Inviting Self-Efficacy Revisited: The Role of Invitations in the Lives of Women with Mathematics-Related Careers

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The purpose of this study was to explore the personal stories of women who selected careers in mathematics, science, and technology to examine whether the verbal persuasions and invitations they received influenced their academic paths. Results revealed that self-beliefs were nurtured by familial, academic, and work-related influences. The self-beliefs, in turn, nurtured the effort, persistence, and resilience required to overcome obstacles. Three interrelated themes emerged: (a) invitations and verbal persuasions were instrumental sources for the development and maintenance of confidence: (b) self-efficacy beliefs, nourished by invitations, fostered resilience to academic and social obstacles: and (c) invitations from others reemerged at critical points as self-invitations that the women used to buttress themselves against challenges.

Women are attending university in ever increasing numbers. Nonetheless, their participation in mathematical, scientific, and technological fields, and their subsequent entry into such careers, continues to be disproportionate to that of men (Sadker & Sadker, 1994). During high school, girls are as likely as boys to take advanced mathematics and science courses, but this parity disappears at the university level, where women earn fewer degrees in these areas (National Center for Education Statistics, 1995). Reasons for this phenomenon vary, but both invitational and social cognitive researchers would suggest that the self-beliefs women hold about their capabilities may provide valuable insights (Bandura, 1997; Novak, 1992; Pajares, 1997; Purkey & Novak, 1996).

Most theories of academic motivation include self-beliefs as a key component. The central construct in Bandura's (1986) social cognitive theory is *self-efficacy*, which for our purposes we will define as

students' judgments of their capability to perform school-related tasks. According to social cognitive theory, students are more likely to be successful when performing tasks they believe they are capable of accomplishing than when performing tasks in which they feel less competent (Bandura, 1997). We believe that the tenets of self-efficacy theory (Bandura, 1997) and of the invitational approach (Purkey & Novak, 1996; Purkey & Schmidt, 1996) complement each other and share similar features. For example, Pajares (1994) provided a model in which the four invitational levels of functioning corresponded to the creation and development of self-efficacy beliefs. In the model, invitations created and increased self-efficacy beliefs; disinvitations destroyed or diminished them. Pajares concluded that common insights from each theoretical camp offered promising directions through which educators and researchers might better understand the ways by which they can help students develop their confidence and competence.

Students form their academic self-efficacy beliefs by interpreting information from various sources. One critical source of efficacy information is composed of the *verbal persuasions* that students receive throughout their academic careers. Verbal messages from significant others help students to exert the effort and maintain the persistence required to succeed, resulting in the continued development of confidence *and* competence. According to self-efficacy theory, positive messages are hypothesized to have the greatest effect on students who already feel efficacious. They tend to be less effective with students who lack confidence in their abilities. Of course, messages can also work to undermine efficacy beliefs when used to convince students that they are not capable. For example, when women receive social messages that they do not belong in a male-dominated field such as mathematics, they may be especially vulnerable to believing that they are not, and cannot be, competent in that area (Bandura, 1997).

It will seem clear from our description that verbal persuasions share critical defining features with Purkey and Novak's (1996) description of the process of invitations as "based on developing, transmitting, and evaluating caring, proactive messages" (p. 4). Invitations and verbal persuasions each involve patterns of communication, and each can be viewed in terms of the messages that one individual or group sends to

another individual or group. When these are sent to students, positive messages convey the view that students are capable, valuable, and responsible. Verbal dispersuasions, or disinvitations, convey the view that students are incompetent, incapable, and irresponsible. Invitational theorists believe that people can intentionally send uplifting and empowering messages both to themselves and to others, and they have thus defined invitational education as "the process by which people are cordially summoned to realize their potential" (Purkey & Novak, 1996, p. 4). In school contexts, the messages that students receive powerfully influence the beliefs that they develop about themselves, for it is these messages that often constitute the bridge on which perception, interpretation, and meaning travel. It is thus reasonable to suggest that verbal persuasions and invitations tap the same phenomenon although they are described from differing theoretical vantage points.

Invitations and self-efficacy beliefs also share similar effects. They influence the academic choices that students make, the amount of effort they expend, their resilience to encountered hardships, their persistence in the face of adversity, the level of anxiety they experience, and the success they ultimately achieve. Invited students with strong self-efficacy beliefs work harder and persist longer when they encounter difficulties than those who doubt their capabilities. Recent evidence suggests that students' self-beliefs are often stronger predictors of academic success than are their prior accomplishments, skill, or knowledge (Multon, Brown, & Lent, 1991; see also Pajares, 1997; Schunk, 1991).

The self-beliefs of college students pursuing mathematics-related majors and careers have received much study. Findings reveal that college women's perceptions of their capabilities to succeed in math-related areas are significantly lower than those of men (Pajares & Miller, 1994). Also, students' confidence in their mathematics capabilities influence their career choice and direction as potently as their performance (Hackett, 1995). In fact, researchers have observed that mathematically competent women often fail to pursue math-related careers because they have low self-efficacy about their competence (Lent, Lopez, & Bieschke, 1993). This is consistent with Bandura's (1997) observation that "girls have a lower opinion of their capabilities for mathematical activities than do boys, even though they perform equally

well in this subject" (p. 430). When college women come to believe that they are not as capable as they really are or that they will be unable to compete in a male-dominated career, they are likely to shy away from math courses, avoid math-related majors, and select academic paths for which they may be less prepared or interested but more confident (Hackett & Betz, 1989).

Nonetheless, there are women who overcome personal and social obstacles and pursue math- and science-related majors and careers. Despite educational and social systems that begin to undermine the mathematics confidence of girls as early as middle school (Midgley, Feldlaufer, & Eccles, 1989), some women maintain the high level of effort, persistence, and confidence in their mathematics skills required to succeed in this area. Self-efficacy theorists would argue that these women have selected math-related majors and pursue math-related careers in large part because their high attainments were accompanied by the corresponding confidence in their capabilities. Invitational theorists would argue that these women likely benefitted from therapeutic invitations that fostered persistence and resiliency. But how were they able to accomplish this in environments similar to those in which most other female students develop lower expectations about what they can achieve?

In this study, we explored the personal stories of women who selected and continue to excel in careers in the area of mathematics, science, and technology to examine whether the messages they received played a role in their decisions to select a math-related career. Our aim was to discover whether the invitational approach and self-efficacy theory can jointly provide insights about how the messages that students receive–the invitations and verbal persuasions–work to provide the confidence and competence required to succeed in academic domains hostile to their success. In essence, we sought to discover whether the verbal persuasions (and *dis*persuasions) that are considered an important source of students' academic self-efficacy beliefs, and which we consider synonymous with invitations (and disinvitations), play a role in the creation and development of positive academic self-beliefs and, subsequently, of academic success.

Methods and Procedures

We selected qualitative methodology to obtain the rich description and narrative that emerge when individuals explore their personal stories (Merriam, 1988). Our choice is in concert with Bruner's (1996) call for a greater use of narrative in studies of psychological constructs to better understand the meanings with which individuals imbue their experiences (see also Lieblich & Josselson, 1994).

Data for this study were gathered from 15 women who currently have a career in mathematics, science, or technology, and it had previously been analyzed to trace how women perceived the importance of the various sources of self-efficacy beliefs (Zeldin & Pajares, 1998). Several careers fulfilled the criteria for this study: mathematics professors, teachers, and researchers in math-related fields at the university level; chemists, physicists, computer software developers, program testers; and engineers. To provide insights relevant to America's educational system, we selected participants who were schooled in the United States. See Appendix A for a description and background of participants.

We designed an open-ended, semi-structured interview protocol (Appendix B) which was designed such that participants would not be led toward a discussion that would have them emphasize their self-efficacy beliefs or invitations in the context of their academic and career histories. If themes related to these constructs were to emerge from the study, we wanted them to emerge from the participants' own narratives rather than as prompted responses to leading questions. All interviews were conducted by the second author and recorded on audio cassette recorder. Recordings were transcribed verbatim. Interview length ranged from 40 minutes to 2 hours. So that participants could clarify or add to the transcript any meaning they thought was necessary, a complete copy of the interview transcription was sent to each participant and changes were made accordingly.

Transcriptions were coded by the guidelines set forth by Miles and Huberman (1994). Codes were generated from each question on the protocol. Start codes were initially descriptive in nature for the purpose of

chunking information into smaller units for analysis. We revised the start list during initial coding to add codes that were needed to describe more specific instances or subjects that were not included in the beginning list.

Results

Three interrelated themes emerged from the analysis of participants' responses. The first was that the messages, the invitations and verbal persuasions, that the women received were instrumental sources for the development and maintenance of confidence beliefs and played a key role in their decision to select a math-related career. Our participants recalled these messages to a greater extent than they did prior accomplishments. The second theme was that the self-efficacy beliefs of women in these male-oriented domains, nourished by the invitations they received, helped the women to be resilient to both academic and social obstacles. The women also demonstrated a great degree of persistence and effort while they continued along their academic and career paths. Finally, it was evident that the messages from others became internalized and reemerged at critical points in the women's lives as *self-invitations* that the women used to buttress themselves against obstacles and challenges.

Messages as Instrumental in Developing Confidence and Competence

Each of the women in our study spoke about a family member, teacher, friend, or supervisor she perceived to have had a positive influence on her academic self-beliefs. The invitations that the women recalled receiving were both intentional and unintentional. Suzanne, a chemist for 30 years, spoke of the unintentional invitation provided by her father's tenacity in pursuing an education in engineering:

> My dad was very, very good at [mathematics], but he never had much of a formal education. But he studied math at home by correspondence school and then he was actually given a degree in what would amount to electrical engineering. He always encouraged me in math and science, and I thought I could do anything the boys could do so it was never a problem.

Mary, a 34-year-old program manager, ascribed her perseverance with mathematics work to her father's encouragement, and she credited him as a primary influence in her career selection.

> [My] pursuit of mathematics is definitely due to my dad. He was very supportive, and I never got the impression that I couldn't do math from my dad. I never got that math anxiety, and in fact when I would not understand something, he would just get up with me in the morning and he would explain it to me and we would work through the problems together and he really emphasized that it just takes practice. You just practice and pretty soon you start to see a pattern.

For some women, the invitations they received from members of their family regarding the idea of women going into male-dominated areas and of women doing what they wanted to do were critical and integral to their later paths. These experiences did not have to be math-related in order to be confidence-enhancing. Martha, a 34-year-old chemist, discussed the powerful invitation she received from her mother during her early school years.

> My mother always engendered in me the attitude that I could do absolutely anything I ever want to do. So she really gave me a confidence that is a big part of success in academics and maybe in other things – sometimes you get to a point where you don't have that much either skill or knowledge and you have to just go on your guts or your confidence. You have to just kind of push your way through something until you have the time to accumulate the knowledge. And I think that that's something she engendered in me just by always being herself so confident of my abilities, rightly or wrongly. And my father certainly never detracted from that. He always portrayed her as being the smarter of the two. So, I was raised in an environment where women were not only capable but were even potentially very well and highly regarded.

A 30-year-old program manager named Laura who had majored in electrical engineering spoke about her grandmother's critical invitation.

> [My grandmother], as a small child she told me and my sister, this was my mother's mother, "You really have to study hard and have your career and your own life." Because my grandfather passed away when she was 32, so she

her whole life had to raise my mom by herself. And she gave us money to go to college and said, "Here's money — go to college – don't spend it on a guy. Don't get married and give it to your husband." It was like, you do it for yourself, you have your own career, be able to take care of yourself.

Tammy, a 44-year-old software developer, credited her grandfather in a similar way.

My mother's father would tell us stories when we were younger, and even as we got older. He died when I was 17. He came to America on the boat, all by himself, when he was 17 years old and he was very influential in saying things like "Take risks. Try something new. It just means another chapter in your life." He would say, "A lot of people will say, 'Don't do this.' But think about it for yourself. Make your own decisions."

Women were especially responsive to the invitations from their teachers. All women spoke about teachers they believed to be highly influential in the development of their competence and confidence. Jean, a 32-year-old chemical engineer, observed that she had been brainwashed by a high school mathematics teacher.

I found that if you were a female who was good at math and science, this particular teacher really believed in getting women into scientific degrees. So every year for two years that I was in his physics class, he said, "Marry a doctor, be an engineer!" When I came to college and I was pre-med, I hated physics though that is what I had planned to major in. Well, somewhere at this point this saying kept going through my head . . . just marry a doctor and be a chemical engineer, and I went into chemical engineering.

The teachers whom the women described arrived at various points throughout their academic and career paths. Cindy, a 27-year-old technical editor, described her experience with a middle school math teacher who paid her the sort of compliment one recalls for a lifetime.

One of our teachers, being most stereotypically weird, nerdy, coke-bottom-glasses, extremely shy math teacher was really quite nice. He walked up to me once some time early in class when I was studying and said one of the nicest things anyone has ever said to me, which was, "You slipped beautifully into the

> disjunctive!" Which was referring to a specific step in a math problem we were doing . . . which is right up there for emotional support.

Both male and female teachers were represented in the women's recollections. Although the instructor's gender did not seem to play a role as far as the perceived intensity of the influence, it was important that women believe that their instructors were *proactively* supportive of them. Patty, a 42-year-old professor of statistics, found this support in her high school algebra teacher.

> It was the first time I had algebra, and I loved it. And then all of a sudden I excelled in it. And the teacher said, "Oh no, you should be in the honors course," or something like that. So, there's somebody who definitely influenced me because I don't think I ever even noticed. I didn't care one way or the other about mathematics. It was just something you had to do. I remember she used to run up and down the aisle. She was real excited. She was just this little, tiny, skinny nun who was just full of energy. She said, "Oh, you gotta go in this other class. You gotta." And she kind of pushed a little bit and I was willing to be pushed, and so that was nice.

Nine women recalled receiving strong persuasive messages and encouragement from job supervisors. Anne, a 26-year-old engineer, credited her manager with affording her the confidence to pursue her current career.

> My manager was a really good influence. He was very encouraging in taking classes. You know, didn't make me feel that because I didn't have a computer science degree like I didn't have a chance. He would

> say things like, "Well, you know, a lot of other people don't too, and you can learn how." I definitely wouldn't have done it if I wouldn't have had him as a manager.

Messages as Instrumental in Developing Resilience

Confidence buttressed by invitations resulted in a pattern of resilience as women continued along their academic paths. The women described themselves as "persistent" and "resilient." Clearly, they had not let obstacles deter them from their paths. Instead, they had turned difficult situations into temporary setbacks rather than into insurmountable hurdles. Lynn, the 40-year-old geneticist in our group, spoke to this issue directly.

> I always knew I was smart. And I guess you get some confidence from just knowing. We always had some sort of struggle going on, and I had a lot of uncertainties in life, and when you deal with those as a young child, it helps you to deal with situations that aren't so comfortable when you're older. It wasn't just one thing that made me know that I could keep on going. I guess it was just watching the people around me. They just didn't believe in ever giving up. I mean not unrealistically, but they wouldn't give up just because adversity came and so I think I picked that up from them.

Note how Suzanne, a 53-year-old epidemiologist, described how a sense of resilience and persistence, of *willing* oneself to succeed, can result from the unintentional disinvitation that often results from a caring family member's efforts at being "realistic."

> About the time that I was graduating from high school, I told [my father] I was going to college. Well, [the family] didn't have any money. He said "Only rich men's children go to college. You can't go to college." I was really shocked that he would say that. I said, "I will." And that's it. I got a scholarship and went. Never a doubt in my mind that I was going to college. It wasn't that I wasn't capable of doing it, he thought. We had no money. Our family had never gone to college, so he didn't see how I would.

It is safe to say that the women in our sample found that their self-efficacy beliefs were resistant to the disinvitations they often received. Although all could speak of instances when they received negative sociocultural messages about women in their field, they either ignored them or did not let them deter them from their goals. Lily, a 31-year-old technical engineer, voiced this most eloquently.

> It was hard . . . because I'd never experienced that before. You got a lot of comments – Make sure you dress nice, and stand next to this equipment at the show and "Do you come with the machine?" You don't like to deal with that when it just brings out the ugly in me. You feel like saying, "Look, I have a master's degree and I can run circles around you mentally, so lay off." But that's an ugly feeling to have to feel that way. And in a business setting, that's not funny. When the manager of our division makes jokes like that, it's pretty unprofessional. It's beyond words. So you just deal with it and keep on going.

Although women sometimes considered peers with similar academic interests and careers to be positive influences, many described instances in which they received negative messages from peers. ("None of the boys wanted to be my lab partner."; "Some guys would make digs about you're really smart or something that was not a compliment at all."). Unable to alter their environment, women selected appropriate and often elaborate coping strategies, but they remained persistent in pursuit of their goals. The following passage illustrates the pain and pathos that disinvitations created for Jean, a chemical engineer and organizational consultant.

> The messages were pretty negative. But not so much about being technical as about being smart. Being too smart in many ways. I hated that. I went out of my way not to let anyone know. It's interesting. I felt a really strong drive to succeed and get good grades but I also tried to very hard to hide my grades from people. And from parents and relatives the good grades were really wanted. But whenever you get in a high school or peer type situation, where you're succeeding at a higher grade level, people look down on you. I think that's fairly common. That it's not considered to be feminine or you must not care about other things, or that must be all you do.

In general, it was evident that the perseverance and resiliency of the women in our sample had been primarily strengthened by the invitations they received from those who had played a critical role in their lives. Without a belief in their own capabilities to succeed that was grounded in their relationships with significant others, the obstacles they encountered might have easily deterred them from their goals. But these women did not consider giving up or giving in as options. Lily put this most eloquently.

> If my dad wasn't there telling me, "Yeah, you can get this," I would have been influenced by some teachers that if they explained it to me one way and I didn't get it, that would be it. Everybody growing up has somebody telling them that you can't do something. It's having the resilience to come back and say, "I don't care what you say. I'm going to try it anyway."

Messages as Instrumental in Developing Self-Invitations

What is also notable from the excerpts above is how messages served to make the women personally and academically *self-inviting*. Because their confidence was developed through the caring of others at the same time that their competencies were taking shape, the women in our sample developed strong self-beliefs and self-invitations that carried them through the tough times in their academic and career history that otherwise could have been potentially devastating. Without purposeful and proactive self-invitations, women could have been easily discouraged in their pursuit of math-related majors and careers. Mary described her experience in college as a mathematics major at a time when academic material started to become very difficult for her.

> I never thought, "Well, I just can't get this." When I went to college I did experience that more, where I didn't understand as much as I used to. But never did I think, "I'm just not good at this." I always thought, "I just don't get this right now. I haven't figured out the right way to look at this to get it." And I had no qualms about going to professors and they never intimidated me. They never scared me. It's like, "I just don't get this and you need to find a better way to explain it to me."

Tammy spoke about the difficulties she encountered in engineering classes and how she overcame these impediments by, in essence, inviting herself to succeed.

> I knew how to work hard. And so I would study and a couple of times. I remember one or two classes I just said, "I'm going to try this later." And dropped out of it before the halfway mark. And then came back a year or two later and took it and it was no big deal. It was just the first time I had seen stuff like that and it scared me. More scared than anything. And so when I came back, then it was okay."

It is noteworthy, but certainly not unusual, that all of the women spoke of encountering obstacles along their paths. Two of them dropped out of college but returned to finish their degrees. Others recalled people in their lives whom they felt had been extremely negative influences, but they found ways to counteract potential harm. For example, Lynn overcame a powerful and intentional disinvitation and had to pursue her own scholarship sources to enable her to go to college:

> I had a very, very poor guidance counselor who, even though I was valedictorian, he told me I really ought to find something easier to do and never helped me with trying to get scholarships or things like that, I had to do that on my own."

Discussion and Implications

In summary, the mathematics self-beliefs of the women in our sample were nurtured by familial, academic, and work-related influences, and these influences were recalled primarily in terms of the encouragement received from people about whom the women cared. The self-beliefs, in turn, nurtured the effort, persistence, and resilience required to overcome personal, social, and academic obstacles. The women consistently recalled experiences that involved an invitation received from an influential person, often during a critical time, who helped them develop their beliefs about their capabilities.

One prominent theme to emerge from the narratives was that, just as important as it was for the women to believe in themselves, it was also

important that *others believe in them.* Bandura (1997) has suggested that the "self-affirming beliefs of others promote development of skills and a sense of personal efficacy" (p. 101). This is reminiscent of Cooley's (1902) metaphor of the *looking-glass self*, the idea that individuals' self-conceptions are, in part, formed as a result of their perceptions of how other people perceive them. That is, the perceptions and judgments of others act as mirrors through which individuals view and define their own self-beliefs. This is also consistent with Purkey and Novak's (1996) description of the influence of significant parents, teachers, and peers on one's own beliefs. All of which is to suggest that other people have a powerful hand in the mental habits that an individual creates and develops.

We also found that our participants were especially attentive and susceptible to the encouragement of those about whom they cared and with whom they felt a relational bond. This is consistent with Bandura's (1997) assertion that the impact of verbal persuasions on one's own self-beliefs is likely to be only as strong as one's confidence in the person who issues them as well as with Purkey and Novak's (1996) contention that, for others to exercise maximum influence, the environment must be carefully prepared. Critical to this preparation is the development of a trusting, caring, and respectful relationship.

The women in our study demonstrated through their experiences with their families, teachers, peers, and supervisors that insights related to their academic competence and career decisions can be provided by understanding the role played by the invitations provided by significant people in their lives. When women struggled with obstacles, they were naturally inclined to remember episodes involving people about whom they came to care or who came to care about them.

Invitations influenced the self-efficacy beliefs that were important factors in helping the women we interviewed to select a nontraditional career. It is evident that educational programs should be geared to helping girls develop stronger self-efficacy beliefs during critical periods in their lives. Girls will develop higher mathematics self-efficacy in classrooms in which teachers break down stereotypical conceptions regarding academic domains, convey the message that success in an academic area is a

matter of desire, effort, and commitment rather than of gender or established social structure, and provide models that verify that message. The women in our study suggested that female models could provide an important vicarious experience for girls considering careers in mathematics and science. It seems especially critical to emphasize that parents, teachers, and those who would seek to be caring agents in the lives of young women be especially reflective and proactive in this regard, especially given the fact that individuals often convey stereotypical and maladaptive messages to girls in unintentional but subtle ways (Eccles, 1989; Bandura, 1997). It is evident that "educators should strive to be intentionally inviting" (Purkey & Novak, 1996, p. 59) if they hope to nurture and maximize their students' self-efficacy beliefs. Inviting school and teaching practices that foster both competence and the necessary accompanying confidence should be identified, as well as practices that "convert instructional experiences into education in inefficacy" (Bandura, 1997, 175).

To women pursuing careers in math-related areas, low self-efficacy may be particularly detrimental because it can result in lower enrollment in advanced college mathematics and science courses, lack of participation in math-related college majors, and failure to pursue math-related careers. When women do not pursue the potentially lucrative math-related careers of which they are capable, they also decrease their chances for a financially stable career future and cannot take advantage of the personal challenge and fulfillment that these types of opportunities represent (Hackett, 1995). Moreover, a society unable to correct its inequities cheats itself out of important and meaningful contributions from a significant portion of its citizens. This is especially critical at a time when there is a proportional decline of male students in college populations and a proportional increase of female students. If this trend holds, it seems evident that American society will have to increasingly rely on the mathematical talents of women to maintain its scientific, technological, and economic viability (Bandura, 1997; Hackett, 1995).

What our findings suggest with some clarity is that these practices should include the types of invitations likely to nourish the self-efficacy beliefs of girls and women as they set out to meet the challenges required to succeed in male-dominated academic domains. Girls will develop

higher academic self-efficacy in homes and classrooms in which parents and teachers stress the importance and value of math skills, encourage girls to persist and persevere in the face of academic and social obstacles, break down stereotypical conceptions regarding academic domains, convey the message that success in an academic area is a matter of desire, effort, and commitment rather than of gender or established social structure, and provide models that verify that message. It seems especially critical to emphasize that parents, teachers, and those who would seek to be caring agents in the lives of young women be especially reflective and *proactively* inviting, especially given the fact that individuals often convey stereotypical and maladaptive messages to girls in unintentional but subtle ways. It is evident to us that self-efficacy beliefs enable women in male-dominated domains to develop and maintain their will. It is equally evident that these beliefs are themselves created and nourished by the invitations that caring individuals extend to their children, their students, their colleagues, and their friends.

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Appendix A
Background of Participants

Name	Age	Ethnicity	Educational Background	Occupation
Lynn	40	Caucasian	BA, MD, Ph.D. candidate, Genetics Epidemiologist, Geneticist	
Suzanne	53	Caucasian	BA, MS, Ph.D. Chemistry	Research Chemist, Epidemiologist
Anne	26	Caucasian	BA Sociology and Communications	Software Test Engineer
Patty	42	Caucasian	BA Chemistry, MA Mathematics, Measurement, Statistics Professor Ph.D. candidate,	
Katy	41	Caucasian	BS, MA Nuclear Engineering	Nuclear Engineer, radiation studies
Dinah	32	Caucasian	BS, Ph.D. Computer Science Computer Science Professor	
Eve	38	Caucasian	BS, Ph.D. Mathematics	Mathematics Professor
Laura	30	Japanese American	BS Electrical Engineering	Software Engineer, Project Manager
Cindy	27	Caucasian	BS Mathematics	Software Programmer, Technical Editor
Tammy 44	Caucasian	On-the-job Technical Training		Software Development, ProjectManager

Appendix A continued

Jean	32	Caucasian	BS Chemical Engineering MBA Business Administration	Chemicat Engineering High-Tech Organizational Consulting
Martha	34	Caucasian	BS Chemistry MS ExperimentaJ Polymer Chem. Ph.D. Theoretical Chemistry	University based Research Chemist Chemistry Software Developer and business owner
Mary	34	Caucasian	BS Mathematics	Program Manager for Technical Exam Development and Certification
Julie	30	Caucasian	BS Computer Science	Software Design Engineer
Lily	31	Latina American	BS Nuclear Engineering MA Metallurgical Engineenng	Technical Engineer, Applications Engineer

Appendix B

Interview Protocol

1. Background information — age, schools attended, family, previous occupations and how many years at current occupation?
2. Please describe your current occupation?
3. What experiences contributed to your decision to pursue your occupation?
4. How were you influenced by others?
5. What did people say to you as you were pursuing mathematics (science or technology)? (Family/Teachers/Peers/ and Culture) What sort of sociocultural messages did you get?
6. How would you describe your feelings and beliefs about mathematics (science or technology) as you were pursuing it?
7. Tell me one memorable story that would really help me understand how you came to do what you do.
8. Why do you think that so few women pursue mathematical-related careers? What could be or should be done to alter that?
9. Considering your academic and career history, if you could have done anything differently, what would that be?

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