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This chapter explores the important social-psychological factors along individuals' developmental pathways that influence youths' computer-related occupational decisions. Findings suggest that these factors differentially influence information technology pursuits dependent on youths' race and gender

Who's Computing? Gender and Race Differences in Young Adults' Decisions to Pursue an Information Technology Career

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Over the past ten years, information technology (IT) has emerged as a vital part of the global economy. Although IT job growth will not be as rapid as the booming growth of the computer industry during the previous decade, as the IT sector matures and routine work is increasingly outsourced overseas, the computer industry still offers favorable job prospects and faces a demand for qualified professionals (U.S. Department of Labor, 2004). As technology becomes more sophisticated and complex, these computer-based job prospects are especially promising for individuals with more advanced levels of training and expertise (U.S. Department of Labor, 2004).

Despite these fruitful career opportunities available in the computer field, women and minorities in the United States are vastly underrepresented

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in IT. It has been estimated that women, although representing 46 percent of the total U.S. workforce, account for less than 30 percent of the IT workforce (U.S. Department of Commerce, 2003) and for only 10 percent of executives in Fortune 500 computer companies (Xie and Shauman, 2003). Despite the growing need for qualified applicants for IT positions, the number of women in IT is actually declining (U.S. Department of Commerce, 2003). Similarly, African Americans, who make up more than 12 percent of the U.S. population, represent only 5 percent of the IT field (U.S. Department of Commerce, 2003). This pattern may not only have negative economic consequences for women and minorities, but ultimately it means the computer industry (and, more generally, society) is deprived of the immense pool of talent that women and African Americans can offer (American Association of University Women Educational Foundation, 2004).

Inequality in the labor force results from a process of differentiation that begins and accumulates in earlier stages of life decisions. An image of a pipeline has often been used to illustrate the set of educational and employment achievements necessary to obtain a science career (Hilton and Lee, 1988; Eccles, 1989). Although the initial pipeline model helps us to conceptualize where in the sequence of prerequisites for an IT profession women and African Americans "leak out," it does not adequately address the conglomeration of social and psychological factors that underlie youths' decisions to either pursue or opt out of a computer science education trajectory. The current investigation aims to gain a greater understanding of why some youth are more vulnerable to leakage from the computer science pipeline by first identifying important social and psychological factors along individuals' developmental pathways (from eighth grade through three years after high school) that influence youths' computer-related occupational decisions. We then examine how these social psychological factors may differentially influence IT pursuits dependent on youths' race and gender in order to gain a greater understanding of the mechanisms underlying gender and race gaps in IT professions. Examining these groups separately will not only shed light on what provisions enhance children's interest and skill in computers but will help us to decipher what types of support are needed for whom.

According to the Eccles et al. Expectancy Value Model, individuals' educational and vocational choices are greatly influenced by their interests, values, and expectations for success. More specifically, the model links achievement choices to interpretative systems like causal attributions, the input of socializers (parents, teachers, and other mentors), gender role beliefs and cultural norms, self-perceptions, aptitude (previous achievement), and one's perceptions of the task itself (Eccles, 1994). The investigation reported here applies the expectancy value model to examine adolescents' pursuit of information technology as a dynamic process that includes the consideration of the multiple social psychological and structural factors along adolescents' developmental trajectories that were found to be influential on their educational and occupational choices.

The investigation hypothesizes that there will be direct effects for gender, race, socioeconomic status (parent education, occupational status, and pretax income), and general academic achievement on adolescent decisions to pursue an IT career. We seek to understand the social and psychological factors that might explain these direct effects. In support of the leaky pipeline theory and previous research findings, we propose that occupational choice is a cumulative developmental process in which early experiences of childhood and adolescence are formative and influence later, more proximal influences of youths' career decisions. Therefore, we hypothesize that more specific computer-related factors are nested within a more distal framework of earlier adolescent social psychological development.

In the study reported here, we examined earlier social psychological factors, measured when youth were in the eleventh grade, which previous research has found to influence youths' decisions to pursue other traditionally male occupations in math and science. These social psychological predictors include youths' self-perceived math ability (Eccles, 1987; Eccles, Barber, and Jozefowicz, 1998; Kiesler, Sproull, and Eccles, 1985; Betz and Hackett, 1983) and the value they attach to math (Ware and Lee, 1988; Eccles, Barber, and Jozefowicz, 1998; Farmer, Wardrop, Anderson, and Risinger, 1995), especially because math skill development is a requirement for the science and technology fields. Youths' concerns about experiencing gender discrimination and feelings of efficacy in combating race discrimination were also assessed because research has documented how gender and race schemas and stereotyped expectations are detrimental to the academic and career pursuits of both females (Heilman, 2001; Jacobs and Eccles, 1992; Wigfield and Eccles, 2002) and some racial minorities (Powell and Butterfield, 1997; Steele, 1997). In addition, we included general academic expectation (how far youth think they will go in school) because of the broad influence it has on career aspirations.

In line with the Eccles et al. Expectancy Value Model and previous research findings regarding women's and minorities' pursuit of math and science careers (Eccles, 1994; Eccles, Barber, and Jozefowicz, 1998; Margolis and Fisher, 2002; Xie and Shauman, 2003; Garcia and Giles, 2003), we propose that proximal psychological factors three years after high school that are specific to the computer field, such as self-concept of one's ability in and enjoyment of computer-related tasks (programming, development of software and hardware, and so on) and such behaviors as taking elective computer-related (science) courses, will be important predictors of whether young adults choose to pursue an IT career. In addition, we hypothesize that social influences, such as the endorsement of negative schemas (geeks, socially isolated) and positive schemas about IT (good for the world, solve problems, and so on), as well as the encouragement the young adults receive from others to pursue IT, play a major role in whether an individual decides to pursue a career in IT.

Along with identifying important factors that influence youths' computer-related occupational decisions, our second aim is to gain a greater

understanding of the mechanisms underlying gender and race gaps in IT professions through an examination of how these social psychological factors may differentially influence IT pursuits dependent on the intersection of race and gender. Although trends found for the underrepresentation of women and African Americans in IT run parallel, research that has investigated these groups independently suggests that many of the underlying barriers that prevent women from entering IT are different from those that create disparities in IT by race (Garcia and Giles, 2003). Little attention has been paid to the interaction of these group identities (intersection of race and gender) as they are related to pursuing a career in information technology.

Method

Participants are from the Maryland Adolescent Development in Context Study (MADICS), a community-based longitudinal study designed to examine the influences of social context on the psychological determinants of behavioral choices and developmental trajectories during adolescence. Longitudinal data were collected at six time points: first, in 1991 when youth were beginning seventh grade, in the summer and early fall following the seventh and eighth grade, during the eleventh grade, and then one and three years after high school. The sample of 1,482 adolescents (49 percent female) and their families is unique because it includes a large proportion of African American families (61 percent African American, 35 percent European American), with as broad a range of socioeconomic status as the European American families (mean pretax family income in 1990: $42,500 to $52,500, with a range of $5,000 to $75,000). The sample is drawn from a Maryland county composed of rural and urban settings and both low- and high-income neighborhoods. At three or more of the measurement occasions, 1,196 families participated.

In this chapter, we report on information collected at three time points: in 1994 after adolescents completed the eighth grade (mean age = 14.2), in 1996 when the adolescents were in the eleventh grade (mean age = 17.1 years), and in 2000 when adolescents had been out of high school for three years. Over 80 percent of our original sample of 1,482 families participated in the eighth-grade and eleventh-grade data collection (86 percent and 81 percent, respectively). When youth were three years post–high school, we obtained data from approximately 60 percent of the original sample. The longitudinal sample for the current study (which participated at each of the time points we examined) contained 118 of the initial 471 African American males (25 percent), 147 of the 426 African American females (35 percent), 80 of the 223 European American males (36 percent), and 98 of the 237 European American females (42 percent). Some of the additional attrition is due to participants' not answering specific questions included in the model. Other ethnic groups were not included in the analysis due to small sample size (25 youth self-identified as various other ethnic groups).

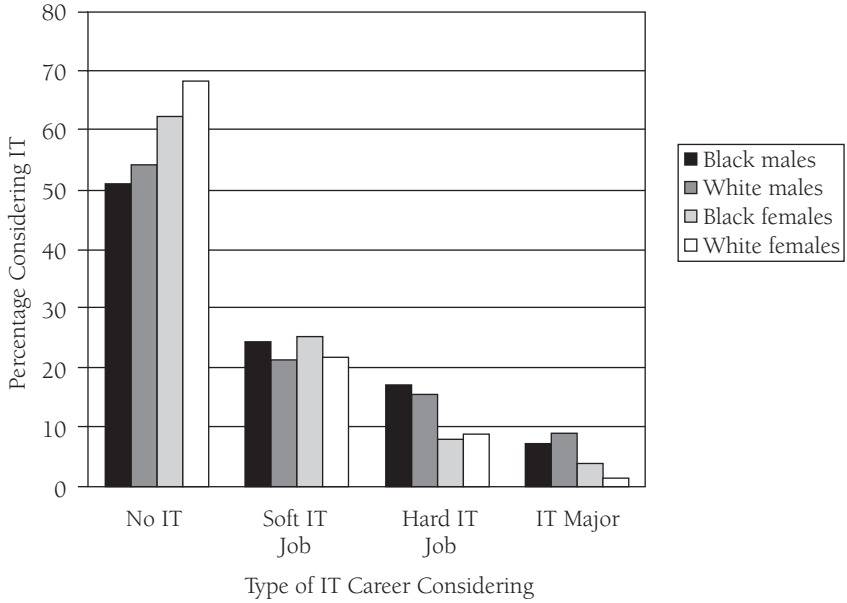
Measures. All demographic, social, and psychological constructs used in this chapter and sample items are presented in the appendix at the end of the chapter.

Information Technology Career Aspiration. In order to assess adolescents' aspirations to pursue an IT career, adolescents were asked, "Have you ever considered getting a job in Information Technology? If yes, which ones?" Responses were coded as 1 = no consideration, 2 = considering pursuing a "soft" IT career, and 3 = considering pursuing a "hard" IT career. Adolescents who reported pursuing a college major in the computer science field were coded as having the highest potential for considering and eventually establishing themselves in a computer-related occupation (coded as 4). "Soft" computer jobs included such occupations as Internet journalism, research, telecommunications, help desk, resource guides, teaching, and statistics. Some adolescents reported already being in the IT field but needed training. They were mainly in audio/stereo sales or secretarial work, coded as soft IT occupations. "Hard" computer jobs included network/systems administrator, information systems/technology, and programmer/computer engineer. A college major in information technology included such fields as computer programming (n = 1), computer science (n = 36), and computer art (n = 2).

Results

Preliminary gender by race differences in youths' decisions to pursue an IT career and the level of advancement in the career (soft, hard, computer science major) was examined using chi square analyses. A gender difference was found: black and white males were more likely to consider pursuing an IT career than white and black females (χ^2 (3, N = 762) = 21.22, p = .00). Black males were most likely to report that they are considering a career in advanced (hard) information technology (adjusted standardized residual, asr = 2.6). White males, however, were most likely to major in IT (asr = 2.3) and thus held the highest potential to pursue the field. White females were least likely to pursue an IT-related career, with 62.2 percent indicating no consideration of IT careers, and they were least likely of any of the other groups to be majoring in IT (asr = 2.5) (χ^2 (9, N = 700) = 26.03, p = .01). Black females were the least likely to pursue a career in hard IT (asr = −2.3). Interestingly, for each group examined, youth who reported considering an IT career were most likely to consider pursuit of a soft IT profession (see Figure 6.1). In fact, among soft IT careers, no differences between groups were found: both black and white females were as likely to aspire to a soft IT career as were the males. Indeed, in separate analyses (Zarrett, Malanchuk, Davis-Kean, and Eccles, forthcoming), we found that black and white females reported that they enjoyed soft computer tasks as much as the male groups did and black females felt they were good at soft computer jobs significantly more so than all other groups. These results

Figure 6.1. Chi Square Analyses of IT Aspirations by Race and Gender



suggest that although gender differences exist in considerations of pursuing an IT career in the higher echelons of the IT industry, females do consider pursuing careers in the IT field but ultimately aspire to pursue the less profitable, less prestigious soft computer professions.

The aims of the study were to examine the social psychological and behavioral determinants of pursuing an IT career and the differences in the impact of these social psychological factors for the intersection of race and gender. Hierarchical (stepwise) regression analyses were used first to examine eighth-grade demographic predictors (race, gender, socioeconomic status, and academic achievement) that previous research and national statistics have identified as predictive of IT career pursuits (distinguish who is in IT careers). Building on the regressions testing whether adolescent demographics and achievement would predict their decisions to pursue an IT career, the second step involved regressing eleventh-grade social psychological factors we predicted would mediate the main effect of gender, race, socioeconomic status, and achievement on more proximal factors that promote IT career aspirations. Next we added the more proximal or direct determinants of pursuing an IT career to the regression to determine what computer-related factors predict IT career aspirations and to see if the more distal effects during eighth and eleventh grades (such as gender, achievement, self-concept in math, value of math, experience of discrimination, and academic expectations) are mediated by the more proximal determinants of computer-related career aspirations.

We then ran a second set of stepwise hierarchical regression analyses for each group separately using the same set of social and psychological factors as in our first analyses in order to identify differences by race and gender in what social and psychological factors are important for promoting IT aspirations of youth.

Across Gender and Race. We first examined the direct effect for gender, race, socioeconomic status (parent education), and general academic achievement measured during adolescents' eighth-grade year on an adolescent's decisions to pursue an IT career. Child's gender significantly predicted career aspirations: young women were less likely than young men to aspire to an occupation in information technology. Eighth-grade academic achievement also predicted whether youth considered an IT career such that the higher the youth's achievement, the higher his or her IT aspirations. Race and SES factors (parental level of education, occupational status, and pretax income) were not significant predictors of IT career pursuits. (See Table 6.1, model 1.)

Of the eleventh-grade social and psychological predictors entered into step 2 of the model, self-concept of math ability and value of math predicted IT career aspirations: adolescents who perceived themselves as being good at math and who endorsed beliefs in the importance of math were more likely to have high IT career aspirations four years later. Contrary to our prediction, child's gender and academic achievement remained significant predictors in model 2. (See Table 6.1, model 2).

In step 3, significant predictors of the level of commitment to an IT career three years after high school included self-concept of ability at hard computer tasks, endorsement of negative schemas related to the computer field, whether youth had taken any IT course and, if so, the level of difficulty of the course, and the amount of encouragement or advice given by others to pursue IT. All findings were in the direction predicted: those who believed they were good at computers, had taken IT courses, and were encouraged by influential others were all likely to be pursuing an IT career, whereas those with negative schemas about people who use computers were not. Although some of the gender variance was accounted for, gender remained a significant predictor in model 3. The influence of a youth's academic achievement was accounted for by the proximal social psychological predictors entered in step 3 (see Table 6.1, model 3).

These findings suggest that adolescents who early on perceived themselves as good at math, had later taken IT courses, and found they would be good at hard computer jobs and received encouragement from influential others to pursue an IT career were those with the highest IT aspirations. In addition, the majority of youth who considered pursuing an IT career were male. These gender differences were strong and remained a powerful predictor of IT career aspirations even after accounting for the multiple social and psychological factors found to influence science and technology career pursuits. Contrary to population differences found in

Table 6.1. Predictors of IT Career Aspirations (N = 508)

	Model 1		*Model 2*		*Model 3*		*Zero-order*
Variable	*B*	β	*B*	β	*B*	β	*Corr*
Step 1							
Parents' education	.00	.00	.00	.01	.00	.00	.05
Parents' occupation	.00	.04	.00	.05	.00	.05	.06
Family income	.00	.00	.00	.00	−.01	−.04	.04
Race[a]	−.16	−.09†	−.13	−.07	.02	.01	−.05
Gender[b]	−.35	−.20***	−.31	−.17***	−.22	−.12**	−.16***
Youth academic achievement	.13	.14**	.12	.13*	.08	.09†	.07
Step 2							
Math self-concept			.06	.11*	.05	.09*	.16***
Math value			.09	.09*	.03	.03	.10*
Education expectations			−.05	−.08	−.06	−.11*	−.02
Gender discrimination			.02	.01	.07	.05	−.01
Race discrimination			.11	.08†	.09	.07†	.09*
Step 3							
Computer self-concept					.13	.19***	.35***
Enjoy computers					.04	.07†	.19***
Positive computer schema					.05	.04	.16***
Negative computer schema					−.17	−.13**	−.21***
IT courses taken					.17	.24***	.36***
Others' Influence					.19	.16***	.29***
Change in R^2	.05		.03		.22		
Adjusted R^2	.04		.06		.27		

*$p < .05$. **$p < .01$. ***$p < .001$. †$p < .10$.

[a]Race was coded as 1 = Black and 2 = White.

[b]Gender was coded as 1 = male and 2 = female.

the IT field, our findings suggest that the blacks in this sample were equally as likely to consider a career in computers as whites. Black males were just as interested in pursuing an IT career as white males, and black and white females held similar low IT aspirations. In addition, a parent's educational, occupational, or economic background did not appear to play a role in a youth's IT occupational consideration, nor did early academic achievement once all other predictors were considered.

The Intersection of Race and Gender. In order to examine differences in the impact of these social psychological factors by the intersection of both race and gender, another set of hierarchical regressions was run with the same set of predictor variables for each of the four groups: black males, black females, white males, and white females. A preliminary ANOVA analysis indicated differences in IT career aspirations for the interaction of race and gender ($F(3, 700) = 7.43$, $p = .000$).

Black Males. In step 1, a main effect of parents' educational attainment was found for black males: the higher the parents' education, the more

likely black males were to aspire to IT careers. All other predictors were not significant.

Of the distal eleventh-grade psychological variables entered in step 2, self-concept of math was a significant predictor of black males' pursuit of an IT career. In addition, expectations of experiencing gender discrimination, as well as a trend for black males' perceived inefficacy in combating race discrimination, were found to predict black males' IT career aspirations. Contrary to what was expected, both expectations of experiencing gender discrimination and feelings of inefficaciousness in combating race discrimination predicted black males' decisions to pursue IT. Parents' educational attainment was accounted for by the social psychological indexes entered in step 2.

Next, hypothesized proximal determinants of IT pursuits were entered into the model. Of the social and psychological factors directly related to the IT field measured three years after youths completed high school, self-concept of computer skills and IT courses taken were significant predictors of black males' decisions to pursue an IT career. The influence of eleventh-grade self-concept of math ability, expectations of gender discrimination, and inefficacy to combat race discrimination remained significant even after more proximal predictors were entered into the model (see Table 6.2).

Therefore, among black males, the early perception of being good at math made a difference in career aspirations. In addition, black males who considered pursuing an IT career were those who had taken IT courses, perceived themselves as good at hard computer jobs, and, most prominent, held expectations of experiencing gender and racial discrimination before they chose an IT career path. Others' encouragement did not play a role in black males' IT considerations once all other predictors were considered.

Black Females. Parent education attainment predicted black females' pursuit of an IT career in the opposite direction to that found for black males: the lower the educational attainment of parents, the greater the commitment was among black females to pursue an IT career. All other predictors entered in step 1 were not significant.

Among the hypothesized eleventh-grade predictors of IT choice, only educational expectations significantly predicted black females' decisions to pursue a career in IT. Interestingly, this finding was in the opposite direction of what was predicted: the more education black females expected to attain, the less likely they were to aspire to IT careers. The zero-order correlation between academic expectations and IT aspirations is also negative, further indicating that academic expectations is inversely related to IT aspiration and that this is not simply due to a suppressor effect. The influence of parents' education on black females' IT aspirations was explained by the eleventh-grade predictors entered in step 2.

Like black males, the significant predictors of black females' aspirations for an IT career at step 3 included self-concept of computer skills, having a positive computer schema, and IT courses taken. In addition, black females' decisions were predicted by the encouragement received from others. Black

Table 6.2. Predictors of IT Career Aspirations by Gender and Race

	Black Males (N = 118)		*Black Females (N = 146)*		*White Males (N = 80)*		*White Females (N = 98)*	
Variable	*B*	*r*	*B*	*r*	*B*	*r*	*B*	*r*
Step 1								
Parents' education	.05	.23**	−.05	−.09	.01	.01	−.01	−.04
Parents' occupation	.00	.13	.01†	.05	.01	.11	.00	.02
Family income	−.01	.09	−.01	.04	−.03	−.04	.00	.09
Youth academic achievement	.03	.16*	.15†	.10	.15	.06	.06	.08
Step 2								
Math self-concept	.13*	.21*	.04	.11	−.05	.14	.04	.16
Math value	−.03	.07	.03	.11	.33**	.26*	.03	.10
Educational expectations	−.05	.03	−.12**	−.09	.05	.13	−.07	−.03
Gender discrimination	.43**	.20*	.02	.04	.03	−.01	.02	.01
Race discrimination	.25*	.19*	.12	.08	.17	.11	−.01	.00
Step 3								
Computer self-concept	.14*	.28***	.13**	.33***	.10	.31**	.14*	.39***
Enjoy computers	.04	.09	.02	.21**	.00	.13	.04	.21**
Positive computer schema	.13	.19*	.06*	.14*	−.11	.20*	−.12	.02
Negative computer schema	−.15	−.20**	−.14**	−.21**	−.24	−.27**	−.21†	−.22**
IT courses taken	.22**	.40***	.18***	.37***	.16†	.37***	.05	.18*
Others' influence	−.01	.26**	.23**	.35***	.49**	.36***	.13	.28***
Change in $R^{2\dagger}$	.17		.29		.25		.18	
Adjusted $R^{2\dagger}$	.26		.30		.25		.10	

Note: Hierarchical regressions were used for all analyses. Prior steps were omitted for space and/or at the editors' request. *B* = unstandardized beta coefficients. *r* = zero order correlation

*$p < .05$. **$p < .01$. ***$p < .001$. †$p < .10$.

females' educational attainment expectation remained a significant predictor of their IT career aspirations when the more proximal IT predictors were entered into the model (see Table 6.2).

These findings suggest that among black females, it was those who received a great deal of advice and encouragement who pursued IT aspirations. They had also taken IT courses, perceived themselves as good at hard computer jobs, and endorsed a positive schema but not a negative schema about who works with computers. Finally, it was those black females who held lower educational expectations for themselves who aspired to an IT career.

White Males. Parent demographics and adolescents' academic achievement were not significant for white males. In step 2, eleventh-grade perception of math value predicted white males' decisions to pursue an IT career. Of the proximal predictors entered in step 3, encouragement and advice that white males received concerning the occupational field predicted decisions to pursue an IT career. At step 3, perceptions of the value in math continued to predict white males' aspirations of an IT career. (see Table 6.2). In essence, what mattered most for white males' IT aspirations was others' encouragement and, importantly, valuing math at an early age.

White Females. Similar to white males, parent demographics and adolescents' academic achievement were not significant for white females. Neither were the eleventh-grade psychological factors predictive of white females' IT career aspirations. In fact, the only predictor of aspiring to an IT career among white females, and a weak one at that, was their perceptions of their self-concept of their computer skills. If white females perceived themselves as competent in computer-related jobs (for example, programming, designing software, and hardware), they were likely to enter the IT field (see Table 6.2). Therefore, unlike the other groups we examined, our model did not explain very much of why white females had IT aspirations.

Discussion

The aims of this chapter were to explore the dynamic pipeline process of youths' IT aspirations where, we hypothesized, more specific computer-related factors would be nested within a more distal framework of earlier adolescent social psychological development and how these social psychological and structural factors differentially influenced IT pursuits dependent on the intersection of race and gender.

Across Gender and Race. Our findings support the hypothesis that occupational aspirations are shaped by a conglomeration of both early (distal) and more current (proximal) social psychological influences in youths' developmental trajectories. Individuals' choice to pursue an IT career relates to their perceived ability or mastery of the field and its precursors and how much they value it, as well as the culmination of their experiences

and subjective interpretations with the subject matter, cultural norms and stereotypes, and the influence of socializers and peers.

These findings have important implications for future interventions. Such early factors as academic achievement, math self-concept and value, educational expectations, and discrimination were found to be either directly influential on later IT-related occupational decisions or indirectly related and accounted for by more proximal computer-related factors. Thus, interventions early in youths' development that address such factors may play a key role for getting young adolescents on track for the pursuit of an IT career. It is also important to note that the influence and input of socializers such as parents, teachers, and peers was among one of the most important factors for youths' IT career considerations and thus should be a focal point for promoting young people to pursue a computer-related career. Therefore, interventions beginning early in youths' development, focused on such issues as stressing the importance of early encouragement of children's interest and confidence in math and the technical and physical sciences, providing a diversity of IT role models, increasing computer provisions, and teaching parents to make computers a priority and of value in the home are as important and essential as the interventions used in schools. In the following section, we discuss these findings in greater detail, with special consideration to how these factors found to be influential on youths' IT career choices were differentially manifested in the groups examined.

Group Differences. Our data point to the importance of considering how trajectories of youths' occupational choices may differ by the intersection of gender and race. There were some major differences found for IT occupational choices by gender across race that warrant particular attention. The women, if considering an IT profession at all, primarily reported considering soft IT careers that require vocational training at most. Overall very few women reported considering an occupation in hard computer science. In addition, we found that black females with higher expectations for educational attainment were those least likely to consider pursuing a career in IT. Thus, women planning to attain the highest levels of education planned to use their knowledge and skills in other areas. Together, these findings suggest a possible difference in gender attitudes toward the IT profession. Men appear to perceive IT as an advanced and affluent career and have high consideration for seeking an occupation in hard computer science; women view the IT career trajectory as one that requires less educational attainment and is overall less prestigious. Ultimately the IT field is not benefiting from the higher educational attainment of women.

These findings also raise further concern about the declining number of females in IT (U.S. Department of Commerce, 2003). Women, because they mainly aspire to soft computer jobs, are most vulnerable to the recent downsizing among IT firms and global outsourcing of these routine (soft) computer jobs. Job prospects for the advanced or hard computer science careers, professions that males were most likely to pursue, remain more

promising in the United States. Although we have specifically addressed gender and race discrepancies in IT found in the United States, women's underrepresentation in the higher levels of IT and overrepresentation at the lower levels have also been of great concern in other Westernized countries (see Panteli, Stack, and Ramsey, 2001, and Tijdens, 1997, for concerns in Europe). Some research suggests that similar mechanisms concerning youth values and perceived ability regarding computers are responsible for these discrepancies (see Farina, Arce, Sobral, and Carames, 1991, for Spain; Colley, Gale, and Harris, 1994, for Great Britain; and Okebukola and Woda, 1993, for Australia).

Why are not more women considering hard computer science occupations? Recent theories suggest that females generally perceive themselves as less capable than males in advanced computer skills and that they lack an interest in computer-related tasks because of the structural, social, and psychological setting of the "computer world" (Margolis and Fisher, 2002; Xie and Shauman, 2003; American Association of University Women Educational Foundation, 2000). Although anticipated gender discrimination was not a determinant of women's IT pursuits, our findings, along with those of others, about the concentration of women in soft IT careers suggest the possibility that more subtle forms of discrimination are at work (Tijdens, 1997; Panteli, Stack, and Ramsey, 2001). Perhaps the women feel that they do not have a place in hard computer sciences. This sentiment may be reflected in our findings concerning women's perceptions of their computer-related abilities. Females across race held significantly lower perceptions of their computer ability in comparison to the males (see Zarrett, Malanchuk, Davis-Kean, and Eccles, forthcoming). In addition, when all predictors were entered into the model, perception that one was good with computers was found to be the only determinant of white females' decisions to pursue an IT career and one of the determinants of black females' occupational decisions. These findings are similar to those found in a middle school sample of girls who participated in focus groups commissioned by the American Association of University Women (2000). These girls rarely reported overt discrimination (they were not told they were less competent than boys at computer-related tasks or discouraged from enrolling in computer-related courses). However, when asked to describe a person who "is really good with computers," they consistently described a man.

These differences echo the disparities found between boys' and girls' perceptions of their education in math (Eccles and Harold, 1991; Eccles, Wigfield, Harold, and Blumenfeld, 1993; Chapter Five, this volume), the prerequisite for technology and science professions (Cooper and Weaver, 2003). As discussed by Linver and Davis-Kean (Chapter Five, this volume) and others (Strauss and Subotnik, 1991), girls often rate their math abilities lower than do their male counterparts. This gender difference is evident even after accounting for youths' math achievement and is just as likely among gifted youth as nongifted youth. Similarly, gender discrepancies in perceived

computer ability do not stem from actual gender disparities in ability (Wilder, Mackie, and Cooper, 1985; Cooper and Weaver, 2003), but rather are thought to result from messages relayed from a computer culture that excludes women (including video games, course work, goals, and uses that strictly appeal to a male audience) and paints the ideal face of a computer professional as male (American Association of University Women Educational Foundation, 2000, 2004; Xie and Shauman, 2003; Cooper and Weaver, 2003). Therefore, the complexity involved in developing self-concepts of ability in the math, science, and technology fields must be addressed in intervention and public policy as one factor that limits females in computer science, engineering, and physical science.

Alternatively, it is also possible that hard computer science is less appealing to women than to men. In the study examined here, attitudes toward computers (positive and negative computer schemas) appear to be important for women's but not males' career decisions. When all predictors were entered into the model, both a positive computer schema and a negative computer schema predicted black females' IT pursuits; a similar trend was found for the endorsement of negative computer schemas as a determinant of white women's IT career decisions. These findings raise some concerns about women's pursuit of IT, especially among white women, because in previous work, we found that they were most likely to endorse negative computer schemas and least likely to feel that they would enjoy a career in the hard computer sciences in comparison to all other groups examined (Zarrett, Malanchuk, Davis-Kean, and Eccles, forthcoming). The importance of girls' attitudes toward computers has been supported by previous research in which middle school girls reported perceiving computer careers and the entire computer "culture" (including software, games, and the Internet) as not only "male" but also as "antisocial" and "geeky" (American Association of University Women Educational Foundation, 2000).

The interaction of these effects (values and perceived ability and expectancies) may be the most logical conclusion as to why there are fewer females in the computer industry. Computer programs favor male interests and male identification (Chappel, 1996; American Association of University Women Educational Foundation, 2000, 2004) and are often proposed as one explanation for the computer anxiety and reticence found among girls. Targeting boys' interests and values and giving them greater experience, confidence, and comfort with computers has led to an established social milieu surrounding computers as one that is oriented toward males (Cooper and Weaver, 2003). Inequities increase over time as girls shun computers because of lack of interest or perceived competence and boys gravitate toward them. Further investigation is necessary to understand how these factors interact over the life course in keeping women out of IT careers.

Although there were similarities in the factors that predicted women's IT aspirations across race, there were also major differences in what contributed to women's IT career pursuits dependent on their race. For example, parent

education did not predict IT career aspirations for white men or women, but did make a difference for black women and black men. The influence of parent education on blacks' decisions to pursue IT may reflect race differences in the quantity of computer-related resources that parents provide in the home. According to the National Science Foundation (as cited by Papadakis, 2000), 46.6 percent of white families in the United States owned a home computer in comparison to only 23.2 percent of African Americans. Although computer ownership increased 18 percent between 1994 and 1998 nationally, the gap between black and white ownership widened by 7 percent. Some research (Nelson and Cooper, 1997) suggests that having early and consistent access to a computer is at least one way to nurture individuals' skills as well as interest and feelings of competency in computer tasks.

In addition, we found that the black females considering pursuing IT not only come from families with less educated parents but also have lower educational expectations for themselves. Keeping in mind that black females were found to mainly consider pursuing a soft IT career, these findings suggest that soft IT jobs, which require less schooling, and thus less time and money, may perhaps be seen by lower-SES black women as a means to establish themselves in a stable career despite their families' lack of resources. In addition, findings suggest that if black females are provided enough support and guidance from others and set on track for pursuing an IT career by enrolling in IT courses, they are likely to consider pursuing an IT profession.

Our findings also suggest an important distinction for black males in regard to the impact that discrimination (both expectations of gender discrimination and their perceived ability to combat race discrimination) has on their decisions to pursue IT. Surprisingly, black males who had higher expectations of experiencing gender discrimination and greater feelings of inefficacy in combating race discrimination were more likely to consider pursuing an IT career. Their level of concern regarding their future experiences of discrimination may be dependent on their chosen career paths. Those who are pursuing more prestigious careers may be more vigilant (or simply more realistic) about the race and gender discrimination they may face as one of only a few black males to pursue employment in the field. Therefore, although black males may express similar levels of interest in pursuing an IT career as white males, concerns about, or experiences of, race and gender discrimination may be one reason black males eventually opt out of these occupational pursuits. It is also just as likely that the IT field is known to be less traditional (and thus less discriminatory) than other industries and therefore appears a promising career option to black males who are concerned about facing discrimination at work. In fact, black males in our sample held highly positive attitudes toward computers and the IT field in general. They were least likely to endorse negative schemas about computers and most likely to enjoy a computer career in comparison to all other groups examined (see Zarrett, Malanchuk, Davis-Kean, and Eccles,

forthcoming). Further investigation is needed to understand how race discrimination and more subtle, structural forms of gender discrimination may influence women's and blacks' decisions to pursue a career in the advanced computer sciences.

Where Do We Go from Here? The study examined here, along with others (American Association of University Women Educational Foundation, 2000, 2004; Cooper and Weaver, 2003), strongly suggests the need to implement programs that begin nurturing youths' talents and interests in the computer sciences early in their developmental trajectories. In addition, the future of IT depends on research and interventions that focus on deciphering what types of provisions work for nurturing future talent in the computer science industry, paying careful attention to what works for whom. Although there was considerable consensus on the important determinants of pursuing an IT career for all adolescents, our examination of youths' IT career considerations by the intersection of race and gender suggests that different social and psychological factors may play key roles for different youth populations. Further research that addresses the needs and interests of underrepresented groups is crucial to generating sound theoretical inferences and practical applications that will be useful to researchers and policymakers who are interested in making tangible contributions to engaging and sustaining youths' interests in IT.

It is important to note that very few people are going into IT. Yet despite the recent economic downturns among IT firms and global outsourcing, information technology is still ranked as the fastest-growing industry in the United States and is expected to remain among the fastest-growing occupations through the year 2012 (U.S. Department of Labor, 2004). Although there are such favorable job prospects in IT, the U.S. computer industry faces a major deficit in qualified IT professionals to fill the workforce demands. In 2003, the Information Technology Association of America (ITAA) reported that the IT industry is still growing at more than twice the rate that the IT workforce is expanding. In our sample, youth who considered pursuing IT is also quite low: only 11.9 percent of our sample of 700 people reported considering a hard computer science career, and a meager 5.1 percent of the sample was majoring in computer science. More research is needed to understand why there is little interest in pursuing science and technology among young people in the United States. Perhaps they are discouraged by the messages relayed in the media about the global outsourcing of IT jobs and the economic downturns of the computer industry. It is just as likely that adolescents are not as interested in computers as they are in other academic and nonacademic activities. Although there is sufficient reason to be concerned about women and blacks' underrepresentation in information technology, we must also continue to work at nurturing all youths' computer skills and interests if we wish to maintain our global standing as an advanced and sophisticated technological society.

Appendix A. Constructs and Sample Items

Scale	*Reliability (Cronbach's alpha)*	*Example item*
Family and youth, eighth grade		
Family income[a]	Single item	From all sources of income you mentioned, tell me your total family income before taxes in 1993.
Parents' occupational status[a]	Open-ended	Status classified using the Nam and Powers (1983) scoring system.
Parents' education[a]	Single item	The highest level of education across mothers and fathers (in years).
Youth's academic achievement*	N.A.	A standardized score of the mean of youths' course grades and Maryland subject achievement tests
Youth, eleventh grade		
Self-concept of math ability	.89	How good are you at math? (range: 1 = not at all to 7 = very good)
Value of math	.63	Do you learn things in math that help with your everyday life?
Academic expectation	Single item	How far do you think you will actually go in school? (1 = eleventh grade or less, 6 = graduate from a four-year college, 8 = earn a doctorate)
Expectations of gender discrimination	.67	Do you think it will be harder or easier for you to get ahead in life because you are a [boy/girl]? (range: 1 = a lot easier to 5 = a lot harder)
Inefficacy to combat race discrimination	.83	There is little you can do to avoid racial discrimination at the job you will have in the future (range: 1 = strongly disagree to 5 = strongly agree)
Youth, three years after high school		
Self-concept of ability at hard computer jobs	.93	How good would you be at an occupation that used computers for [six hard IT jobs identified, including developing hardware, developing software, and programming]?
Enjoyment of hard computer tasks	.92	How much do you think you would enjoy a job that used computers for [6 hard IT jobs identified, including developing hardware, developing software, and programming]?
Positive computer schema	.62	Computers can solve social problems (range: 1 = disagree to 5 = strongly agree)
Negative computer schema	.78	Working on computers is isolating and deprives people of social interaction (range: 1 = strongly disagree to 5 = strongly agree)

Appendix A. (Continued) Constructs and Sample Items

Scale	*Reliability (Cronbach's alpha)*	*Example item*
Computer courses taken[b]	Single item	Have you taken any courses related to IT? (1 = no IT courses taken, 2 = soft IT courses, 3 = medium IT courses, 4 = hard IT courses)
Influence of others	Single item	Adolescents reported how much encouragement and/or advice they received (1 = none, 2 = advice or encouragement, 3 = advice and encouragement)

[a]Parents reported family income, parents' occupational status, and parents' educational attainment. Youths' academic achievement was obtained through school archival records. All other measures were based on youth reports.

[b]Soft computer courses = using computers solely as a basic tool (word processing, secretarial training, marketing and advertising, and so on). Medium courses = more advanced technical skills than soft courses, but did not specifically focus on computer-related technology (chemistry, biology, geology, pre-med, and so on). Hard courses = specifically geared toward understanding the technological and structural elements of computers (computer engineering, aeronautics, computer science, programming, network/systems administrator). Young people who had taken multiple courses were categorized into a group based on the most advanced course they took.

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