conversations, which could explain the larger number of mentors who did not feel they were providing guidance on a consistent basis. On the other hand, what might have been regarded as casual chat by mentors was viewed as meaningful exchanges for students, as the following cases reveal.

Thematic Analyses of Learning Experiences in *Telementoring* Relationships

These preliminary findings led us to delve more deeply into how relationships transpired online between mentors and students and to identify the different kinds of learning experiences that did occur. We assumed that each *Telementoring* experience was unique and dependent on the individual circumstances that students

were facing. Nonetheless, we were interested in understanding the range of *Telementoring* relationships that could occur. To do so, we examined many factors about the student, her mentor, and the unfolding of their online relationship. Given the complexity of this endeavor, it was helpful to ground our examinations in some basic questions:

- What appears to open up meaningful conversations between mentors and students?

- What key issues or conflicts did mentors and students explore in their online conversations?

- How did students gain a sense of science, engineering, and mathematics careers in the context of these conversations?

We examined transcripts of mentor-student online correspondence for prevalent themes. In addition, we analyzed interviews conducted with 40 students. Within the tangle of young women's relationships, social and academic fears, anxieties, and aspirations, we created composites of different types of learning experiences that were supported in mentoring relationships. These composites offer a window into the possibilities that *Telementoring* can offer students.

DISCOVERIES ABOUT SCIENCE IN DIFFERENT CONTEXTS

One prevalent occurrence in *Telementoring* relationships was students and mentors using personal interests as a springboard for discussing science in contexts that were meaningful to the students. In discussing personal hobbies and interests (frequently unrelated to science, math, or computing), many students often discovered unexpected connections to these fields. For instance, 16-year-old Nia[2] indicated that biomedicine and mathematics were possible career interests, but also remarked, "My favorite thing to do is to read. I like almost all kinds of fiction books, ranging from horror to romance to suspense." Nia's mentor, a post-doctoral fellow in biomedicine, shared a similar passion for books, and the two quickly struck up a relationship discussing their recent reads and recommending books, as well as chatting about their families and customs.

When interviewed, Nia was asked if she had been surprised in any way by her mentor or her mentor's work. Immediately, she responded yes. After a conversation about historical fiction, Nia's mentor described her own scientific inquiries as stories — with characters, plots, conflicts, and suspense. This was something the young woman had not previously considered, and a world of possibilities opened up for her. Later, Nia noted, "I realized that science can be an option for a career . . . "

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[2]Names of participants have been changed to ensure confidentiality.

Angel's tale was similar. While introducing herself, this 17 year old from southern Tennessee wrote, "The love of my life is MUSIC!@#$ %! Everything that I do is connected to music — school, church, 'recreation' — everything. I sing alto in classical as well as gospel music, gospel being my favorite." Though Angel's mentor was not a musician herself, she was very interested in jazz and gospel, and her husband regularly performed in such groups. The two discussed performers, producers, and scores.

At one point, Angel's mentor offhandedly mentioned that her husband grew into a career in computer programming after working as a musician and electronic technician. This information led to a discussion of computer composition. Later, Angel wrote:

> *You know, before we started this program, I couldn't possibly see how comput-ers could have anything to do with what I wanted to do in the future. Now I think differently. I believe I felt that way because I didn't understand too much about computers. You've helped me more than you realized.*

In cases where these "moments of 'Aha!'" occurred, the students' discoveries were often motivated by some kind of personal connection. Their mentors were able to capture some spark from the student's personal life and gently stretch it so that it began to illuminate the realms of science or technology.

BALANCING RELATIONAL/FAMILIAL CONFLICTS AND ACADEMIC GOALS

Many *Telementoring* relationships simply seemed to help the students stay afloat in the tumultuous world of adolescence. Most of the young women in the program were preoccupied with parental, sibling, friend, and boyfriend matters, which invariably affected their choices about courses to take, colleges to consider, and resources (financial and psychosocial) to investigate.

For example, one 17 year old confided to her mentor that she often lived with her grandmother because of the extreme difficulties she had with her mother. Among the delicate matters they broached was applying for financial aid. The young woman was worried, since it would require her mother's involvement, and her mother was unwilling to disclose any information about income. Together, the student and her mentor discussed options for acquiring financial aid within this less than ideal context, such as exploring the possibility of filing for independent status with the help of her school counselor.

Another example came from Candy — the oldest of six children and the first in her family to consider attending college. A good student and an ambitious one,

Candy hoped to become a pediatrician, but she was also seriously involved with a young man. The two had been dating for nearly 18 months and planned to marry.

Candy's mentor, a software engineer and mother/stepmother of eight, did not question her attachment to her boyfriend. Instead, the two openly discussed a range of family matters, and, at some point, Candy began to share her mentor's comments and questions with her boyfriend. Gradually, the mentor began to pose questions about Candy's future for Candy and her boyfriend to discuss together. Within the safety of her existing relationship and with gentle encouragement from her mentor, Candy began to explore the possibilities of going away to college and maintaining a relationship over long distance and heavy course loads. In doing so, she received consistent support and praise from her mentor. At the close of her *Telementoring* relationship, Candy wrote this: "I would say that she is the greatest mentor and that she helped me to find the real me."

Judging from transcripts of online student-mentor conversations, much of what transpired involved some degree of this triage — identifying the relational and familial conflicts most important to the students and using them as a basis for further exploration. As a result, students and their mentors often arrived at concrete strategies to enhance the students' chances for success in school and in life.

Strengthening Academic and Work Skills

Virginia, a 16 year old who noted that she did not expect to communicate with a mentor very often and that she "made [herself] a participant because [she] wanted to talk to people from everywhere," often used her *Telementoring* correspondence to ask for advice about school projects or getting a job. She seldom divulged personal information and did not seem interested in her mentor's career or life.

This relationship appeared to be mostly informational. However, after an unsuccessful attempt to access a website her mentor had recommended, Virginia wrote in, discouraged. Her mentor responded, "I am sorry that the http address did not work for you, but please do not *ever* give up that easily, okay? Persistence will get you very far."

Following this exchange, Virginia's mentor began to share inspirational news stories, poems, and quotes on the preciousness of every moment, the value of a stable inner core, and the importance of persisting in the things you believe in. Gradually, Virginia opened up to this advice and began to relate her own stories of persistence — applying for two more jobs when the first did not materialize, and trying to lose weight. This strategy of persistence made its mark on Virginia, and she indicated that communicating with her mentor had undoubtedly influenced her feelings about continuing on in computing.

Concrete strategies for dealing *directly* with academic challenges also emerged in *Telementoring* relationships. For instance, after nearly two months of twice-weekly exchanges, Kristi (a first- generation American, a dedicated member of her school's basketball team, and an ''accelerated'' student) mentioned to her mentor that she would like to get at least Cs in her classes, but she was not certain she could do so. Until that moment, there had been little indication that Kristi was struggling with her courses. According to her mentor, she seemed articulate, engaged, and very busy with her school activities.

Amidst discussions of daily activities and travels, Kristi's mentor (also a first-generation American) restated the student's goal and probed for factors that could be hindering her. She asked Kristi to ''send me a list of each subject with the grade you currently have and the new grade you want. (I know you said all Cs, but you may want to consider shooting for the best grade you can possibly get . . . I have a feeling you have what it takes to do better than Cs.)'' She then provided some concrete strategies, such as tips on time management — balancing basketball, family life, and studies. In her interview, Kristi remarked that these strategies were extremely beneficial and things she would not have thought of herself.

Even more common was the exchange of strategies related to selecting college courses and majors that could bridge diverse interests. Many of the students had little idea how to select freshmen college courses if they were interested in more than one discipline. For instance, Serenity wrote to her mentor (a computer consultant with her own company), ''Will you please tell me more about your major? I am really interested in finding a way to combine computers and business.'' Her mentor emailed her some ideas for types of college courses that might be useful to take and suggested programs such as ''Management Information Systems'' that might encapsulate the young woman's interests.

Exploring Gender Issues

Some students and their mentors explored larger issues related to the role of gender in society and the world of work. One such student was Elise, a high school senior from New Mexico. After a few introductory exchanges, Elise explained to her mentor that over the previous summer she had interned at an electronics laboratory and was the only female in her department. She wrote, ''I want to know if you encountered difficulties in your field gaining respect and confidence. Last summer it was frustrating because when I did something well all the guys acted surprised! Ugh!'' Later, she added that she thought her mom had faced similar challenges: ''My mother had a hard time convincing her bosses she could handle projects because she was a mom.'' Her mentor responded with similar stories of her own, using them as a bridge for talking about the larger issues of gender inequity. As their

relationship developed, they began to consider the issue beyond their own lives (with regard to the experiences of friends and related news items), and to speculate on the ways this type of discriminatory behavior might be institutionalized and ways it might be changed.

While the *Telementoring* program was primarily about career mentoring — connecting young women with an interest in science, math, or computing with professional women in these fields — it became immediately clear that, for the most part, the young women's concerns about their personal lives were preeminent and integrally associated with any academic/career issues they might have. *Telementoring* offered many opportunities to explore these issues in an interconnected and personal way that appeared to be highly valued by students.

Perceptions of *Telementoring* Relationships

Students were exploring a broad range of issues in their relationships. Since emotional support and personal guidance were also central goals of the project, we wanted to discern how supported and satisfied participants felt over the course of their online *Telementoring* experience. How did they perceive these relationships? Did they feel that they gained anything significant from their online experience? Were they satisfied with their relationships and the advice they received? How did students think mentors influenced their ideas about science and technology? Similarly, we were interested in learning about mentors' perceptions of their mentoring relationships and their satisfaction with these relationships.

Students' Perceptions of *Telementoring* Relationships

We asked students to comment directly on how they felt about their relationships. These self-reports were collected through online evaluation surveys emailed near the end of the academic year and a Web-based attitudinal survey collected shortly afterward.

Perceptions of Support

Based on research findings from previous pilot years, we developed a measure to assess the degree to which students felt supported by their mentors in their online relationships. It probed for positive and negative characteristics that students had indicated were important to them. Students were asked to rate eight positive and six negative statements about their mentors on a scale of 1 to 10, where 1 was "not true at all" for their relationship and 10 was "completely true." Ratings were collapsed into a three-point scale to represent low, medium, and high ratings for each statement.

Overall, students were very positive about their relationships. Respondents (n=41) felt their mentors paid close attention to them (86 percent reported this was true), and many felt that they received useful information in the context of their relationships (see Table 1). Responses to individual statements also indicated that students felt their mentors helped to broaden their horizons and assisted them with their personal problems. Slightly fewer students felt their mentors helped them learn about what scientists are really like (58 percent) and about careers fields (52 percent).

Table 1: Students' Positive Supportiveness Ratings* (n=41)

Positive Statement	% Students Low Rating (score=1–3) Not True At All	% Students Med. Rating (score=4–6) Somewhat True	% Students High Rating (score=7–10) Completely True
She paid attention to details about me.	7%	5%	89%
She provided useful information.	12%	7%	81%
She helped me learn about different people and places.	17%	17%	67%
She helped me with personal problems.	28%	9%	63%
She gave me an idea of what scientists/ computer scientists are really like.	28%	14%	58%
She helped me learn about new careers.	25%	23%	52%
She helped me with my school work or project work.	17%	33%	50%
She boosted my confidence in my abilities.	41%	15%	44%

* Percents have been rounded

Students gave low ratings for all of the negative characteristics that were offered on the end-of-year evaluation survey (see Table 2). This confirmed that *Telementoring* participants generally felt very supported by their mentors and had positive perceptions of their relationships, aside from a small percentage of students (17 percent) who believed that their mentors were all work and no play.

Table 2: Students' Negative Supportiveness Ratings* (n=41)

Negative Statement	% Students Low Rating (score=1–4) Not True At All	% Students Med. Rating (score=5–7) Somewhat True	% Students High Rating (score=8–10) Completely True
She was too personal and made me uncomfortable.	98%	2%	0%
She couldn't provide the information that I needed.	91%	2%	7%
She didn't answer my questions.	85%	5%	10%
She was too busy for me and didn't have enough time.	76%	14%	10%
She wasn't personal enough.	75%	11%	14%
She was all work and no play.	66%	17%	17%

* Percents have been rounded

To gain a more holistic sense of how students perceived their relationships, *Overall Positive Rating* and *Negative Rating* indices were calculated by taking the sum of the numerical ratings for the eight positive statements and the sum of ratings for the six negative statements on the end-of-year evaluation surveys. These scores were then aggregated into three categories — low, medium, and high — for both positive and negative ratings. Frequencies were calculated for each category.

Overall, 78 percent of student respondents (n=41) scored a high *Positive Rating*. Correspondingly, 92 percent scored a low *Negative Rating*. These findings suggest that students had overall positive perceptions of their *Telementoring* relationships.

Qualitative data from interviews and the evaluation surveys supported these claims. Nearly all students spoke of their mentors in congenial terms and pointed to specific helpful advice they received in the context of their relationships. For example, many students said that their mentors were "more than a friend but not like a parent" in that they provided advice and support that was not judgmental.

THE RIGHT MATCH?

At the beginning of the project, efforts were made to match students with mentors based on preferences expressed on applications. However, our mentor pool did not always offer all the qualities students asked for. To further understand how students regarded their mentors, students were asked to rate the quality of their match, i.e., how well their mentor matched their field of interest, on the end-of-year evaluation surveys. Nearly three-quarters (68.2 percent) of student participants (n=44) indicated that their match was good.

PERCEIVED INFLUENCE OF MENTORS

At the end of the year, students were asked to comment on whether communicating with a Telementor had influenced the way that they felt about science, mathematics, or technology. Of the 68 students who responded to this question on the post-attitudinal survey, 44 percent (n=30) indicated that they had been influenced.

The term *influence* carried many meanings. For some, it related to perceptions of academic disciplines or career fields; for others, it meant their own ability to succeed in these areas. As one student explained:

> *I have always been interested in science . . . well, at least archaeology. I had a lot of doubts on pursuing that career for many reasons, but with [my mentor's] help I now know that I can do it even though I am a woman and live in a small town. [My mentor] has helped me.*
>
> *— 16 year old, Tennessee*

For other students, Telementors influenced how they approached or pursued particular endeavors and the importance they assigned to these activities, as the comments below reveal:

> *It has exposed me to different fields of science and technology. It has also exposed me to the many different kinds of people in these fields.*
>
> *— 17 year old, New Mexico*
>
> *It has helped me in choosing my future.*
>
> *— 18 year old, Tennessee*
>
> *It has really made me understand the subjects a little bit more.*
>
> *— 17 year old, Alabama*
>
> *I feel more comfortable with these subjects since I've had a Telementor.*
>
> *— 18 year old, Iowa*

I am more familiar with the life and work of a true woman scientist, and what I need to accomplish to get there.

—18 year old, Iowa

I've decided to major in computer programming because I fell more in love [with] it while talking to my mentor.

— 18 year old, Tennessee

It doesn't seem as hard or impossible.

— 16 year old, Tennessee

It proved that there are interesting jobs that you can have in these fields.

— 15 year old, Iowa

You see how the things you learn are actually applied to work.

— 16 year old, New York

Because it let me see different and fun things about science, math, and technology that I didn't know about.

— 17 year old, Tennessee

Students who did not report having been influenced with regard to mathematics, science, or technology often mentioned that they had benefited in other ways by communicating with an older, more experienced woman who was outside their immediate sphere of influence. Students explained how they "never really thought how science and technology was all that important, and this has changed my mind" or how their mentor "influenced the way I went about things, not so much what I thought."

Mentors' Perceptions of *Telementoring* Relationships

Students provided one side of the *Telementoring* story. We were also interested in learning how mentors assessed the quality of their mentoring relationships. Through an emailed evaluation survey, mentors were asked to rate their overall satisfaction with their *Telementoring* relationships and their satisfaction with the tone of the relationship. They also were probed for their own perceptions of how they influenced their mentees and for whether they would consider participating in the program again.

Overall Satisfaction Rating

At the end of the *Telementoring* year, mentors were asked to "comment on your mentoring assignment; were you satisfied?" Their responses were coded on a three-point scale by two independent coders. Overall, 74 percent of the 96 mentors who responded to this question noted that they were satisfied or somewhat satisfied with their relationships; 55 percent indicated that their assignments were good, 19 percent of mentors said their relationships were fair or moderately satisfactory, and 26 percent were dissatisfied with their online mentoring experiences. Those who were dissatisfied tended to indicate that they did not communicate regularly enough with their students or that the student was not interested in career-related discussions.

Satisfaction with Tone

In our pilot research, mentors raised issues about the somewhat "chatty" or personal quality of their conversations with mentees and how this impacted their satisfaction with their relationships. This led us to probe how satisfied mentors were with the overall tone of their conversations — the overall spirit and conversational manner of their online relationships with students. Mentors' satisfaction with the tone of their relationships was somewhat less than their overall satisfaction ratings. Forty-three percent of the 100 mentors who completed this item indicated satisfaction with the tone of their *Telementoring* relationships. Twenty-seven percent were somewhat satisfied but felt the experience could have been improved in a number of ways, and 23 percent were not satisfied with the tone of the communication.

In examining the commonalities among mentors reporting positive experiences, several themes emerged. Overall, mentors who felt positive about their relationships were those who had relatively flexible, open-ended expectations, often formed by previous mentoring experiences with teenage students. These mentors were not concerned about becoming "just" a pen-pal for their students. Generally, they saw their role as someone who could be there for the student. These mentors tended to describe their students as "new friends," rather than as younger protégées who needed advice and guidance. They were also likely to state that their mentee matched or exceeded their expectations; as one mentor explained:

> *I was pleasantly surprised by how well my student did with email. I had been prepared for her to have primitive systems and limited ability to handle long email messages. None of this was true, which contributed to the positive experience for both of us.*

Mentors who were not satisfied or only somewhat satisfied with their mentoring relationships tended to cite lack of depth and infrequency of communication as primary reasons:

> *It was satisfactory, but I feel that it could have been more productive. Our relationship was at a very shallow level, and, except for a few discussions about college and work, it was mostly a pen-pal type of relationship.*
>
> *I would have preferred more focus on future preparation for careers, etc. But perhaps that is unrealistic for most teenagers.*

Mentors were clearly more critical of relationships than students, which may have derived from their expectations of what mentoring should involve.

INFLUENCE ON STUDENTS

Overall, mentors had a range of perceptions about their impact on their mentees. Mentors who described their students as accomplished, capable, and self-confident often felt they did not influence their students. These mentors felt the students were doing fine on their own, although they enjoyed the contact with them. Mentors who described mentees as having intense personal lives also did not feel they had a great impact, since many of these students were most interested in discussing more traditional marriage and family issues that mentors did not always feel comfortable discussing. Mentors who described students as interested yet undecided about their careers most frequently reported that they expanded their student's awareness of career options and often provided examples of how they did so.

WILLINGNESS TO SERVE AS A TELEMENTOR AGAIN

Though only about half of participating mentors indicated that their *Telementoring* relationships had met their expectations in terms of depth and breadth of communication, almost all of the women (91 percent) indicated that they would participate in the program again if given the opportunity. This finding suggests that mentors understood the challenges of trying to building trust and developing deep and rich conversations online with strangers, and yet their experiences with young women led them to believe it was possible and productive to do so.

Combined Student-Mentor Perceptions of Online Relationships

To gain a better sense of the dual rather than individual experience of participants in relationships, we mapped student and mentor satisfaction/support indicators against each other to understand the extent to which students and their mentors agreed in their perceptions of their *Telementoring* relationships.

Using *Overall Positive Ratings* (for students) and *Overall Satisfaction* and *Tone Satisfaction Ratings* (for mentors) as indicators of *Telementoring* support and satisfaction, we examined how well students' and mentors' perceptions matched.[3]   We also looked for factors common to the relationships where there was agreement and where there was not. Data necessary for this analysis were available on 31 mentor-student pairs.

Of these 31 pairs, two-thirds (n=19 pairs) were in agreement and expressed a high degree of satisfaction or support in their relationships. Two additional pairs (6 percent) also agreed on the quality of their relationships, but in these cases, both students and mentors indicated that they were *not* satisfied with the experience.

In eight cases (27 percent of pairs), mentors and students disagreed about the quality of their relationships. In six of these pairs (19 percent), mentors rated the *Telementoring* experience higher than students. In three pairs (10 percent), students were more satisfied than their mentors with their *Telementoring* experience, and in one pair the student and her mentor shared neutral feelings about their relationship. Table 3 summarizes these results.

Table 3: Mentor-Student Agreement About Their Relationship (n=31)

	Mentor Satisfied	**Mentor Not Satisfied**
Student Satisfied	64% (n=19 pairs)	10% (n=3 pairs)
Student Not Satisfied	19% (n=6 pairs)	6% (n=2 pairs)

These data suggest an overall alignment of student-mentor expectations. In most cases, both students and mentors felt positive about the state and progress of their relationships.

In the instances where there was not agreement, students or mentors often mentioned that communication had been irregular. Generally, when mentors rated

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[3]It must be noted that measures of satisfaction and support between students and mentors may not be entirely comparable, as students did not directly rate their satisfaction with the experience, while mentors did. Instead, students rated a series of statements related to satisfaction and support.

the relationships more positively than their mentees, mentors suggested that the relationship had potential but time and technical constraints were problematic. For instance, one mentor noted, "We exchanged only half a dozen messages or so. Unfortunately, due to technical glitches on both sides (her computer went bad for a while, then mine did), we really didn't take this relationship as far as it should have or could have gone."

Students in this same category, however, did not attribute their less-than-positive experiences exclusively to lack of communication. Three of the six students indicated that they would not have wanted to communicate any more frequently with their mentor. The other three students indicated that they would have liked to communicate more *personally* with their mentors. For instance, one student described how, early in their relationship, her mentor had talked much about her own teenage children and family — occasionally asking the student for advice and suggestions. Later, as her mentor focused more on career issues, the student felt less connected and less motivated to write.

Factors Mediating Participants' Degree of Satisfaction and Support

In examining the differing perceptions of mentors and students, we were interested in examining further what factors might play a role in satisfactory or supportive relationships. We speculated that frequency of communication, age, and race of the participants might play a role in students' and mentors' satisfaction and support experienced in *Telementoring* relationships. Each of these factors is examined below.

FREQUENCY OF COMMUNICATION

Three-fourths of mentor-student pairs in which there was positive agreement about the quality of the *Telementoring* relationship (i.e., both mentors and students indicated that they felt satisfied or supported by *Telementoring* experiences) indicated that they communicated at least once a week. The remaining 25 percent (n=5) communicated every couple of weeks. In contrast, pairs that were in negative agreement or in disagreement about the quality of their relationships tended to communicate less frequently, managing to maintain only biweekly or monthly contact.

In examining the relationship between frequency of communication and students' perceptions of being influenced, it was also notable that students who communicated with their mentors at least once every two weeks indicated that they were more influenced by their mentor than students who communicated less often. However, weekly or biweekly contact was by no means required for impact. Some

students who had corresponded with their mentors only a handful of times over the course of the year described with great clarity how important their mentors' presence had been to their lives and the decisions they had made.

DEMOGRAPHICS: AGE AND RACE

Research in prior years of the project suggested that the age of the mentor might play a role in the satisfaction participants experienced with their relationships. To investigate this issue, we conducted chi-square analyses to identify any significant patterns between age and some of the indicators of satisfaction and support we identified. Mentor age was a marginally significant factor in mentors' satisfaction with the tone of their relationships ($p = .05$). Younger mentors (between the ages of 18 and 29) tended to be more satisfied than older mentors. This is not surprising, since younger mentors may have more in common with young women making a transition between high school and college. These young mentors, recent college graduates or graduate students, are more familiar with many of the decisions and dilemmas the young women are experiencing.

Additionally, older mentors, who are more steeped in careers and perhaps more reflective about the information and advice that would have made their journeys easier, may have had greater expectations about what can be accomplished through these conversations. In their evaluation surveys, mentors who were dissatisfied often cited that they were unable to get into "deeper, more intellectual" career-oriented discussions with their mentees.

Mentor age was not significantly related to other indicators of support or satisfaction (*Positive Rating, Overall Satisfaction*). Nor was the mentor's race a significant factor in any of the analyses. In addition, student age and race were not significant factors in mentors' or students' perceptions of the quality of their relationships.

Impact of *Telementoring* on Students' Career Aspirations, Attitudes, and Behaviors in Science and Technology

Since the program was designed to promote positive attitudes toward science and technology and to spark awareness of careers in these fields, we were also interested in assessing the kind of impact *Telementoring* could have along these dimensions. Given the range of student participants' interests, aspirations, and proficiencies, as well as the limited time of possible influence, impact was broadly defined in the *Telementoring* research. We speculated that the *Telementoring* experience could positively affect young women participating in the program in the following ways:

- *Telementoring* may sustain or increase students' inclinations to pursue careers or studies in mathematics, science, and computing through exposure to mentors working in diverse scientific or technical fields.

- *Telementoring* may broaden understandings of what scientists, computer scientists, and engineers are like and what it takes to be successful in these fields.

- *Telementoring* may help young women acquire specific strategies for pursuing and succeeding in endeavors (classes, internships, jobs) related to math, science, and computing.

Utilizing data from online attitudinal surveys completed by students before and after the *Telementoring* experience as well as end-of-year evaluation surveys and interviews, we examine these three core areas of impact: (a) career aspirations, (b) perceptions of scientists and engineers, and (c) student behaviors.

Career Aspirations and Career Awareness

As adolescents transitioning from high school to young adulthood, nearly all students are apprehensive about making decisions about who and what they want to be. This is a particularly complex time for female students who are thinking of entering less traditional fields like engineering and computing, and balancing that with their immediate desires for independence and their long-term goals for creating a family of their own. As many researchers have pointed out, females' career-seeking strategies are often connected to people they meet along the way, rather than an abstract trajectory that they have planned out for themselves (Hancock, 1989).

One of the goals for developing the *Telementoring* program was to provide female students with intimate access to female role models working in engineering, computing, and science who could provide firsthand knowledge about career options in these fields. To better understand how *Telementoring* impacted students' career

aspirations, their career interests were gauged prior to their participation in the project and at the end of the academic year through attitudinal surveys. In addition, we examined factors that might play a role in students' career choices and the kinds of information students attained about careers in the context of their relationships.

STUDENTS' BASELINE CAREER ASPIRATIONS AND INTERESTS

Students were asked the following open-ended question: *What career field are you most interested in pursuing?*

Overall, participants had a diverse set of career interests before participating in the *Telementoring* project and held higher than average science and technology career aspirations for themselves. According to the National Science Foundation's report on Women, Minorities and Persons with Disabilities in Science and Engineering (NSF, 1996), only 2 percent and 3 percent of college-bound females taking the SAT intended to major in computer sciences or engineering, respectively. This contrasts with the reported career aspirations of our *Telementoring* participants, 16 percent of whom indicated interest in pursuing engineering compared to 3 percent nationwide.

Figure 9: Student Participants' Career Interests before *Telementoring* (n=81)
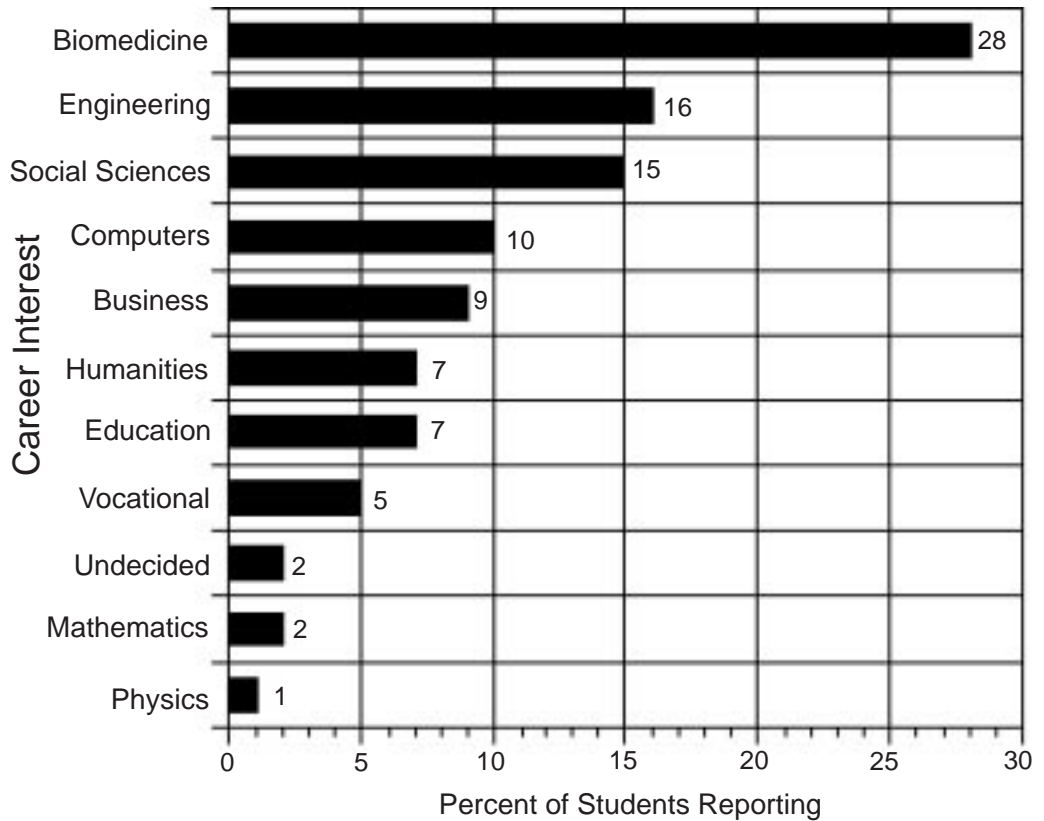
FACTORS INFLUENCING CAREER ASPIRATIONS

Based on data from students' applications to the program and interviews conducted during the middle of the academic year, a myriad of factors emerged as possible influences on students' career aspirations.

BALANCING PERSONAL CONCERNS

In our interviews, it was clear that students were weighing many concerns in their decisions to go on to college to pursue science or technical fields. These included leaving family behind, the ability to combine family interests with a demanding career, the need for advanced mathematics and schooling, and the influence of scholarships on pursuing business over science courses. Personal concerns had a strong influence on the aspirations students had for themselves, and these concerns were dealt with differently in *Telementoring* relationships.

NEGATIVE IDEAS ABOUT ENGINEERING AND COMPUTING

In their applications, students revealed unfavorable opinions about the nature of scientific and computational work that factored into their decisions about what fields they wanted to pursue after high school. These concerns often centered around levels of stress and boredom and lack of contact with other people. For instance, students wrote:

> *I'm not extremely interested in pursuing a career in the above mentioned fields because I enjoy learning about people and interacting with others.*
>
> *No, because I have more interest in working with people, over working with ideas.*
>
> *No, because I don't think that I am well suited for a job in those [areas]. I would like something a little less stressful.*
>
> *My first [choice] is law. I would like it because it's interesting and the results are surprising.*

Students' perceptions of technical fields in particular also seemed colored by the ways in which their computer classes heavily emphasized programming code rather than showing how programming can be used to address problems that were meaningful to the students. Over the course of the interviews, a subset of students revealed that they generally liked computers, yet their classes dissuaded them from pursuing computing fields. For example, one student explained that her computational science class taught her that "programming was unforgiving, or you needed to be a genius to do this work."

Through our analysis of student interviews and online conversational data, it was clear that mentors discussed these issues with students. However, some students weren't always interested in hearing about mentors' careers. For the students who did report that their mentors influenced their ideas about science and technology, it appears that they already had strong notions of what they wanted to do, or their mentor was successful in helping them to see science in the context of their interests and lives.

SOCIALLY ORIENTED PERSPECTIVES

A number of *Telementoring* participants expressed the need to pursue a job that was socially oriented or had some direct impact on society. In these cases, students spoke of the desire to work in the health sciences, teaching, or social sciences, since they perceived them to be fields that would enable them to "interact with people." This orientation and desire to make a difference was evident in comments that students shared in their applications:

> *I would like to pursue a career in engineering because I am interested in developing the future. I would like to see medical advancements and social developments everywhere, from artificial body parts to flying cars. Hopefully, I will still be alive to see these things and to have a part in developing them.*
>
> *I'm intending on pursuing a career in the medical field because I want to heal people and give life.*
>
> *I really love science and the reason why is because I like learning about the different technological advances of the world to try and make things better for the future.*
>
> *I have always wanted in some way to further the advancement of society. Whether it is by developing technology or being a doctor.*

In some mentoring relationships, students indicated that their mentors enabled them to see how technical fields could encompass these values. One student described how she learned from her mentor that "if you look around the room, you can find something that wouldn't have been there if somebody hadn't asked a question about something in science or technology." However, it was not clear from our data that these broadened perspectives would necessarily change students' career aspirations directly.

AFFECTIVE AND PRAGMATIC BASES FOR CAREER ASPIRATIONS

Students also indicated that their career aspirations were based on what they had enjoyed and been successful at in the past. Many described positive experiences in earlier science and mathematics courses, as the comments below indicate:

> *When I took chemistry in my tenth grade year I loved it, and it was so interesting to me.*
>
> *I am thinking about a career in engineering, because I have always liked math and science classes. Math has always been my strongest subject since elementary school.*

Others described their career aspirations in terms of future status and compensation. As one student explained, "[I've considered a career in science or technology]. Mostly for the money and influence of people." For these students, mentoring was a matter of giving them practical ways in which to pursue these goals.

HOW CAREER INFORMATION WAS CONVEYED

Promoting career awareness was difficult for mentors to tackle in the online medium. The project expected them to share information about their careers with their mentees while simultaneously addressing the students' immediate questions or interests that often did not focus on careers per se. To begin the task of exposing students to the mentors' careers, mentors crafted personal biographies to introduce themselves to the students they were matched to. Some mentors provided a great deal of technical detail about their jobs, while others gave brief descriptions. Still others allowed aspects of their work to grow organically out of more general conversations they had with students. Given this diversity in approach and the challenges presented by the medium, we were interested in exploring how mentors conveyed information about careers in science and technology to their mentees.

It was clear from our interview data and thematic analyses that students engaged in productive discussions about careers. To varying degrees, mentors recognized the need to share the drama of their jobs, (i.e., to share what was exciting, what was difficult, and who comprised the cast of characters they worked with). Some shared published articles on the work they were doing; some picked up on students' interests and showed them how science or technology could be relevant. This occurred for a student who revealed that her mentor showed her how to blend her interests in biology and teaching. Students also reported that their mentors gave them practical advice to allay their fears about future majors in college. Students tended to describe mentors as helping them feel safer about testing out different fields by using the first

two years of college to decide what they wanted to pursue. Some students described how their mentors encouraged them to pursue a career in which they could have a passion for what they were doing. This was particularly important to several of the girls in rural areas where most of the community worked in the local factories.

STUDENTS' CAREER ASPIRATIONS AFTER *TELEMENTORING*

Pre-post data analyses of students' attitudinal surveys suggested that students remained fairly stable in their career aspirations, with slight positive changes in the areas of computer science and business career interests, and small negative changes in biomedical aspirations. The most substantial change occurred in the percentage of students reporting uncertainty about career goals. After participating in the *Telementoring* program, 8 percent of students reported not knowing what career they would pursue. Before the *Telementoring* experience, only 2 percent of students did not know.

Figure 10: *Telementoring* Participants' Career Aspirations, Pre and Post
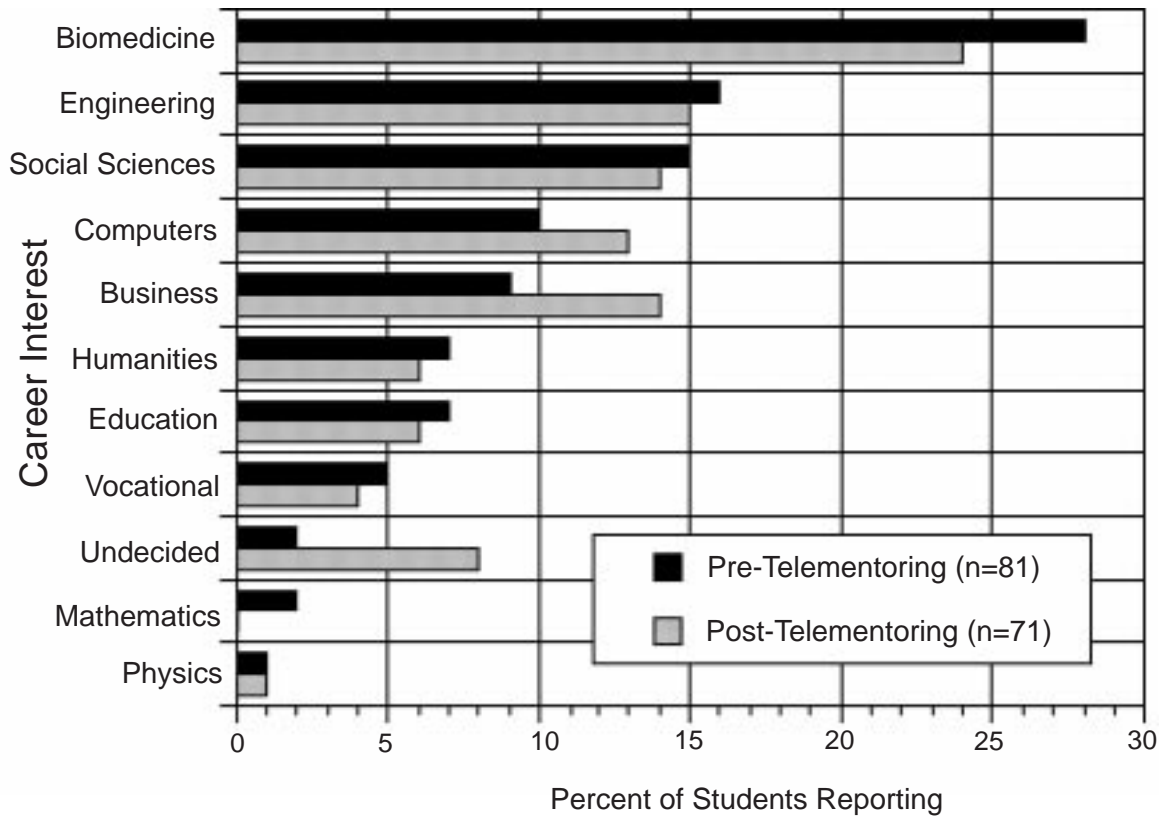
Changes in Perceptions of Mentors as Scientists/Engineers

Aside from supporting and promoting career awareness, we believed that ongoing communication with female professionals in science and technology might broaden young women's perceptions of what scientists, computer scientists, and engineers are like and of what it takes to be successful in these fields. To address questions about shifts in students' perceptions of what scientists are like, email evaluation surveys administered at the end of the year asked participants, *Was your mentor what you expected a woman in science or technology to sound like or be like? How or how not?* Their responses greatly illuminated the students' preconceptions (both positive and negative) about women in science and technology careers and about how these preconceptions could change through *Telementoring* experiences.

Forty students (n=40) responded to this question on the end-of-year evaluation survey. Surprisingly, more than half of these students (58 percent) started *Telementoring* with a positive sense of the kinds of people professional women in science would be. Thirty percent of these same students (n=12) indicated that their mentors confirmed the positive characteristics they expected of a woman in science. These characteristics clustered around *intelligence*, *confidence*, *communicative ability, friendliness*, and *well-roundedness*. Interestingly, one student wrote, "I expected her to be intelligent and well-spoken but not so smart as not to have a life outside of work." For these students, *Telementoring* afforded an opportunity to discover in a personalized way what they already hoped professional women in science and technology were like.

Most striking was that 28 percent of respondents indicated that communicating with a mentor had altered, in a positive way, their attitudes about women in science. They described negative attributes they formerly associated with women in these careers and then noted that these perceptions had been changed. Some of the negative preconceptions centered around female professionals' *relationships to work*. The young women had expected their mentors to be "all work, no play/ boring," "very serious," or "completely focused on work." Other negative preconceptions clustered around female scientists' *relationships to other people*. "Non-sociable," "very serious," "not very personable," "too sophisticated," and "completely independent/not relying on anyone" were phrases that the young women used to describe what they had expected of a woman in science/technology before communicating with their Telementor. A handful of participants indicated that they had expected their mentors to be "not so young" and "not cool." These young women were pleasantly surprised by their *Telementoring* experiences.

Almost one-third (32 percent) of students indicated that their perceptions had *not* changed because they had not begun the program with any defined expectations of women in science and technology. Two students mentioned that their mentors were just as they had expected, in a rather negative sense. One wrote, "Yes, [my mentor is what I expected] because I thought women in a science or technology field would be really on the go and not have a lot of free time."

Finally, three students (1 percent) noted that their perceptions had changed. However, their feelings about the valence (positive or negative) of these changes were indeterminate. These students mentioned that their mentors were younger than expected, more driven, or more devoted to their careers. Table 6 summarizes students' perceptions of women in science and technology.

Table 4: How Mentors Met Expectations About Women in Science (n=40)

Was your mentor what you expected a woman in science or technology to sound like or be like? How or how not?		
Expectation	**# (%) of Students Reporting**	**Examples of Student Responses**
Met *Neutral* Expectations	13 (32%)	• I don't know because I didn't really go into the program with a set description of what a scientist would be like. • I didn't have a view on what they would be like, I thought that they were just like everyone else.
Met *Positive* Expectations	12 (30%)	• She was just how I expected her to be. Determined, intelligent and friendly. • Yes, very confident!!
Met *Negative* Expectations	2 (<1%)	• Yes, she reads all those boring science magazines.
Indeterminate	3 (<1%)	•Yes, she seemed very into her job.
Exceeded Expectations *(Positive)*	11 (28%)	• Not really. I expected them to be tightwads and non-sociable. She was out there like most normal people. • My mentor was not what I expected a woman in science to be like. She was willing to help in any situation. I thought she would only want to talk about work. • No, she was more personable than I expected.

In considering these data, it is important to keep in mind that student participants were nearly evenly split in their preconceptions of women in science and technology professions. Approximately one-third said they had no opinions; 30 percent said they had positive associations that were later confirmed by their *Telementoring* experiences; and 28 percent said that they had negative associations that were not validated in their online experiences. These findings suggest that changes in students' negative perceptions can take place over time with exposure to women working in these fields.

PERCEPTIONS OF MENTOR LIFESTYLES

Telementoring students were very curious about mentors' lifestyles, and they predominantly connected with their mentors along these dimensions. Students were hungry to hear about their mentors' families, the strategies they used to balance work and family, and the kinds of activities they did for fun. In fact, when interviewed, most (68 percent) *Telementoring* participants indicated that they would like to have their mentors' lifestyles.

Overall, it seemed that the *Telementoring* program was most effective in helping students see that scientists and engineers are people with well-rounded interests and lives. This accounts for the fact that roughly two-thirds (68 percent) of the students interviewed mentioned that they would like to lead the lives their mentors did. Of these students, more than half identified that their mentors led lives in which they balanced family, career, and recreation. The remaining students mentioned that they were impressed by the mentors' career or academic accomplishments.

More than one-third of the students (37 percent) indicated that they liked aspects of their mentors' jobs or qualities but did not want aspects of their personal lives. These students spoke of how they did not want to be divorced, unmarried, or a single mom like their mentors.

Impact on Student Behaviors

Because *Telementoring* was designed to offer students specific strategies for pursuing science and technical interests, we were also interested in assessing what kind of impact *Telementoring* might have on students' career-enhancing strategies. To assess how communicating with a Telementor might affect the likelihood of students seeking career-enhancing opportunities, we asked students who had been matched with mentors to rate (on a three-point scale) how likely they were to pursue various activities. We then compared the students' pre- and post-*Telementoring* responses to determine what changes had occurred in how they perceived their own tendencies to pursue opportunities related to career and

academic success. We expected a positive migration of ratings, with more students reporting that they were "very likely" to pursue the activities described and fewer students reporting that they were "not likely" to do so. Change data are reported for students for whom we have both pre- and post-data (see Figure 11). Additionally, we excluded cases in which students indicated that the behavior was "not applicable."

Figure 11: Students' Opportunity-Seeking Behaviors (n=39)
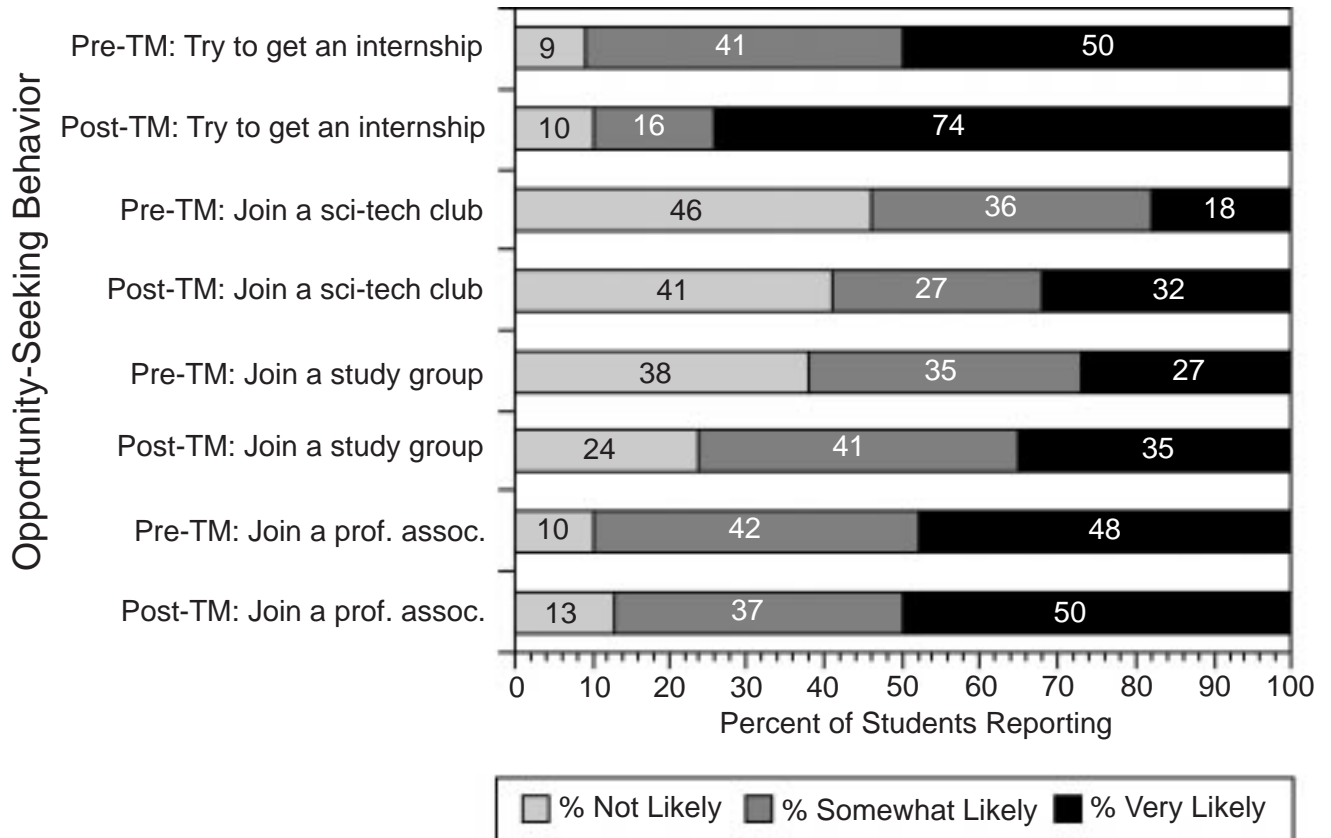
These data suggest that the greatest changes occurred in the students' likelihood of applying for an internship, joining a science or technology club, and joining a study group. In the first two cases, students who were "somewhat likely" to engage in these activities prior to *Telementoring* became "more likely" to do so after the experience. In the latter case, however, the behavioral shift was most pronounced among students who indicated that they were "not likely" to join a study group. Following participation in the *Telementoring* project, nearly 15 percent of these students noted that they were "somewhat likely" or "very likely" to do so.

Our interviews with students confirmed some of these findings. Several students mentioned how their mentors gave them practical strategies and specific information for pursuing internship opportunities in their own local neighborhoods (e.g., contacting the local veterinarian for an internship opportunity). These students often described how they would never have considered these possibilities. Others revealed that their mentors helped them with their study skills.

Discussion of Findings

Students went far beyond our expectations of what they would explore in their online relationships with their mentors. While the *Telementoring* program was primarily about career mentoring — linking young women with an interest in science, mathematics, or computing with professional women in these fields — it became immediately clear that, for the most part, girls' conflicts about their personal lives as young adults were preeminent and integrally associated with any academic and career issues that they had. *Telementoring* offered many opportunities to explore a broad range of these issues in an interconnected and personal way, which appeared to be most valued by students.

Perhaps most prevalent in *Telementoring* relationships were instances in which mentors helped students craft strategies for dealing with the daunting transition from high school to college. This included discussions about selecting college courses, balancing their personal relationships with their academic interests, and overcoming personal or financial obstacles that stood in the way of pursuing particular goals. *Telementoring* was, in the best cases, very much an individualized experience that allowed mentors to respond to students' immediate needs and concerns.

As a result, many students found their *Telementoring* experiences rewarding. More than three-quarters felt positive about their relationships, and nearly half stated that their mentors had influenced their ideas about science and technology. While mentors' perceptions of their relationships were slightly more varied, 91 percent were willing to be Telementors again. Frequency of communication seemed to be an important ingredient in how satisfied mentors and students were with respect to their relationships, with more communication contributing to more positive feelings.

We also learned that *Telementoring* can have a positive effect on students' perceptions of women in science and technology. The subset who held negative perceptions of women in these fields was pleasantly surprised to find their mentors to be well-rounded people with lives they would like to have. Furthermore, students indicated that they were more inclined to pursue internships and other career-enhancing activities after *Telementoring*, suggesting that perhaps the advice and strategies they gained from their mentors encouraged them to take more pro-active roles in their future academic and career development.

However, our evaluation also revealed some of the complexities involved in promoting and assessing career awareness among students who are still far removed from the world of work. Despite the broad range of career aspirations *Telementoring* students had at the outset of the project, specific discussions about careers in science and technology were not always obvious in their online exchanges with mentors.

This issue raised questions about how to promote career development online at this stage in young women's development. It was clear that students and mentors held different conceptions of what they considered to be worthwhile conversations about careers in science and technology. Mentors' comments on evaluation surveys revealed that several had high expectations for specific career-oriented conversations, which could explain why many mentors didn't feel as though they were providing guidance on a consistent basis. On the other hand, students revealed that they had gained further insight into science and technology and the kinds of exciting lifestyles that one can lead in these fields, especially in cases where these issues emerged organically from a discussion of students' and mentors' immediate interests and hobbies.

These data suggest that what mentors might have regarded as casual chat, students often viewed as meaningful exchanges. At the crux of these findings is the notion that career mentoring online requires finding ways to address girls' immediate interests while simultaneously broadening their relatively narrow understanding of how their interests connect to the world of work. For many young women in the project, particularly in Alabama and Tennessee, traditional values of marriage and family loomed large in their immediate futures. Mentors who were able to accept and work through these issues with students often found themselves exploring broader issues about life choices, which ultimately will have an impact on how students approach their career aspirations.

Conclusion

Overall, *Telementoring* was a positive experience for students and mentors. In looking ahead, it is important to examine how best to assess the impact of such programs on participants. While positively affecting students' career aspirations was an outcome we deemed important, our research also revealed that college course-taking behaviors might be most influenced by *Telementoring* experiences. This points to the importance of conducting longitudinal studies that can shed light on how such online experiences affect students' decision-making behaviors as they enter college.

Recent anecdotal data also reveal that students are continuing to correspond with their Telementors as they enter college and reestablish their email access, sometimes two to three years beyond initial participation in the program. A more rigorous follow-up on how these relationships deepen and the impact they have on students would help to illuminate what kind of impact more prolonged relationships can have.

Finally, it is important to consider the strengths of telecommunications in supporting particular types of online mentoring experiences and how recent advances in the medium can help to deepen these exchanges. Conversational and interview data revealed the complexity of young women's decision-making processes about their aspirations, and email appears to be a very powerful medium for exploring these issues. Email both supports prolonged communication and messages, and, like a journal, can be returned to for reflection and analysis. However, further explorations of how the World Wide Web could be used more dynamically and graphically to give students a sense of mentors' workplaces and lives would be worthwhile. This would only strengthen the career enhancement potential of such online conversations.

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