6

Persistence and Resistance: Staying in Computer Science

The Persistence Roller Coaster

During our research we were often surprised by which students stayed in the program and which left. Especially in the first two years, many women ride an emotional roller coaster of certainty and doubt from term to term, indeed from week to week, and whether they decide to finish the ride or get off before it ends is unpredictable. Although we interviewed students each semester, students' decisions to leave the program or to stay surprised us more than once.

Paula, for example, began the program excited, enthusiastic, and confident. She had completed a summer internship at one of the local computing labs and was enthusiastic about majoring in computer science. But not long after her arrival, she began to have doubts about her interest and abilities and started talking about leaving. The following semester she told us she had decided to stay, was happy in the program, and was sure she would continue. In her third semester, she told us she had decided to transfer out because "it just isn't worth it" any more.

As often as we were unprepared when women who seemed happy left, we were also sometimes surprised to find them staying. In *Talking About Leaving: Why Undergraduated Leave the Sciences*, E. Seymour and N. Hewitt also refer to this back-and-forth dynamic of students' decision-making process. The one thing that did become predictable was timing: students would most likely leave in the sophomore year, the time when most students, across all majors, do their switching.

What determines whether a woman chooses to stay in or leave computer science? In this chapter we look at what we call the pillars of persistence—the qualities, experiences, and strengths that allowed the women we

interviewed to persist despite doubt and uncertainty. We are particularly intrigued with the counterintuitive stories of some of the women students. While a segment of the female persisters resembles the majority of men in certain ways, the portraits of many successful majors run contrary to expectations and assumptions about who can and will succeed.

The Expected: "I Have Always Been Around Computers"

One may intuit that women who persist are likely to come from backgrounds similar to many of the males: computer-intensive families, lots of parental support, a fair share of hands-on experience, fascination with computers. But one of the most surprising findings of our research is that the backgrounds of the women persisters varied wildly. Brenda is someone whose background is similar to what we've described, except that her family includes female role models. She describes her family as "basically a whole family of nerds." Brenda has had computers in her house since she was in kindergarten. The whole family used them, and they often had several going at once. As a result, she says computers and her interest in them are "natural" to her. Brenda's dad is an engineer, her mom is a librarian, and her sister is studying computer science at MIT:

> So I've always been around computers, and it's just . . . natural to me. Even when we first had an Apple, they'd [parents] encourage me to just pick up stuff and try around. . . . We'd do it cold—do it without a disk—and I started programming in Apple Basic, just very simple stuff, and it got me interested in it. So everything else later just came naturally that I wanted to learn about.

Brenda's family didn't watch TV much, and computer games were her entertainment. She "dabbled a bit in Apple Basic to see what fun stuff I could do," learned word processing, and did her science projects on the computer. Her parents have lots of computer-literate friends, and when they visited, they would all play computer games together. In junior high, Brenda started getting involved in the Internet through her sister and mother. She helped run bulletin boards. She also had friends who used computers, though not as much as she.

Brenda's "family of nerds" helped her sense of fit and belonging in computer science. Computers were part of her furniture; they became "natural" to her. Perhaps unsurprisingly, Brenda describes her decision to major in CS as a "kind of a default." She had a wide variety of interests, from music to math to writing, "so it was kind of a toss-up of what I really wanted to do." But she decided that she was "probably the most comfortable around computers in general." She adds, "I'm not sure exactly what area I want to go into. I only know . . . I like computers. So that's a good place to start." Even though she found many of her classes very challenging, Brenda is satisfied with how she did in all of them. She enjoys learning to write code. She says, "I know how to think like a programmer." But she adds, "I'm also not a super-genius or anything."

Family make-up emerged in our study as worthy of further investigation. As in Brenda's case, we repeatedly heard women with no brothers attribute their interest in computer science to this fact. While we do not have enough data to draw a firm conclusion, we heard many reports of boys claiming the title of "family computer wizard," with this spot seemingly opening up for a girl in families with no brothers.

The careers and interests of a student's parents also have a major influence on whether a woman pursues an interest in science or engineering. Not only do women with parents in technical occupations pick up language and concepts around the dinner table, but the intimidation factor decreases, and parental mentoring and encouragement increase. The impact of parents is documented by Paula Rayman and Belle Brett's (1993) Pathways Project, a longitudinal research effort at Wellesley College that investigated the experiences of young women in science and mathematics during their undergraduate, graduate, and early career years. Rayman, Brett, and their colleagues found that parental support is one of the pivotal factors that distinguish women who go on to science careers from those who do not.

Coming from a computing or engineering family certainly provides important emotional and intellectual stepping stones for majoring in computer science, but our research shows that it is not required. Forty-eight percent of the persisters we interviewed did *not* come from "computing families." These students' stories provide us with an opportunity to find other stars in the constellation of persistence.

The Counterintuitive Persisters

Some of the most fascinating stories of persistence were told to us by women students who had absolutely no computing experience in their

family background. These were mostly international students, raised and educated primarily in countries other than the United States. (Approximately 30 percent of the female computer science majors at Carnegie Mellon during the course of our study have been international women—primarily from Asia and Eastern Europe.) Their motivations for choosing computer science, along with their lack of computer experience, make them the antithesis of the "computer-obsessed since childhood" stereotype. In fact, many of these women were only marginally interested in the field when they began the program.

From their experiences, we learned that despite the tremendous range of computing experience among students, women who are complete novices are no less likely to persist than the most experienced women. Their stories show us that prior computer experience does not make the critical difference. The portraits of these students fly in the face of expectations and assumptions about who can and will succeed in a competitive computer science program.

Little Experience and "No Choice"

Kanitha was a junior from Thailand. As one of ten children, her parents could not afford for her to attend university in Thailand. She came to the United States for high school, where she took her first computing class. Her decision to major in computer science was not based on prior experience or love of computing. She told us about her completely pragmatic, and in some ways very uninformed, decision to major in computer science:

> Actually, I came from Thailand, and basically I hadn't dealt with any computer at all before I came. And after that I got a scholarship to study computer science, but I didn't know anything about computer science. And then I went to high school here, and then I started taking a course about computer programming, and it was kind of interesting. But then I mean, I have no choice, so that is why I am doing computer science.

Kanitha came to Carnegie Mellon on a corporate scholarship, which requires her to return to Thailand after graduation and work for her scholarship sponsor. She is very clear that the chance to study abroad is most important to her; what she studies is secondary. She eventually decided to choose computer science as a major over electrical engineering because the best scholarship offered was from the Bank of Thailand, which wanted

computer science majors. We asked her why she chose computer science over electrical engineering:

> Why? I don't know. . . . Actually, like the scholarship itself, you know, for this different scholarship I have a different sponsor for it, so after I graduate, I have to work for a different person. So now I am thinking about which one I want to work for. And then I finally ended up, "OK, I think I want to work for this sponsor." So that is why I picked computer science. It's not because of the difference between those two. I don't even know what the difference is. Because I have to go back and work, so I just like consider the workplace and like the sponsor.

When asked, "How did you end up getting a scholarship to study computer science with no computer background?" she answers, "I just want to study abroad, so anything is fine with me." Kanitha has been an extremely successful student at Carnegie Mellon and is considering graduate school in computer science.

"You Have This Bridge You Have to Walk Over, and You Just Don't Look Down"

In another set of accounts, we hear how the pressing need of many international students to become breadwinners for their families leads them to pursue economic opportunity over personal interest. Concern for their families motivates them to stick it out and work hard despite doubt and lack of confidence.

Larissa, for example, moved to the United States with her family from Russia two years prior to attending Carnegie Mellon. She learned English while attending an American high school for two years. While Larissa had more prior computing experience than did Kanitha (she used to play computer games with her dad), she had little experience in comparison to either men and women from the United States. Throughout her four years at Carnegie Mellon, Larissa consistently ranked at the top of her class. She was thoughtful in reflecting on her experiences learning to live with the computer culture, accepting how little she knew compared to the peers around her.

Larissa described her first two years as walking over an "abyss." It was very difficult for her, and she frequently doubted herself:

> You have this bridge you have to walk over, and you just don't look down. . . . There were cases when I started looking down, and it was really scary. I'd think,

"WHY am I putting myself through this?" . . . But I have to do this, anyway, because I have to.

Larissa felt there was no option for failure, since her entire family was counting on her for financial support. Her father had been a research scientist in Russia, but in the United States has been managing a small restaurant. Her brother's ability to go to college depends on the money she will make after graduation. She has no financial safety net beneath her and feels she must persist. She believes that "you cannot have everyone doing what they want to do," that there is "supply and demand with jobs and what needs to be done," and that "basically, we have to do good to stay here." And she adds, "It's just a matter that if I'm doing something, I have to be good at it, so . . . you just work hard."

Degrees of Freedom

Motivations like these can boost persistence of students, even in less than ideal circumstances. Seymour and Hewitt (1997), in *Talking About Leaving*, speculate that "gender differences in perceived degrees of freedom to choose and to change direction" lead more women than men to leave the sciences (p. 278). They suggest that especially among students from socially and economically advantaged backgrounds, women choose disciplines "largely by the degree of personal satisfaction they offer" and "pay less regard to their economic viability" (p. 279). The result is that when the math-science tightrope becomes culturally or academically uncomfortable, women with safety nets may jump: "Reports of relatively easy release from initial commitment to a science, math, or engineering major were most common among women from economically advantaged families" (p. 278). On the other hand, Seymour and Hewitt found that black women, older women returning to school, and women from working-class families did not feel the same degree of freedom. We found this also to be the case with many of the international women students.

We do not advocate that women forgo personal happiness and sacrifice academic pleasure in the interest of expediency or financial incentives; rather, we are pointing to ways that motivations can affect persistence. But what also is required is a strong sense of self-efficacy. From interviews with these counterintuitive persisters we were able to identify several "pillars of persistence" that help boost students' sense of self-efficacy.

Attributional Beliefs about Intelligence and Talent

Research on learning motivation based on U.S. students has found that students generally hold one of two opposing views on intelligence. One view is that intelligence is a fixed trait—as in "you are born with the talents that you have, and nothing you do can change them." Students who hold this view tend to focus on performance issues such as grades and other forms of external approval. The other view holds that intelligence is a malleable quality—as in "if you work hard and practice, you will improve." These students tend to orient toward learning goals such as improvement and developing mastery.

Which of these dueling views a woman in computer science holds can make a difference in her sense of self-efficacy and persistence. The research of psychologist Carol Dweck (1986), who studies learning motivation, shows that "a focus on ability judgments can result in a tendency to avoid and withdraw from challenge, whereas a focus on progress through effort creates a tendency to seek and be energized by challenge" (p. 1041).

Believing in the link between effort, hard work, and success seems to be the mantra for many of the international women students. A woman from Thailand, in describing her first-year experiences, credits hard work for her success:

I know it's hard, it's really hard, because I remember my freshman year. I want to give it up because it's hard. But then I thought, "That's a loser's talk." So then I should try it and work hard. I think I can do it.

An Indian student attributes her persistence to "lagan," a Hindi term akin to "putting your nose to the grindstone." Using an example from Indian math education and its routine disciplined drills, she connects her cultural and educational training to her success in computer science:

But that routineness, I think, is something that isn't taught enough here. . . . And so people here have, from my experience with my classmates, I see they have a lot of insight, a lot of intelligence. . . . You know, they [snaps finger] pick things up as quickly, but they don't have the grit to sit down with something for, say, six hours and say, "All right, I'm going to get this done no matter what."

When we ask Larissa what factor she feels contributed most to her success, she tells us, in no uncertain terms, that it was "hard work." She believes that despite knowing less than other students, she will catch up and succeed by working hard.

Culturally Inscribed Attributions of Success

Psychology professors Harold Stevenson and James Stigler (1992) have conducted a cross-cultural examination of beliefs about achievement. Their research aimed to figure out why American children seem to be forever losing educational ground compared to children in some Asian countries. In their book *The Learning Gap: Why Our Schools Are Failing and What We Can Learn from Japanese and Chinese Education,* they examine the organization of schooling and the practice and profession of teaching. They also look at attributions of success and show how these beliefs are culturally inscribed.

Stevenson and Stigler (1992) consider the prevailing philosophies in Asian cultures and note that Confucian philosophy promotes the belief that lack of achievement is due to insufficient effort rather than to a lack of ability or to personal or environmental obstacles. In other words, a person who works hard will master a task. Many Asian students grow up hearing adages like those of Chinese philosopher Hsun Tzu: "Achievement consists of never giving up. . . . If there is no dark and dogged will, there will be no shining accomplishment; if there is no dull and determined effort, there will be no brilliant achievement" (p. 97).

In elementary schools throughout China, young children hear parables instructing them to work hard, put in the effort, and learn. One such tale is about Li Po, a poet who walks by a small stream and sees a white-haired old woman who has made a needle from a rock. The woman advises Po: "All you need is perseverance. If you have a strong will and do not fear hardship, a piece of iron can be ground into a needle." Other sayings and mottos convey the belief in hard work and effort, such as "The rock can be transformed into a gem only through daily polishing," and "the slow bird must start out early" (Stevenson and Stiegler 1992, p. 98).

Suzuki, the early childhood educator who introduced a now world-famous method of teaching the violin to very young children, had a similar philosophy about children's learning. Teaching violin to young children is not a question of seeking out the naturally talented. Suzuki (1978) believed that all children, with daily practice and hard work, could learn to play the violin. A boy or girl does not have to be a child prodigy to learn to play very young. Suzuki's teaching model compares violin playing to language acquisition: it happens through regular practice and repetition at a very young age.

Jane has read her daughter the story of Lilia, the 1996 Olympic gymnastic gold medalist from the Ukraine. In the official version of the Ukrainian gymnastic federation, Lilia is not a "natural" gymnast. Her hands are too small for the bars, and her back is weak. But Lilia's coaches recognize her determination—"a will to win and work exceptionally hard." Almost every section of the book repeats this refrain. The book also describes how it takes a team effort of Lilia, her coach, and her choreographer to win the medal. None of them could do it alone. Rather than the single famous star, the book is about a team that works hard until it wins.

Hard Work Versus the "Computer Gene" Theory

When faced with difficult course work, American women also work hard—very hard. Yet too quickly they hit bottom, concluding that they lack the "natural and innate talent" with which the men seem to be born. Lily, a U.S. student who was full of enthusiasm when she began a year ago, in her last interview questions whether she should be in the program:

> I don't really feel like I should be in the department. What am I doing here? So many other people know so much more than me, and this just comes so easy to some people. . . . It's just like there are so many people that are so good at this, without even trying. Why am I here? Do I want to work my butt off for four years, when there are so many people that it comes naturally to? Should I be here for the sake of the field even? You know, someone who doesn't really know what she is doing?

Lily ultimately despairs, concluding that no amount of practice or time spent on a task could improve her mastery of the material. As another female student says:

> There are people who are born to do this, and I am not one of them. And it's definitely not one of those things that, like, "Oh, with practice, you will become one who is born to do it." . . . I think a lot of people are just born with it. You just gotta be like, "Computers! Yeah! they are awesome!! They are my life!" You know, a lot of computer scientists, that's all they do.

We continued to hear this refrain, as women looked around and experienced their male peers knowing more and doing the work with greater ease. We have found too many American women fall victim to the "computer gene theory," even if unconsciously.

Gender and the Entity View of Intelligence

In her article "Motivational Processes Affecting Learning," Carol Dweck (1986) suggests girls may be more likely than boys to subscribe to an "entity" view of intelligence—seeing ability as a fixed, static trait—and therefore exhibit a tendency toward low expectations, challenge avoidance, and debilitation under failure. She describes a series of studies by Leggett who assigned a novel "concept formation task" to bright junior high school students (Leggett 1985). Researchers observed a greater tendency of those girls who subscribed to the "entity" view to avoid challenge.

The entity view of intelligence can take its toll even on a student who works extremely hard. We witnessed how a student who attributes her math success to hard work rather than ability can have low expectations for future success precisely because she thinks her future courses will be even more difficult and demanding than the ones in which she is currently enrolled. A top student in her class reasoned that her As were the result of hard work, not ability; in her view, others got As without working so hard. Despite her 4.0 average, she ended up leaving the major, convinced that she was ill-suited for the field because she put in so much effort.

Cultural Resistance

In chapter 4, we discussed how the male hacker has become the cultural norm in computer science, the standard to which women students begin to compare themselves. We have found that women who persist are those who find a way to get grades they are satisfied with and who can develop a personalized view of computing and their place in it. Women who accept the prevailing culture as the norm and who continuously compare themselves to this norm and find themselves coming up short are the ones who suffer the most.

The majority of women struggle to find a place where they can feel comfortable in the prevailing culture. One female student told us how she has refused to conform to the image of the myopically focused "computer geek." And since she is "getting really good grades without changing myself," she is ever more confident that she can remain in the major and be herself. When the interviewer asks her if she feels any need to conform to the culture around her, she answers:

> I refuse to. I was worried what if I don't. Will I need to conform to that? Will I need to read books on computers all of my free time or something to survive here? And I feel so far I haven't. I'm getting really good grades without that . . . without changing myself. So I feel much more confident now that I don't have to. It's kind of nice. I can prove them wrong or something.

Ironically, it is in this area of relationship to the culture that the international women may have an edge. The international women do not as readily use the U.S. male hacker as their reference group. Since they are not fully part of this culture, their reference group is elsewhere. Many international students have alternative success norms and social bonds that protect them. Other priorities are dominant, and with these come other scales for self-evaluation.

It is important to note that some women students do feel the prevailing culture is a relatively good fit for their interests and personality. They take pleasure learning to walk the walk and talk the talk; becoming part of this culture helps them persist. An American female student talks of a sense of mastery when she became familiar with computer science (CS) jargon: "It kind of feels like becoming part of a club—CS club." She observes that her new adopted lingo may not be required but that "it is what you grow into:"

> I've had several friends who are walking along the sidewalk and make a joke and say it in code. It's something that non-CS people or maybe an arts person would just think is totally stupid, but we think it's funny. It comes naturally.

Another woman reports, *à la* Star Trek, that "resistance is futile" and takes pleasure in the thought.

Breaking the Isolation and Building Support

"Surround yourself with supportive people!" is the mantra of a current American graduate student who attended Carnegie Mellon as an undergraduate. She attributes her undergraduate survival to the support she received from her family and friends. She recently tells of being the only woman in her lab in graduate school. She didn't mind that except that there was a "guy in the lab who was a sexist pig, to put it nicely." She describes the support she got from the other students in the lab:

> But the best part of it all was that any remarks he made would be stifled by the other men in the lab. I had good friends! They were shocked at this guy, and he shut up (and thankfully left school) eventually.

Rebecca, a junior, tells us that her boyfriend, "can't really help me with my assignments, but he's good moral support." She describes him as "one of those people who, when I am saying 'I can't do this assignment anymore!' he's like, 'Yes, you can. I know you can. I've seen you do these things before!' "

Vera, a junior, talks about the support she received from a computer science women's dinner. She begins by describing her earlier social isolation, being one of a minority of women in the midst of male bonding:

> Being female is scary in this program. First you feel alone, and you don't know who to go to, and you don't know who to talk to. You just feel weird because you see the immediate bonding between other people, just male bonding . . . just showing off and talking. . . . I can still get intimidated easily. And you just feel like you're in a minority. It's just a weird feeling.

She then describes how her self-doubt turned around when she attended her first dinner for computer science women students. She realized that others shared similar feelings and she was not alone:

> I had all those feelings, and I didn't think that anyone shared those. I remember we had a CS dinner with the women in grad school. And it helped me a lot because I wasn't talking, but I was listening, and I thought everybody was saying the exact same things that I was feeling . . . like everybody was talking about them. And it was a big relief for me to realize that actually other people, other females were feeling the same way. And I just felt so much better. I remember after feeling . . . it was such a big relief.

Chirudee, a Thai student, also notes the importance of having a support network of friends. It was the presence of many Thai students on campus that convinced Chirudee to come to Carnegie Mellon in the first place. And indeed the Thai social circle turned into her support network. She says she pulled through one of her difficult programming classes and even enjoyed it because her friends were also taking the course:

> I kind of enjoyed it. But not many people enjoyed this class. But I did because there were many of my friends taking it and we would kind of like suggest with one another. And then I felt like fun doing it, so I mean I enjoyed it. The instructor . . . I felt he was OK. . . . I mean he wasn't that great. But my friends didn't like it, but . . . because of my friends I kind of enjoyed it.

Supportive Learning Communities

Salina grew up in Malaysia and has ten brothers and sisters. Both her father, a forester, and her mother, a housewife, were computer illiterate. She attended a boarding school and was in the "science track." When she arrived at Carnegie Mellon, she "knew a bit about Basic, and I had never really done any hard programming work at the time." She rated her preparedness at the time of beginning Carnegie Mellon as two on a scale of five and had low confidence. By her junior year, she rated her preparedness as a four and her ability as a three.

Salina describes her first year as a "really hard year for me." Her confidence was low, and "I see all these other students just grasping the concept in less time that I could." She sat in class, feeling lost and "in shock," feeling that maybe she couldn't make it. She says, "I was just totally scared at the time." But she says, "just by working harder I eventually caught up with the whole class, and I ended up getting an A in the class."

Salina attributes her success partly to the support she received from friends. She said that everybody was just helping each other out. In her second semester she took 15–211, the course with a reputation of being a major hurdle:

> I was really just baffled in that class because I just couldn't understand anything, so my confidence went down again at that point, plus I didn't know anybody in that class. So I dropped the class because I didn't have any confidence in doing that. . . . I took the course again in sophomore year, and things started to get clearer for me. Understand things better, plus at the time I made a lot of friends in the major. And you know, it is just the feeling that you have people going through the same thing with you. So it makes it better.

Former University of California calculus professor Uri Treisman (1992) believes that a supportive learning community is critically important for the success of minority students in math and science. Seeking answers to the high failure rate of African American students studying calculus at the University of California at Berkeley, Treisman observed that Asian American students formed social communities in which they helped each other with math, competed at mastering the material, and generally supported each others' learning, similar to what was described by Chirudee above.

He also found that most African American math students he studied were highly motivated, worked hard, and studied long hours but that even the best-prepared among them were failing. What stood out between the Asian and African American students was not a difference in motivation, preparation, or family support but in integrating studying and learning into social lives. African Americans were academically isolated and did not congregate into learning social communities the way the Asian students

did. Instead, their academic interests and social interests were separate while they worked hard (and somewhat unproductively) on their own.

Observing the extra boost that comes from living and engaging with the material, Treisman has formed communities for African Americans similar to those created by Asian American students. These communities are built around intellectual interests (in this case calculus), provide well chosen problem sets that drive group interaction, and foster a supportive learning environment. Currently, Treisman-inspired Emerging Scholars programs operate in numerous colleges and universities and achieve high rates of retention in calculus courses among African American and Hispanic students.

Computer Science as an Acquired Taste

Studying the life arcs of women students in computer science over a four-year period has revealed to us some patterns of persistence. If students are able to stick it out through the second year, get grades they are pleased with, and reconcile their relationship to the culture, then their initial level of confidence often returns, accompanied by an increase in interest.

Interviews with persisters often reveal a key moment of success or achievement that keeps them going. For one senior, this moment was in her third semester, when she got over the hump of the data structures course (211) and began taking more advanced classes. She says that she had no confidence after 15–211 and "thought I would flunk out or get kicked out of CS." But then she ended up getting an A in the course that immediately follows in sequence (15–212). She is in awe that she mastered the more advanced material. And the fact that she did it on her own became very important for her. In 211 she frequently needed to consult her teaching assistant, but in 212 she "was able to go right through the course without help." That was her confidence builder:

> In 211 I was constantly going to the TA, and I was like, "I don't know how to do this!" And I felt like he was practically writing my programs for me because every time I'd have a bug or something, I'd be going to my TA two or three times for each program, at least. Then in 212 I was able to go right through the course without help or anything. It was just a great feeling for me, and I feel I learned a lot. And it was just a big transition for me. It was a lot of big "Ah-hah! So that's what we were learning before!" All of a sudden things started clicking. It was just like a really big transition for me.

While this feeling of self-sufficiency may seem contradictory to the confidence gained from working with a supportive group, one way or another students have to internalize a sense that they can do it. If students persist for a sufficient amount of time (at least through the sophomore year), the odds are that they will regain confidence in themselves. Brenda, a sophomore student, talks of this confidence:

> But it's kind of like if you're running, and you get to this big hill, and you're like, "Oh man, I'll never be able to run up that." And you do, and then you get to the next big hill. So it's like you're not exactly dreading it because once you get to the top, you feel really good about yourself. I guess I used to be afraid of a lot of things, but as I keep getting over and over these courses that I never thought I could pass, I think I'm ready to do the next step. And I don't know how I'm ever going to do senior-year courses, but I'll know when I get there.

We have found that if students get through the first two years, that a sense of mystery about computing turns into a sense of mastery. Asked if her interest in CS had increased or decreased, one junior provides an example of an upward spiral of confidence and interest:

> I think partly it's increased just because I put so much work into it. It's like when you invest this much time in something, you want to do good in it. And also, I think the more I learn the more I think, "I can do this thing!" I just need to work really hard at it. But yeah, I think I've gotten more interested in it.

A Malaysian woman describes the satisfaction she felt in sticking it out:

> It's like an acquired taste for me. . . . At first it was very hard. . . . After a couple of years, I realized it's kind of late to back out. I sort of went through with it, and along the process I'm beginning to think I like it more and more. So at the end, I just went along with it, and it's pretty exciting, now that I learn more about it.

Conclusion

Despite doubts and uncertainties, women tend to persist in computer science when they reject and find alternatives to the dominant culture of the field. A larger question, though, is what institutions can and should do to eliminate the negative factors that lead students to leave computing programs. We touch on several ideas for high schools in chapter 7 and for universities in chapter 8.