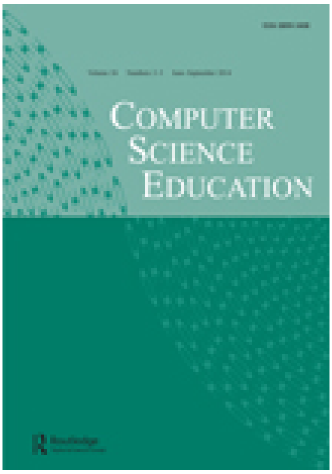


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# Why are women underrepresented in Computer Science? Gender differences in stereotypes, self-efficacy, values, and interests and predictors of future CS course-taking and grades

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# Why are women underrepresented in Computer Science? Gender differences in stereotypes, self-efficacy, values, and interests and predictors of future CS course-taking and grades

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This study addresses why women are underrepresented in Computer Science (CS). Data from 1319 American first-year college students (872 female and 447 male) indicate that gender differences in computer self-efficacy, stereotypes, interests, values, interpersonal orientation, and personality exist. If students had had a positive experience in their first CS course, they had a stronger intention to take another CS course. A subset of 128 students (68 females and 60 males) took a CS course up to one year later. Students who were interested in CS, had high computer self-efficacy, were low in family orientation, low in conscientiousness, and low in openness to experiences were more likely to take CS courses. Furthermore, individuals who were highly conscientious and low in relational-interdependent self-construal earned the highest CS grades. Efforts to improve women's representation in CS should bear these results in mind.

**Keywords:** recruitment of women; retention of women; STEM; underrepresentation of women; self-efficacy; stereotypes



Computer Science (CS) is the only science, technology, engineering, and math (STEM) major that has experienced a precipitous decline in the representation of women. In 2011, only 22.3% of American Bachelor's degrees in CS were conferred on women (National Science Foundation, 2013). Only .4% of female first-year students intended to major in CS compared to 2.9% of their male counterparts (National Science Foundation, 2013). Further exacerbating female underrepresentation in CS is the fact that the average attrition rate for women is 32%, which is considerably higher than for male CS students (Cohoon & Lord, 2006). It is important to mention that neither women's underrepresentation in CS nor their higher attrition rate is due to lower grades or lower math ACT scores (Tam & Bassett, 2006).

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Why are so few women interested in pursuing CS and which factors contribute to this phenomenon? Which factors predict who will take a CS course and who will do well? This paper will address these questions by looking at the primary group from which most CS departments can hope to recruit majors, viz., first-year college students. Before explicating the theoretical orientation for addressing this question, I will provide a rationale for investigating women's underrepresentation in CS. Why should we care?

Women's underrepresentation in CS is an important topic for economic and social justice reasons. It raises ethical questions surrounding fairness and equity. CS careers are lucrative (Lockard & Wolf, 2012) and there is a smaller gender pay gap than in other areas (Weinberger, 2006). Thus, women's underrepresentation in CS hurts their income potential. An economic consequence for the USA and most other Western countries experiencing a similar problem with female underrepresentation is that an Information Technology (IT) labor shortage is expected as the field is projected to undergo rapid growth through 2020 (Lockard & Wolf, 2012). Thus, the low number of women in CS hurts the ability of businesses to hire qualified employees. Another consideration is that the field loses an opportunity to harness women's perspectives and innovativeness. Important breakthroughs, creativity, and true innovation require outside-of-the-box thinking, which may be fostered by diversity (Mannix & Neale, 2005). Indeed, diversity is good for business. It increases sales revenue and profits (Herring, 2009).

An impressive research body on women's underrepresentation in CS has accumulated (e.g. Margolis & Fisher, 2001; for a recent review see Beyer, 2014). An important finding is that female underrepresentation in CS is not due to lack of ability. Male and female CS students do equally well in their CS courses (Beyer, 1999a, 2008a). Given that there are many women who could excel, why are women so underrepresented in CS?

## Theoretical model and goals of this study

The present research is grounded in Eccles' classic model predicting educational and career choices and success, which employs an expectancy × value framework (e.g. Eccles, Barber, & Jozefowicz, 1999). According to the model, variables such as stereotypes and classroom experiences affect expectancies of success (self-efficacy), which in turn affect course selection and career choices. People's values, which are strongly influenced by stereotypes, also affect course selection. Research has shown that these social psychological variables influence educational and career choices and course success in many fields (e.g. Eccles, 1994; Eccles et al., 1999; Lips, 1992; Simpkins, Davis-Kean, & Eccles, 2006).

The present paper focuses on gender differences in first-year students' stereotypes about CS, interests, self-efficacy, values, and classroom experiences. Gender differences in these variables could suggest why women are less likely to take CS courses and even less likely to become CS majors. What sets this study apart from other studies is its large sample of undeclared first-year students and focus on assessing social psychological variables as they relate to CS, rather than STEM in general. Furthermore, this paper assesses predictors of CS course-taking and grades within the next year. The prospective nature of these aspects of the study is one of its strengths. I will now turn to a review of the literature of the variables to be assessed.

## Stereotypes and beliefs about CS

Stereotypes about CS and CS majors are often negative (e.g. Siek et al., 2006). Computer scientists are viewed as single-minded, lacking outside interests, and intelligent but deficient in interpersonal skills; in short they are considered nerds, geeks, or hackers (Cheryan, Plaut, Davies, & Steele, 2009; Margolis & Fisher, 2001; Meeden, Newhall, Blank, & Kumar, 2003; Rommes, Overbeek, Scholte, Engels, & de Kemp, 2007; Yasuhara, 2008). A common view of CS is that one has to sit in front of a computer all day long (Carter, 2006; Yasuhara, 2008).

Stereotypes are powerful influencers of behavior. For example, female role models in CS do not have the expected effect of increasing computer self-efficacy among female CS non-majors, if the female role models exemplify geek stereotypes (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011).

In addition, via the phenomenon of stereotype threat, stereotypes can produce performance impairment in a stereotyped group. It is well documented that under stereotype threat conditions (i.e. when gender is made salient), women perform worse on masculine gender-typed tests (e.g. math tests; Good, Aronson, & Harder, 2008). Furthermore, stereotypes about a field's gender-congruence, e.g. that CS is inappropriate for women, undermine the development of a sense of belonging in the field (Cundiff, Vescio, Loken, & Lo, 2013). These stereotypes can negatively affect course selection and selection of a major (e.g. Eccles et al., 1999). This study set out to determine whether gender differences in stereotypes about CS exist in undeclared first-year students and whether these stereotypes affect future course-taking and grades in a CS course.

Based on previous research by Beyer and Haller (2006) on CS majors, it was hypothesized that gender differences in stereotypes do exist and that females hold more positive stereotypes than males. Given the earlier research on the impact of stereotypes on performance in the short term (e.g. stereotype threat research), I hypothesize that negative stereotypes predict a decreased likelihood of taking CS courses and lower grades in a future CS course.

## Values and interests

The supposed obsession of computer scientists with machines and lack of interest in people, and associations of technology with masculinity conflict with women's desire to have a "balanced" life with multiple roles and goals (Eccles, 1994; Eccles et al., 1999), and many women's interpersonal orientation i.e. their tendency to value careers with opportunities for social interaction and nurturing (Lippa, 1998; Rommes et al., 2007; Zahn-Waxler, 2000). Research has consistently found that many men do not share women's greater interest in people rather than things (Su, Rounds, & Armstrong, 2009; but see Valian, 2014, for a critique of this research). Thus, if women believe that careers in CS do not reflect their interpersonal values and satisfy their life goals or interests, they should not desire to pursue a CS major, even if it can lead to lucrative careers.

According to Schmidt (2011), gender differences in interests affect technical knowledge and aptitude, creating a vicious circle where the lack of knowledge leads to lower self-efficacy and less interest. Interest in CS was found to be a predictor of intention to major in CS among community college students (Denner, Werner, O'Connor, & Glassman, 2014). Interest affects work and academic performance by providing individuals with direction, vigor, and persistence (Nye, Su, Rounds, & Drasgow, 2012). This study therefore assesses whether female students in their first year demonstrate different interpersonal values and interests from males and whether these differences affect CS course-taking and grades.

Based on the above research it was expected that gender differences in interpersonal values, life goals, and interests would emerge and that individuals with stronger interpersonal values and less interest in CS would be less likely to take a CS course than those with weaker interpersonal values.



## Computing self-efficacy and experience

Expectancies of success (i.e. self-efficacy) are critical in educational and occupational choices (Correll, 2004; Eccles et al., 1999). For example, computer self-efficacy predicts involvement with computers (Compeau, Higgins, & Huff, 1999) and intention to take CS (Sáinz & Eccles, 2012) and Information Science (Govender & Khumalo, 2014) courses. According to Lips and Temple (1990), increasing women's computing and mathematical self-efficacy would positively affect their representation in CS.

Women tend to have low self-efficacy and believe they have little natural ability in male-dominated domains, including mathematics, chemistry, engineering, Management Information Systems (MIS), and CS. Their self-efficacy is inaccurately low when compared to their actual abilities, skills, or performance (Beyer, 1990, 1998, 1998/1999, 1999b, 2002, 2008a, 2008b; Beyer & Bowden, 1997; Beyer & Haller, 2006; Correll, 2001, 2004; Durndell & Haag, 2002; Ehrlinger & Dunning, 2003; Jagacinski, 2013; Roach, 2011; Stout, Dasgupta, Hunsinger, & McManus, 2011; Syzmanowicz & Furnham, 2011; Watt, 2006; Ziegler, Dresel, & Schober, 2000). The fact that these areas are considered masculine is important. The more a subject is considered appropriate for males, the lower females' self-efficacy (Correll, 2004; Ziegler et al., 2000). A recent survey of program directors of women in engineering programs found that they believed the single greatest obstacle to greater female representation to be low computer confidence (Fox, Sonnert, & Nikiforova, 2011).

Computer self-efficacy is affected by computer experience (He & Freeman, 2010; Nelson & Cooper, 1997) and previous performance (Correll, 2001, 2004; Ziegler et al., 2000). Women have less programming experience (Beyer & Haller, 2006; He & Freeman, 2010; Katz, Aronis, Allbritton, Wilson, & Soffa, 2003), are exposed to computers at an older age (Ash, Rosenbloom, Coder, & Dupont, 2006; Varma, 2009), and show an interest in CS later than men (Lang, 2010). Having taken computer courses in high school contributed to choice of an IT major in college (McInerney, DiDonato, Giagnacova, & O'Donnell, 2006). A major determinant of experience is interest. Women's lesser interest in technology results in less experience and ultimately less knowledge (Schmidt, 2011).

For these reasons, this study assessed gender differences in computer experience and self-efficacy of first-year college students. It was hypothesized that women have less experience with computers and lower computing self-efficacy. Importantly, this study investigated whether self-efficacy predicts future course-taking and course success. Expectancies of success (i.e. self-efficacy) can affect grades (Lopez, Lent, Brown, & Gore, 1997), but this has not been investigated in detail using prospective designs and to my knowledge has not been assessed with respect to CS, except for Beyer (2008a) in a sample of CS majors. Other studies in CS (e.g. Sáinz & Eccles, 2012) assessed intentions rather than actual course-taking. It was hypothesized that greater self-efficacy predicts a greater likelihood of taking a CS course and higher future CS grades.



## Experiences in CS courses and role models

Experiences in K–12 school settings are crucial. For example, receiving encouragement in high school is an important predictor of females' eventual interest in CS and engineering (Zarrett, Malanchuk, Davis-Kean, & Eccles, 2006) and engineering. Two studies found that female students who had had female computer teachers in high school were more likely to major in CS (Beyer & Haller, 2006) and MIS (Beyer, 2008b) than female students without female computer teachers. Being exposed to female role models who are similar to the self changes female students' implicit self-views enabling them to envision themselves in those roles (Asgari, Dasgupta, & Stout, 2012).

A recent study of students enrolled in a calculus class demonstrated that both female and male students participated more and asked more questions if the class was taught by a female rather than male professor (Stout et al., 2011, study 3). For female students having a female rather than male professor also increased implicit liking of math and they identified more with math and their professor. In turn, identifying with a female professor predicted higher self-efficacy at the end of the semester for female students (Stout et al., 2011, study 3). In a study of engineering majors, having a female role model was related to persistence in engineering (Amelink & Creamer, 2010).

Encouragement from instructors is an important factor in retention in science courses (Dingel, 2006). However, the importance of peer encouragement should not be underestimated either as it predicts intention to major in CS among female community college students (Denner et al., 2014). Peer respect is also of critical importance in the persistence of male and female engineering majors (Amelink & Creamer, 2010). And positive student interactions predict students' intentions to major in CS (Barker, McDowell, & Kalahar, 2009).

CS courses have been stigmatized as "bastions of poor pedagogy" (American Association of University Women, 2000, p. 41). Even women with high computer self-efficacy prefer cooperative learning styles more than men do (Salminen-Karlsson, 2009). These kinds of learning styles are still unpopular with many CS instructors who are often characterized as less supportive than instructors in other disciplines (Barker, Garvin-Doxas, & Jackson, 2002). STEM instructors, in general, tend to be more authoritarian and lecture-oriented than instructors outside of STEM, which is to their students' disadvantage (Astin & Astin, 1992), and increases the likelihood that they will leave STEM (Packard, Gagnon, LaBelle, Jeffers, & Lynn, 2011; Seymour & Hewitt, 1994). For example, students in general, but especially females, are more likely to drop out of a physics course taught in the traditional lecture style rather than a mixed style (Fencl & Scheel, 2006). Engineering students who were satisfied with the quality of teaching they had received were more likely to predict they would still be in engineering 10 years later (Amelink & Creamer, 2010). Poor pedagogy is problematic because students' experiences in their CS courses affect their decisions to major in CS and their retention rates (Cohoon & Cohoon, 2006). A good Introduction to CS course is a great recruiting tool (Cohoon, Cohoon, & Soffa, 2013).

Because of the importance of classroom experiences, this study asked those students who had had a CS course already about their experiences and how they affected their intention to enroll in a subsequent CS course. It was predicted that negative classroom experiences reduce students' intentions to take CS courses.

## Personality

The Eccles expectancy x value model does not explicitly include personality variables as predictors of major and career selection. However, other researchers did find that personality variables predict course outcomes. For example, conscientiousness and openness to experiences (two of the Big Five personality traits [John & Srivastava, 1999]) predict academic performance (Poropat, 2009). Conscientious individuals are reliable, trustworthy, organized, and tend to persevere. Those who are open to experiences thrive on novelty and avoid routine. These deep thinkers like to investigate and value artistic experiences. The effect size for conscientiousness in Poropat's meta-analysis was moderate ($d$ = .46), virtually on par with intelligence in predicting academic achievement. The effect size for openness was a bit smaller at $d$ = .24. Students with greater openness to experiences had better graduation rates, better grades, and stronger persistence rates than students scoring lower on this personality dimension (Ackerman, Kanfer, & Beier, 2013). Thus, the present study presents an opportunity to replicate these findings with respect to CS grades in a large sample of first-year undergraduates. Additional personality variables that were assessed include neuroticism, self-esteem, masculinity, and femininity. Furthermore, the study assessed levels of stress experienced. Because no interesting patterns emerged for these variables, they will not be addressed further.

## Summary of hypotheses

One of the goals of the present research is to increase our understanding of gender differences in first-year students' stereotypes about CS, values, interests, self-efficacy, and classroom experiences. It is at this critical juncture, before students have declared a major, where the right kinds of efforts to recruit women into CS could prove most effective. In order to do this successfully it is imperative that we gain a better understanding of the differences in young women's and men's interests, stereotypes, self-efficacy, and values. This would go a long way towards establishing the best "low-hanging fruit" approaches for recruitment of women. Based on previous research reviewed above I hypothesize that first-year university women compared to men show less computing self-efficacy, lower interest in CS but greater interest in female-dominated majors, and hold stronger interpersonal values, but do not harbour more negative stereotypes of CS. This is expected to be the case for averages, with the clear understanding that there are many exceptions among individuals.

I also hypothesize that some of these variables predict future CS course-taking and grades. Specifically, there should be an increased likelihood of taking a CS course and higher CS grades for students who show high computer self-efficacy, high interest in CS, weaker interpersonal values, and positive stereotypes about CS. In addition to testing established models, this study tries to break new ground by conducting exploratory work, adding personality variables such as conscientiousness and openness to experiences, as potential predictors of CS course-taking and grades. In addition, for students who had already taken a CS course, positive experiences in the classroom should predict intentions to take another CS course.

No one study can do justice to the complexity of issues involved. In the present study, the focus is on social psychological rather than structural variables (such as gender discrimination). Participants were American undergraduates, most of whom were White and working class to middle class (the majority were first-generation college students). At the present institution, students enter with an undeclared status and often do not select a major until their second or even third year of study. It is at institutions where major selection is delayed where a better understanding of how to recruit more women into CS may bear the most fruit. Because the data were collected at a single institution, this makes generalizations to non-American educational institutions, individuals of color, or people from a higher socioeconomic status difficult.



## Methods

### *Participants*

A total of 1319 first-year students (872 female and 447 male) enrolled at a small, public liberal arts university in the Midwest of the USA with an undergraduate enrollment of close to 5000 students participated in this study. Each student received payment of $2 for participation. To reach this number of participants, surveys were sent out to all incoming full-time first-year students for three years in a row (over 2400 total). The response rate was 53% with 83% of participants being White, 7% Hispanic, 5% African-American, 4% Asian, and less than 1% Native American. The survey assessed socioeconomic status of the family of origin using paternal and maternal education as a proxy.

A subset of 76 (44 men and 32 women) students had already taken a CS course. These students answered additional questions about their CS classroom experiences. Another subset of 128 (68 female and 60 male) students took a CS course within the year following their initial participation in the survey. This subset of students is used to predict future CS course-taking and grades.

### *Materials*

Participants completed a survey assessing demographic information, stereotypes about CS, values, computer self-efficacy and experience, personality variables, and experiences in CS courses. The complete survey can be found in the Appendix 1. In addition, participants gave permission to access their college transcripts.

Surveys were mailed to the home addresses of first-year students. Students returned the surveys using prepaid envelopes. Follow-up postcards, additional mailings, and telephone reminders were used to increase response rate. The survey was composed of a combination of existing instruments and items created specifically for this research. Most survey questions used Likert rating scales. All items that were used as composite scores are listed in Table 1, which includes information on the number of items, rating scale, the items themselves, and α (reliability of the scale). The survey was pilot-tested and based on student feedback changes were made to ensure maximum clarity of questions. The pilot data are not included in the analyses.

### *Stereotypes and beliefs about CS*

I constructed my own questions and also used existing scales to assess students' stereotypes and beliefs about CS. Participants rated personality characteristics of CS majors. From three items I created a composite score (see all composite scores in Table 1) measuring the stereotype about CS majors' purported positive traits labeled "positive stereotypes" with $\alpha = .77$. Eleven items from the Role Conflict Scale (Lips, 1992) assessed students' beliefs about the compatibility of work and family for women in CS, the difficulty of CS careers, and the sociability of computer scientists. A factor analysis of this scale showed that five of the items loaded on the factor compatibility of work and family for women in CS ($\alpha = .74$). I also created an eight-item scale called positive attitude toward CS ($\alpha = .66$).

### *Values and interests*

Students filled out 12 items of the Values Important to Career Selection Scale (Lips, 1992) to measure their work-related values. Of these, I created a four-item scale measuring intrinsic motivation with $\alpha = .75$. Three items formed a scale called family orientation with $\alpha = .64$. To address interpersonal orientation, students answered six questions from the relational-interdependent self-construal scale with $\alpha = .82$ (RISC; Cross, Bacon, & Morris, 2000). I also assessed students' interest in and perceived difficulty of seven majors (biology, business, CS, English, mathematics, nursing, and psychology).

### *Computer self-efficacy and experience*

To measure their self-efficacy regarding computer skills, participants answered nine questions indicating comfort level with computing and computers. A composite computer confidence score was calculated ($\alpha = .87$). Participants also indicated how difficult five specific computer tasks would be for them. The composite score had $\alpha = .76$. Additional questions addressed the extent of experience with computers and CS courses. Those who indicated that they had never taken a CS course answered a series of questions about why not. Those who had taken or were currently enrolled in a CS course answered questions about their experience (see next section).

Table 1. Composite measures.

| Name of scale (author): items | Items | Likert scale | Coeff. alpha |
|---|---|---|---|
| *Positive stereotypes* (Beyer): The average students majoring in CS are: hard-working; good at math and science; and intelligent | 3 | 7-point | .77 |
| *Role Conflict Scale* (Lips, 1992), only items related to compatibility of CS with family, referred to as *Family compatibility*: | 5 | 7-point | .74 |
| It is very difficult for a woman to combine a career as a computer scientist with a family life | | | |
| If a woman computer scientist takes time away from her career to have children, she will never catch up again | | | |
| A woman who is considering a career as a computer scientist should probably plan not have children | | | |
| Computer scientists lead lonely lives. | | | |
| Most computer scientists are more interested in numbers than people. | | | |
| *Positive attitude toward CS* (Beyer) | 8 | 7-point | .66 |
| Doing well in CS courses enhances job/career opportunities | | | |
| The rewards of a degree in a computer-related field are well worth the sacrifices | | | |
| I am very interested in CS | | | |
| I intend to take more math courses in the future | | | |
| I intend to take more science courses in the future | | | |
| Computers are useful tools | | | |
| Using computers is fun | | | |
| The career opportunities of CS majors are excellent | | | |
| *Values Important to Career Selection Scale* (Lips, 1992), only items referring to *Intrinsic motivation* | 4 | 5-point | .75 |
| I believe that I can do the job well | | | |
| I believe that the job will be interesting to me | | | |
| I believe that I will enjoy the job | | | |
| I believe that I will have opportunities to use my special abilities to the fullest | | | |
| *Family orientation* | 3 | 7-point | .64 |
| I would never let my career take priority over my family | | | |
| I would be very satisfied to devote all of my time to my home and family | | | |
| To me, having a career is more important than having a family (R[1]) | | | |
| *Relational-interdependent self-construal scale* (RISC; Cross et al., 2000) | 6 | 7-point | .82 |
| My close relationships are an important reflection of who I am | | | |
| When I feel very close to someone, I feel like that person is an important part of who I am | | | |
| I usually feel a strong sense of pride when someone close to me has an important achievement | | | |
| When I think of myself, I often think of my close friends or family also. | | | |
| In general, my close relationships are an important part of my self-image | | | |

(*Continued*)

Table 1. (*Continued*).

| Name of scale (author): items | Items | Likert scale | Coeff. alpha |
|---|---|---|---|
| Overall, my close relationships have very little to do with how I feel about myself | | | |
| Computer self-efficacy (Beyer) | 9 | 7-point | .87 |
| It would not bother me at all to take a computer course. | | | |
| I would feel at ease in a computer class. | | | |
| I could get good grades in a computer course. | | | |
| I do not think I could handle a computer course (R). | | | |
| I am sure I could handle a computer course. | | | |
| I do not feel threatened when others talk about computers. | | | |
| I am no good with computers (R). | | | |
| I have lots of self-confidence when it comes to working with computers. | | | |
| I get a sinking feeling when trying to use a computer (R). | | | |
| *Computer difficulty* scale (Beyer): How difficult is each task for you? | 5 | 7-point | .76 |
| Managing files | | | |
| Using a word processor | | | |
| Analyzing data | | | |
| Troubleshooting problems | | | |
| Programming | | | |
| *Big 5 Personality traits* (John & Srivastava, 1999): *Conscientiousness:* | 9 | 7-point | .78 |
| Tends to be lazy (R) | | | |
| Perseveres until the task is finished | | | |
| Tends to be disorganized | | | |
| Does a thorough job | | | |
| Can be somewhat careless (R) | | | |
| Reliable worker | | | |
| Does things efficiently | | | |
| Makes plans and follows through | | | |
| Easily distracted | | | |
| *Big 5 Personality traits* (John & Srivastava, 1999): *Openness to experiences* | 10 | 7-point | .78 |
| Likes to reflect | | | |
| Has an active imagination | | | |
| Original | | | |
| Inventive | | | |
| Curious about many different things | | | |
| Values artistic, aesthetic experience | | | |
| Sophisticated in art, music, or literature | | | |
| Prefers work that is routine (R) | | | |
| Ingenious, a deep thinker | | | |
| Has few artistic interests (R) | | | |

[1]Refers to a reverse scored item.

## *Experiences in CS courses and role models*

I constructed 17 questions assessing students' experiences in their current or past CS courses and with instructors. The items are listed as question 18 in the appendix. Only 72 students (43 males and 29 females) indicated that they had had a previous or current CS course and the analyses of course experience data rely on those students. All participants were also asked about their experiences with computer teachers in middle and high school.

### *Personality*

Students responded to dimensions from the Big 5 personality inventory (John & Srivastava, 1999). Nine items assessed conscientiousness and 10 items openness to experiences both with $\alpha = .78$.

## Results

Due to the large number of statistical tests, only results that are significant at $p < .01$ or better will be reported. The reader is reminded that statistical significance does not necessarily equal practical significance. To aid the reader in interpreting the size of the effects, partial $\eta^2$, an indicator of the effect size, is reported for analyses of variance (ANOVAs), while $R^2$, a measure of the amount of variance explained, is reported for regression analyses. A partial $\eta^2$ of .01 is considered small, .09 moderate, and .25 large. For $R^2$, .02 is considered small, .13 moderate, and .26 large (Osteen & Bright, 2010). As a reference, about 30% of psychological gender differences are practically zero and 48% are in the small range but may still result in measurable, cumulative effects over time (Hyde, 2007). Thus, most gender differences are expected to be in the small range. Of course there is always variability. Even if a significant gender difference is found, this does not mean all males or females differ from each other. As is customary, all statements refer to average differences between groups, not differences among individuals. Table 2 displays the means and standard deviations of important variables.

### ***Demographic background***

The student body at this public university consists mostly of White, lower middle-class and working-class individuals, with a majority being first-generation college students. This is corroborated by the finding that the highest degree of the father was a high school diploma or less for 44.1% of the participants and some college for an additional 23.1%. Only 21.2% of participants had a father with a college degree and 11.2% had a father with any education beyond college. Similarly, 44.1% had mothers with a high school diploma or less and 23.9% had mothers with some college experience. Only 23% had a mother with a college degree and 8.7% had mothers with formal education beyond college.

There was a significant gender difference in educational goals ($\chi^2(3, 1242) = 12.49$, $p < .006$). A college degree was the highest educational goal for 36.6% of female students and 45.5% of male students. Some graduate

Table 2. Means (and standard deviations) for selected variables.

| | Women | | Men | |
|---|---|---|---|---|
| How important was financial aid in decision to attend college (1–5)[1] | 3.25[a] | (1.6) | 2.97[a] | (1.6) |
| How certain are you that you will have enough money to finish college (1–5) | 3.45[a] | (1.3) | 3.64[a] | (1.3) |
| Proportion of students with children | .16[b] | | .09[b] | |
| The overuse of computers may be harmful and damaging to humans (1–7) | 3.53[c] | (2.0) | 3.97[c] | (2.1) |
| Computers are dehumanizing to society | 2.54[c] | (1.6) | 2.96[c] | (1.9) |
| Belief that CS majors are nerdy (1–7) | 4.17[c] | (1.7) | 4.55[c] | (1.7) |
| Belief that CS majors enjoy games like chess (1–7) | 4.52[c] | (1.6) | 4.84[c] | (1.5) |
| CS is one of the most difficult and demanding careers (1–7) | 3.34[a] | (1.5) | 3.61[a] | (1.6) |
| It is difficult to pursue a computer-related major and still have a social life (1–7) | 3.09[a] | (1.4) | 3.33[a] | (1.5) |
| Positive CS stereotypes (1–7; 3-item scale) | 5.89[a] | (1.0) | 5.70[a] | (1.0) |
| What is the average GPA of a Computer Science major? (0–4) | 3.41[c] | (.4) | 3.30[c] | (.4) |
| Intrinsic motivation is important for career selection (1–5; 4-item scale) | 4.58[b] | (.5) | 4.47[b] | (.6) |
| Chance to work with people rather than things is important for career selection (1–5) | 3.85[c] | (1.2) | 3.44[c] | (1.2) |
| Opportunities to be helpful to others or society are important for career selection (1–5) | 4.07[c] | (1.0) | 3.68[c] | (1.1) |
| Ability to combine work and family is important for career selection (1–5) | 4.03[c] | (1.1) | 3.67[c] | (1.2) |
| Many job openings in the field is important for career selection (1–5) | 3.93[c] | (1.0) | 3.62[c] | (1.1) |
| Family orientation (1–7; 3-item scale) | 5.32[c] | (1.2) | 5.03[c] | (1.3) |
| Relational-Interdependent Self-Construal Scale (RISC; 1–7; 6-item scale) | 5.42[c] | (1.1) | 5.19[c] | (1.1) |
| Positive attitude toward CS (1–7; 8-item scale) | 4.61[c] | (.8) | 4.83[c] | (.9) |
| Ranked interest in Business major (1–7) | 3.56[c] | (1.9) | 3.05[c] | (1.8) |
| Ranked interest in Mathematics major (1–7) | 4.83[c] | (2.0) | 4.23[c] | (1.9) |
| Ranked interest in Computer Science major (1–7) | 5.09[c] | (1.5) | 3.93[c] | (1.8) |
| Ranked interest in English major (1–7) | 3.60[c] | (1.9) | 4.02[c] | (2.0) |
| Ranked interest in Nursing major (1–7) | 3.88[c] | (1.9) | 5.23[c] | (1.8) |
| Ranked interest in Psychology major (1–7) | 3.00[c] | (1.7) | 3.58[c] | (1.7) |
| How many hours per week do you use a computer for enjoyment? | 4.89[c] | (5.1) | 6.30[c] | (6.0) |
| Proportion of Ps who have ever opened a computer to install hardware | .21[c] | | .44[c] | |
| Proportion of Ps who have taken any CS courses | .06[c] | | .13[c] | |
| Proportion of Ps who have not taken a CS course because of lack of interest | .58[c] | | .42[c] | |
| Proportion of Ps who have not taken a CS course because they believe they would not do very well | .30[a] | | .21[a] | |
| Proportion of Ps who have not taken a CS course because they were not aware of them | .14[a] | | .06[a] | |
| Computer self-efficacy (1–7; 8-item scale) | 4.76[c] | (1.2) | 5.14[c] | (1.1) |
| Computer difficulty (1–7; 5-item scale) | 3.32[a] | (1.2) | 3.14[a] | (1.2) |
| Ability in CS (1–7) | 3.07[c] | (1.5) | 3.95[c] | (1.7) |
| Females have as much ability in CS as males (1–7) | 6.50[c] | (1.1) | 6.18[c] | (1.3) |
| Ability in Math (1–7) | 3.70[c] | (1.9) | 4.22[c] | (1.9) |

(*Continued*)

Table 2. (*Continued*).

| | Women | | Men | |
|---|---|---|---|---|
| Ability in Business (1–7) | 4.22[c] | (1.7) | 4.63[c] | (1.6) |
| Ability in English (1–7) | 4.85[c] | (1.6) | 4.35[c] | (1.7) |
| Ability in Nursing (1–7) | 3.92[c] | (2.0) | 2.93[c] | (1.8) |
| Ability in Psychology (1–7) | 4.56[c] | (1.6) | 4.15[c] | (1.6) |
| Computer teacher's knowledge: Grades 1–8 (1–7) | 4.00[c] | (1.5) | 3.63[c] | (1.4) |
| Computer teacher's knowledge: High School (1–7) | 5.49[c] | (1.4) | 5.16[c] | (1.5) |
| Conscientiousness score (1–7; 9-item scale) | 5.19[c] | (.8) | 4.86[c] | (.9) |
| Openness score (1–7; 10-item scale) | 4.80 | (.9) | 4.84 | (.9) |
| Intend to take a CS course in the future (1–7) | 2.84[c] | (1.8) | 3.71[c] | (1.9) |
| Took a CS class up to one year later | .08[b] | | .14[b] | |
| Future CS grade (0–4) | 2.73 | (1.1) | 2.69 | (1.0) |

Note: Gender differences are denoted by letter superscripts.
[a]$p < .01$.
[b]$p < .001$.
[c]$p < .0001$.
[1]Range for Likert scale.



school was the goal for 9.2% of female students and 9.3% of male students. A Master's degree was envisioned by 33.8% of female students and 31.4% of male students. The biggest difference arose for the goal of attaining a doctoral or professional degree, with 20.3% of women and 13.8% of men aspiring to this goal.

Female students were a bit worse off financially because they indicated that receiving financial aid was more important in their decision to attend college and men were more certain that they would have enough money to finish college ($F(1, 1257) = 8.53$, $p < .004$, partial $\eta^2 = .007$; $F(1, 1259) = 6.72$, $p < .01$, partial $\eta^2 = .005$, respectively). Women were also more likely to have children than were men ($\chi^2(1, 1263) = 10.45$, $p < .001$).

Part 1 examines gender differences. Part 2 presents the results for the small subset of students who took a CS class within a year after taking the survey. In that section I present variables that significantly predicted whether students took a CS class in the future and their grades.

## Part 1: gender differences

Gender differences were examined by conducting ANOVAs with gender as the between-subjects variable.

### *Stereotypes and beliefs about CS*

In some ways men had more negative attitudes towards computers than women did, albeit to a small degree. Men were more likely to believe that the overuse of computers may be harmful to people ($F$(1, 1260) = 14.16, $p < .0001$, partial $\eta^2 = .011$), and that computers are dehumanizing to society ($F$(1, 1253) = 17.07, $p < .0001$, partial $\eta^2 = .013$). They also viewed CS majors more stereotypically by describing them as nerdy ($F$(1, 1203) = 12.83, $p < .0001$, partial $\eta^2 = .011$), and believing that they enjoy games like chess ($F$(1, 1229) = 11.37, $p < .0001$, partial $\eta^2 = .009$). Men saw CS as a more difficult and demanding career ($F$(1, 1252) = 8.12, $p < .004$, partial $\eta^2 = .006$), and felt that it is difficult to pursue a computer-related major and still have a social life ($F$(1, 1248) = 7.80, $p < .005$, partial $\eta^2 = .006$). On a three-item scale measuring stereotypes about CS majors' purported positive traits (good at math and science, intelligent, and hardworking), women scored higher than men ($F$(1, 1200) = 9.39, $p < .002$, partial $\eta^2 = .008$). Women thought that the average GPA of CS majors was higher than men thought it was, $F$(1, 1211) = 18.94, $p < .0001$, partial $\eta^2 = .015$.

### *Values and interests*

On a four-item scale of intrinsic motivation regarding job selection women felt stronger than men that intrinsic factors are important deciding factors in choosing a career ($F$(1, 1244) = 10.69, $p < .001$, partial $\eta^2 = .009$). Women also emphasized the opportunity to interact with people rather than things, opportunities to be helpful to others or society, and the ability to combine career and family ($F$(1, 1251) = 38.59, $p < .0001$, partial $\eta^2 = .03$; $F$(1, 1253) = 39.62, $p < .0001$, partial $\eta^2 = .031$; $F$(1, 1251) = 29.01, $p < .0001$, partial $\eta^2 = .023$, respectively). However, women were also pragmatic. They were more likely than men to indicate that many job openings in the field was an important deciding factor in choosing a career ($F$(1, 1247) = 25.47, $p < .0001$, partial $\eta^2 = .02$).

On a three-item scale measuring family orientation and on the RISC Scale (Cross et al., 2000), women scored higher than men ($F$(1, 1265) = 14.75, $p < .0001$, partial $\eta^2 = .012$; $F$(1, 1260) = 13.26, $p < .0001$, partial $\eta^2 = .01$, respectively).

Men demonstrated a more positive attitude toward taking CS, math, and science courses than women on an eight-item composite scale ($F$(1, 999) = 15.79, $p < .0001$, partial $\eta^2 = .016$). Interest in majors followed along stereotypical gender lines. Women were less interested in Business, Mathematics, and CS as majors than men were ($F$(1, 1225) = 21.73, $p < .0001$, partial $\eta^2 = .017$; $F$(1, 1221) = 24.89, $p < .0001$, partial $\eta^2 = .02$; $F$(1, 1217) = 137.77, $p < .0001$, partial $\eta^2 = .102$, respectively). Men were less interested in English, Nursing, and Psychology than women were ($F$(1, 1217) = 13.00, $p < .0001$, partial $\eta^2 = .011$; $F$(1, 1219) = 145.71, $p < .0001$, partial $\eta^2 = .107$; $F$(1, 1218) = 33.30, $p < .0001$, partial $\eta^2 = .027$, respectively).

***Computer self-efficacy and experience***

Men reported spending more time on computers for personal use and enjoyment ($F(1, 1214) = 18.13$, $p < .0001$, partial $\eta^2 = .015$), and were more likely than women to have opened a computer to install hardware ($\chi^2(1, 1265) = 76.33$, $p < .0001$). When asked if they had taken a CS course since arriving at the university, men were more than twice as likely to indicate that they had ($\chi^2(1, 1025) = 15.97$, $p < .0001$). When explaining why they had not taken a CS course yet, women were much more likely than men to say that they did not have any interest in CS ($\chi^2(1, 907) = 21.65$, $p < .0001$), that they would not do well ($\chi^2(1, 907) = 7.83$, $p < .005$), and that they were not aware of CS courses ($\chi^2(1, 437) = 7.00$, $p < .008$).

For the composite score of computing self-efficacy, men had significantly higher scores than women did ($F(1, 1245) = 28.94$, $p < .0001$, partial $\eta^2 = .023$). On the composite score of how difficult they would find five computing skills, women felt that these tasks were more difficult than men did ($F(1, 1263) = 6.73$, $p < .01$, partial $\eta^2 = .005$). Females rated their CS ability much lower than males ($F(1, 1264) = 87.35$, $p < .0001$, partial $\eta^2 = .065$). While women rated their CS ability lower, they were more likely than men to believe that women have as much ability in CS as men ($F(1, 1262) = 22.54$, $p < .0001$, partial $\eta^2 = .018$). Females also rated their math and business ability lower than males ($F(1, 1266) = 21.06$, $p < .0001$, partial $\eta^2 = .016$; $F(1, 1267) = 17.17$, $p < .0001$, partial $\eta^2 = .013$). The reverse pattern emerged for English, nursing, and psychology where females attributed much more ability to themselves than males did ($F(1, 1267) = 25.72$, $p < .0001$, partial $\eta^2 = .02$; $F(1, 1261) = 75.28$, $p < .0001$, partial $\eta^2 = .056$; $F(1, 1266) = 18.60$, $p < .0001$, partial $\eta^2 = .014$).

*Experiences in CS courses and role models*

Women rated the knowledge of their middle school and high school computer teachers higher than men did ($F(1, 1137) = 20.47$, $p < .0001$, partial $\eta^2 = .018$; $F(1, 1181) = 14.31$, $p < .0001$, partial $\eta^2 = .012$, respectively).

I asked the subset of 76 students who had already taken a CS course about their classroom experiences. Out of 17 questions pertaining to the classroom no gender difference reached significance at $p < .01$. A regression of the individual questions plus gender to predict intention to take more CS classes found that positive classroom experiences mattered. The more students believed that their instructor was good, that their instructors' exams were fair, and that the exams reflected what they were taught, the more they wanted to take additional CS courses ($F(1, 69) = 9.331$, $p < .003$, adjusted $R^2 = .113$; $F(1, 69) = 7.09$, $p < .01$, adjusted $R^2 = .087$; $F(1, 69) = 11.28$, $p < .001$, adjusted $R^2 = .134$, respectively). Students who did not want to take another class with their current instructor did not want to take more CS classes even with a different instructor ($F(1, 69) = 14.48$, $p < .0001$, adjusted $R^2 = .168$).

*Personality*

On the Big 5 personality dimension conscientiousness women scored higher than men ($F(1, 1263) = 44.23$, $p < .0001$, partial $\eta^2 = .034$; $F(1, 1261) = 74.48$, $p < .0001$, partial $\eta^2 = .056$). On the Big 5 personality dimension openness to experiences, there was no gender difference ($F(1, 1260) = < 1$).

## Part 2: predictors of future CS course-taking and grades

The results presented in this section focus on predicting behavior: Who is likely to take another CS course and what predicts grades in the course(s)? Do the predictors differ for females and males? These analyses were conducted for the 128 (68 female and 60 male) students who took a CS course up to one year after completing the survey, making this portion of the study prospective. Students who were enrolled in a CS course at the time they filled out the survey were not included in these prospective analyses because it would have made drawing conclusions impossible. For example, does low computing self-efficacy cause low CS grades or do low CS grades cause low computing self-efficacy? Students currently enrolled in a course were asked about their course experiences instead (see above).

Because only a subset of students contributed data to these regression analyses, this unfortunately reduces statistical power. This does succinctly illustrate the nature of the problem I am investigating: Few students take CS courses and women are underrepresented amongst even that small group (68 out of 872 women or 8% vs. 60 out of 447 men or 14%).



### *Predictors of future CS course-taking*

Female students indicated that they were less likely to take a CS course in the future than males did ($F(1, 720) = 35.79$, $p < .0001$, partial $\eta^2 = .047$). This is corroborated by actual behavior. Women were significantly less likely to take a CS course within the next year than men (8% vs. 14%; $\chi^2$ (1, 1269) = 10.72, p < .001).

In order to predict who would take another CS course, I conducted a logistic regression using backward elimination (using SPSS Binary logistic regression, Backward: Wald). I included 11 theoretically relevant predictors in addition to gender. They include interest in CS, computer confidence, stereotypes of CS, positive attitude towards CS, intrinsic values, relational-interdependent self-construal, family orientation, perception of compatibility of women with CS, conscientiousness, openness to experiences, and perceived difficulty of CS tasks. A model with five predictors was significant ($\chi^2(5) = 42.13$, $p < .0001$; see Table 3).

Students who ranked their interest in CS high (indicated by a low score) were more likely to take a CS class than students with low-ranked interest. High computer confidence and low family orientation also predicted a greater likelihood of taking a CS class. In addition, students who were high in the two personality variables openness to experiences and conscientiousness were less likely to take a CS class.

### *Prediction of future CS grades*

I conducted multiple regression analyses where the same 11 theoretically interesting variables (interest in CS, computer confidence, stereotypes of CS, positive attitude towards CS, intrinsic values, RISC, family orientation, perception of compatibility of women with CS, conscientiousness, openness to experiences, and perceived difficulty of CS tasks) in addition to gender were entered in backward elimination (using SPSS linear regression: Backward) to predict students' grades in a CS class (taken up to one year after the survey). Because multi-collinearity could hamper interpretation of the results, collinearity diagnostics were conducted on the variables included in the multiple regression. All VIF (variance inflation factor) scores were below 2, indicating that multi-collinearity is not likely to be an issue.

Researchers have found no gender differences in the grades or standardized test scores of students in mathematics-intensive majors (Beyer, 1999a, 2008a; Cross, 2001; Jagacinski, 2013; Voyer & Voyer, 2014), and no significant gender difference in CS grades emerged in this study ($F(1, 118) < 1$).

Table 4 shows that the significant model included two predictors ($F(2, 70) = 7.07$, $p < .002$, adjusted $R^2 = .144$). The higher a student scored on conscientiousness, the higher the student's CS grades up to one year later. The lower a student's relational-interdependent self-construal, the higher the CS grade.

Table 3. Predictors of taking a CS course.

| | *B* | SE | Wald | d*f* | Sig. | Exp(*B*) |
|---|---|---|---|---|---|---|
| Interest in CS | −.233 | .078 | 8.878 | 1 | .003 | .792 |
| Computer confidence | .381 | .130 | 8.547 | 1 | .003 | 1.463 |
| Family orientation | −.162 | .095 | 2.908 | 1 | .088 | .850 |
| Conscientiousness | −.285 | .160 | 3.154 | 1 | .076 | .752 |
| Openness to experiences | −.399 | .144 | 7.694 | 1 | .006 | .671 |
| Constant | .772 | 1.193 | .419 | 1 | .518 | 2.164 |

Note: −2 Log likelihood 464.869; Cox & Snell $R^2$ .046; Nagelkerke $R^2$ .106

Table 4. Predictors of future CS grades.

| | Unstandardized *B* | Standard Error | St. Beta | *t* | Sign. |
|---|---|---|---|---|---|
| Constant | 2.185 | .877 | | 2.491 | .015 |
| RISC | −.3216 | .131 | −.275 | −2.482 | .015 |
| Conscientiousness | .438 | .135 | .359 | 3.235 | .002 |

## Discussion

The reader should bear in mind that the analyses in Parts 1 and 2 have disparate levels of statistical power as the analyses of gender differences had an N of 1319, whereas the analyses of the subset of students who took a CS course up to a year after they filled out the survey had an N of 128. Thus, the analyses of predictors of CS course-taking and CS grades should be viewed as preliminary and exploratory.

### *Stereotypes and beliefs about CS*

Stereotypes about CS are quite negative (e.g. Beyer, 1999a, 1999b; Cheryan et al., 2009; Craig, Paradis, & Turner, 2002; Goode, Estrella, & Margolis, 2006). However, in this study women exhibited less negative stereotypes about CS and CS majors than men did, replicating Beyer and Haller's (2006) study of CS majors. Men viewed computers as potentially more harmful and dehumanizing, viewed CS majors more negatively, and felt that pursuing CS interfered with one's social life more than women did. Women saw CS as a more promising career and showed more respect for students majoring in CS. Thus, it is simply not the case that women's view of CS is more stereotypical or negative, making it unlikely that gender differences in stereotypes directly explain women's underrepresentation in CS. However, stereotyping CS as a masculine field can indirectly affect interest and persistence in CS if women get a sense of not belonging in the field (Cundiff et al., 2013). When presented with an article that described CS as a geeky compared to a non-geeky field, women were less likely to show interest in CS (Cheryan et al., 2009). Even ambient cues associated with "geekinees" such as a room with a Star Trek poster and video games reduced women's sense of belonging and interest in CS (Cheryan et al., 2009) and their intention to enroll in a CS class (Cheryan, Meltzoff, & Kim, 2011). Thus, the geek image of CS clashes with women's self-perceptions, deterring them from entering CS. This research on the power of ambient cues suggests that CS programs need to carefully consider the implicit messages they send to students through the physical lab setups and classroom configurations. And, as is detailed in the next section, stereotypical images of CS may deter women from CS because of the perception that CS conflicts with their values.

### *Values and interests*

Like others, this study found that women show more intrinsic concerns when selecting a career. They seek careers that match their interests, allow them to help others, work with people, and provide the opportunity to combine career and family (Beyer & Haller, 2006; Creamer, Burger, & Meszaros, 2004; Keup & Stolzenberg, 2004; Margolis & Fisher, 2001; Sax et al., 2003; Weisgram & Bigler, 2006; Weisgram, Dinella, & Fulcher, 2011; Woszczynski & Shade, 2010). Women desire careers with opportunities for social interaction and nurturing (Carter, 2006; Cross & Madson, 1997; Lippa, 1998; Rommes et al., 2007; Zahn-Waxler, 2000). This study found that women value interpersonal interdependence. However, it is important to point out that women are also pragmatists. For example, the number of job openings in a field was a factor they mentioned for their career choices, which corroborates a finding by Zhang (2007). And when women are strongly identified with a STEM field like engineering, they are even more likely to persist than men and do well (Jones, Ruff, & Paretti, 2013).

Despite the lack of negative stereotypes about CS majors, women were much less interested in CS and less likely to intend to take a CS course in the future. Instead, interest in majors followed stereotypical gender lines. Women were less interested in Business, Mathematics, and CS and men were less interested in English, Nursing, and Psychology. Beyer and Haller (2006) found that female CS majors showed less interest in CS than their male counterparts did. Thus, while women evinced respect for CS majors and viewed CS more positively than men, when it came to attitudes towards taking more CS, math, and science courses, women balked. CS simply did not fit their interests and value system. Gender differences in interests showed moderate effect sizes, which are relatively rare in psychology.

Females who attach great value to helping others and are family-oriented are less likely to desire a career in the sciences (Eccles, 1994) and more likely to defect from science majors (Astin & Astin, 1992). In fact, many women shun STEM careers due to their communal orientation: They do not view STEM careers as supporting those goals (Diekman, Brown, Johnston, & Clark, 2010). Social stereotypes of math-related fields deter women because they deny them a sense of belonging in the field (Cheryan, 2011). This is the case even when controlling for self-efficacy, explaining why even highly talented women often avoid STEM careers. Thus, even though women do not hold more negative stereotypes towards CS than men, the stereotypes collide with their values.

Large-scale studies of college students' career interests show that women's interpersonal orientation draws them to science practitioner careers (e.g. medicine, veterinary medicine, and clinical psychology) rather than science or technological careers (Astin & Astin, 1992; Simpkins &

Davis-Kean, 2005). Even mathematically gifted females gravitate towards occupations that involve working with people (Lubinski, Benbow, Shea, Eftekhari-Sanjani, & Halvorson, 2001). According to Weinberger (2006), a third of female college students majoring in female-dominated fields felt that IT careers do not represent socially important work. These perceptions may not be entirely inaccurate. Male and female CS students alike are less people-oriented than male and female psychology majors (Radford & Holdstock, 1995). But for all too many women, CS does not even enter into their consciousness as a possible major because women are more affected by the gender-congruence of a profession than whether the profession matches their interests and talents (Rommes et al., 2007). Unfortunately, women are not aware that work in CS can be people-oriented (Cheryan et al., 2009). This suggests that interdisciplinary programs that combine aspects of CS with fields that are applied and people-oriented might be more successful in attracting greater numbers of women (Carter, 2006).

### *Computer self-efficacy and experience*

This study showed that women use computers as academic tools extensively, but show less passion for computing than men (Michie & Nelson, 2006), and have less interest in the mechanical workings of computers or experience in programming (e.g. Beyer & Haller, 2006; Carter, 2006; He & Freeman, 2010; Katz et al., 2003; Salminen-Karlsson, 2009). This is exemplified in this study by men's greater likelihood to have installed internal components such as RAM. Men were also much more likely than women to have taken a CS class.

Women had lower self-efficacy regarding their computer skills and thought computing tasks would be more difficult for them. The major reasons women enumerated why they had not taken a CS course include low computer self-efficacy, lack of interest, and lack of awareness. Similar reasons for not majoring in Information Science were given by South African college females (Govender & Khumalo, 2014). Many other studies have found that women's computer self-efficacy is lower than men's (Cassidy & Eachus, 2002; Colbeck, Cabrera, & Terenzini, 2001; He & Freeman, 2010; Keup & Stolzenberg, 2004; Lee, 2003; Lips, 2004; Ogan, Robinson, Ahuja, & Herring, 2006; Salminen-Karlsson, 2009; Sax et al., 2003; Young, 2000; Zarrett et al., 2006). One study found that when controlling for computer anxiety, experience, and knowledge, the gender difference in computing self-efficacy became non-significant (He & Freeman, 2010). Beyer and Haller (2006) found that female CS majors actually had less confidence in their computing skills than male non-majors did. Underscoring women's low confidence in their computing skills is another study which found that women pursuing a graduate career in IT had similar levels of computer self-efficacy as men who were pursuing a graduate career in a non-IT

Business major (Michie & Nelson, 2006). However, this does not mean that women endorse stereotypic views of women's computing ability. Women in this study were more likely than men to believe that females have as much computing ability as males.

Ability ratings of women and men were highly gender stereotypical with women rating their math, business, and particularly CS ability lower than men, whereas the reverse was true for English, nursing, and psychology. Of these six majors CS ability was rated lowest by women, whereas men rated nursing ability lowest, mirroring the actual occupational segregation occurring in the fields of CS and nursing. These gender differences in ability ratings approached moderate size.

#### *Personality*

Females scored higher on conscientiousness, but there was no gender difference on the Big Five personality dimension openness to experiences. This dimension refers to a preference for routine (low openness) as opposed to new and challenging (high openness) experiences.

### ***Experiences in CS classes and role models***

Female students rated their computer teachers in grades 1–8 as more knowledgeable than did male students, which had also been found for CS (Beyer & Haller, 2006) and MIS majors (Beyer, 2008b). Women are often influenced in their career choices by the opinions of those close to them (Lang, 2010; Mishra et al., 2013; Roach, 2011; Zhang, 2007). They also often become interested in CS because a close family member works in or is interested in CS (Schulte & Knobelsdorf, 2007). Critical experiences such as attending the Grace Hopper Conference can provide a boost in confidence, change stereotypes about CS, and expose undergraduates to a plethora of female role models, all of which enhance the chances that they will major or remain in CS (Alvarado & Judson, 2014). Thus, attempts to increase female representation in CS should consider the importance of parents, peers, teachers, and exposure to exciting educational opportunities in the process.

I investigated whether CS classroom experiences related to students' intention to take more CS classes. Cohoon and Cohoon (2006) had found that students' experiences in their CS courses affect their decisions to major in CS and their retention rates. Eney, Lazowska, Martin, and Reges (2013) and Cohoon et al. (2013) found that many CS majors, especially females, had not intended to major in CS until they took their first CS course. Indeed, the present study found that positive experiences with the instructor in their first CS class predicted greater intention to take more CS classes. This prediction reached moderate size. If students did not want to take another class with their current instructor because they were dissatisfied, they did want to take any additional CS classes, even with a different instructor. Thus, all it takes is one bad classroom experience to turn students off. CS cannot afford this. Alvarado and Dodds (2010) and Roach (2011) also found that the first experience in a college CS course was critical for sustaining interest in the CS major. These findings corroborate other research, which found that students at institutions where faculty are strongly student-centered as opposed to mainly research-oriented, tend to persist more in STEM majors (Abraham, 2006; Astin & Astin, 1992). Women prefer majors where the culture is focused on student–faculty interaction, which is not typical of many CS courses, at least when compared to the humanities or social sciences (Knight, Mappen, & Knight, 2011; Whitten et al., 2007). Students, particularly women, are more likely to drop out of physics lecture classes than more non-traditionally held physics class (Fencl & Scheel, 2006). The take-home message is that pedagogically sound and engaging CS courses are critical in the recruitment and retention of female students (cf. Wang & Degol, 2013).

### *Predictors of future CS course-taking*

Women were much less likely to indicate that they would take a future CS course and this was corroborated by their actual CS course-taking within the next year. Interestingly, gender was not a significant predictor of taking a CS course when other predictors were included in the model. Five significant predictors emerged: interest in CS, computer confidence, family orientation, conscientiousness, and openness to experiences. Some of these were expected, others are a bit surprising.

It is not too surprising that interest in CS predicts who will take a CS course. There does exist a substantial gender difference in interest, thus fewer women will take a CS course. Also, the gender difference in computing self-efficacy is highly reliable. The present study found that those with little confidence in their computing ability avoid taking CS courses. In two studies of high school students who were interested in STEM, one of the best predictors of selecting a STEM major in college was math self-efficacy, even when controlling for math ability (Correll, 2004; Mau, 2003). Thus, self-efficacy in a domain may be important for taking courses and eventually selecting a major in that domain. A healthy dose of computer self-efficacy is probably necessary to be interested in a CS major in the first place and to remain in the major (cf. Wang & Degol, 2013).

Those students who were high in family orientation were less likely to enroll in a CS course, demonstrating that certain values (like valuing family life over career) decrease the likelihood of taking CS courses. In a study of twelfth-grade girls with a professed interest in male-dominated professions, eight years later only 18% of the original sample still showed an interest in these fields. The best predictor of continued interest was low emphasis on family flexibility in a job (Frome, Alfeld, Eccles, & Barber, 2006). Thus, a clash with life goals and values can deter students from CS.

Conscientious students also avoided future CS courses. It is unclear why this was the case as these are the types of students who tend to do well in difficult courses. Another surprising predictor of CS course-taking is a personality variable that is not associated with gender differences: openness to experiences. Those who are open to experiences thrive on novelty and avoid routine. They are deep thinkers, like to investigate, and value artistic experiences. Apparently, these kinds of individuals are NOT the ones interested in taking CS courses. This points to the possibility that there might be other groups of individuals besides women and people of color who are underrepresented in CS. Whether this reflects a certain truth about the field of CS or simply reifies existing stereotypes about CS, the fact of the matter is that many individuals who could greatly enrich the field are dissuaded from CS. I hasten to point out that this finding is based on a small number of participants but it does suggest that personality variables may predict CS course-taking. One may speculate that those who do not like too much structure and seek exciting new experiences avoid CS, a field that is stereotyped as boring and uninspiring. Interestingly, Bernold, Spurlin, and Anson (2007) lament that engineering disproportionately loses students who are creative and think outside of the box. Does the same occur in CS?

The fact that gender was not a significant predictor when including the above variables is important. It suggests that it is not gender per se that is driving course-taking but rather the interests, confidence (or lack thereof), values, and personality characteristics that are often associated with gender.



### *Prediction of future CS grades*

Despite the small sample size of 128 students who took a CS course within the following year, a model with two significant predictors emerged that explained a substantial proportion of variance in CS grades. Gender was not a significant predictor of CS grades, but conscientiousness was. The more conscientious students earned higher grades. Those are the students who faithfully complete their assignments and spend time studying and preparing for exams. In all likelihood those are also the students who do well in all majors that require a large amount of study time and dedication. In fact, it has been shown that conscientiousness predicts higher grades for college students (Chamorro-Premuzic & Furnham, 2006) and better job performance (Schmidt, Shaffer, & Oh, 2008).

More surprising is the fact that a student's score on a test of relational-interdependent self-construal significantly predicted CS course grades. Specifically, those who felt interconnected with others, trusted, and relied on others for support did worse in CS than those who scored lower on this variable. Do individuals who are highly interconnected and interdependent make poor computer scientists? Do individuals who score high on this variable feel out of place and unsupported and therefore do poorly? The present data cannot begin to address this, but it does suggest future avenues for investigation.

### *Strengths, limitations, and future directions*

A strength of this study is its large sample size of an undeclared first-year college student population. A further strength lies in greater generalizability of results than in most studies. Unlike many previous studies, this study did not use a restricted student sample from a certain discipline, but instead sampled from all incoming first-year students, making it much more representative of the undergraduate population. A limitation is the small sample size of students who had either already taken a CS course or proceeded to take CS classes in the following year. This limitation is emblematic of the problem at hand, viz., the fact that few students take CS courses, let alone major in it, and that women are underrepresented in this already small group. For this reason, the results pertaining to CS course-taking and CS grade prediction should be considered preliminary. Furthermore, the sample was American, mostly White, and lower middle class, making generalizations beyond those groups difficult. Studies with larger and more diverse samples are needed. I would particularly encourage more research on personality variables.

## Conclusions

Women's underrepresentation in CS is not inevitable. In order to effect changes in women's representation in CS in a cost-effective and sustainable way, we need a clear understanding of the reasons for the dearth of women in CS. I suggest that social psychological variables are excellent candidates for factors to be studied because they have been shown to influence career choices. Furthermore, because cultural forces shape social psychological variables, these variables can help explain cross-cultural differences in women's representation in CS (e.g. Varma, 2011).

This study found evidence for gender differences in computer self-efficacy, stereotypes, interests, values, interpersonal orientation, and personality variables. In addition, males and females alike wanted to take more CS courses when they had excellent instructors using pedagogically sound practices. The fact that instructor variables strongly related to interest in future CS courses for males and females underscores that good pedagogical practices are paramount to attracting and retaining students in CS. Although having good instructors is likely important for students in all majors, given the difficulty level of CS, instructor variables may be even more important for the success of CS students.

An important contribution of this research was the investigation of predictors of future CS course-taking and grades. Students who were interested in CS, had high computer confidence, were low in family orientation, low in conscientiousness, and low in openness to experiences were more likely to take CS courses. Furthermore, individuals who were highly conscientious and low in relational-interdependent self-construal earned the highest CS grades. These findings, while they should be considered preliminary due to the small sample size, suggest that social psychological and personality factors should be investigated to better understand female underrepresentation in CS. This knowledge can be harnessed to provide an optimal environment for all, but especially female, students. It is my hope that this research will inform future studies of the kinds of variables to study and inspire CS departments to take these findings into account when implementing changes to attract more women.

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## Appendix 1. Survey

Survey

1. How old were you when you first used a computer? ____ years

2. Do you own a computer? ____ Yes ___ No

3. How many hours per week do you use a computer for work or school-related activities? ____ Hours

4. How many hours per week do you use a computer for personal use and enjoyment? ____ Hours

5. How many hours per week do you spend on school work? ____ Hours

6. Have you ever opened a computer to install hardware (e.g., RAM, harddrive, etc.)? Yes No

7. Using the following scale, please rate your responses regarding how difficult each task would be for **you**.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| extremely easy | | | | | | extremely difficult |

___ Organizing and managing files
___Using a word processor to create documents
___ Using a computer to analyze data
___Troubleshooting computer problems
___ Writing simple computer programs

8. Besides homework, email, and surfing the web, you have experience in using computers for: (Please check all items that apply.)
___Programming ___Data analysis ___Games ___Organizing and managing files

9. Do you know anyone with a Computer Science degree?
No
Yes Please check all that apply:

| Mother | Female relative | Female friend/acquaintance | Female co-worker |
|---|---|---|---|
| Father | Male relative | Male friend/acquaintance | Male co-worker |
| Other (specify and indicate male or female)_________ | | | Male Female |

10. Using the scale below, how knowledgeable were your computer teachers?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not knowledgeable | | | | | | very knowledgeable |

____ Grades 1-8 ____ High school

11. Using the scale below, what was the sex of your computer teachers?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| all male | | | half male/half female | | | all female |

____ Grades 1-8 ____ High school

12. Computer Science involves: (check all that apply)
___Developing application programs
___ Fixing computers
___Wiring computers in a network
___ Developing and analyzing algorithms
___Installing and configuring software
___ Designing ways to interconnect computing systems

For questions 13, 14, 15, and 16 provide an estimate if you do not know the answer.

13. What is the average starting salary of a computer scientist with a BS? $ _______ per year

14. What is the average number of hours worked by a computer scientist each week?_____ hours

15. What percentage of computer scientists are women? ___%

16. What is the average GPA of a Computer Science major here? (on a 4-point scale) ____

17.Since coming here, have you taken any Computer Science courses?

___ Yes Please skip to question 18.

___ No Why didn't you take any Computer Science courses? (Check all that apply.)
___ I never had any interest in Computer Science.
___ Computer Science courses are very difficult.
___ Computer Science courses are very boring.
___ I don't think I would learn anything useful in a Computer Science course.
___ I don't think I would do very well in a Computer Science course.
___ Computer Science courses are not offered at times that fit my schedule.
___ I don't think I would fit in with the other Computer Science students.
___ Computer Science professors are not very approachable.
___ I am not required to take any Computer Science classes.
___ I was not aware that Computer Science courses were available.
___ I need to fulfill my other (non-Computer Science) course requirements.
___ Other. Please specify _______________
Now skip to question 19.

18. Which Computer Science course(s) are you currently taking? List up to 3 classes on the lines provided:
Computer Science class #1: _______________
Computer Science class #2: _______________
Computer Science class #3: _______________

For the Computer Science classes you listed above, use the following scale to rate your responses.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| strongly disagree | | | neutral | | | strongly agree |

Computer Science class:

| #1 | #2 | #3 | |
|---|---|---|---|
| ___ | ___ | ___ | I feel overwhelmed by the work in this class. |
| ___ | ___ | ___ | I am doing well in this class. |
| ___ | ___ | ___ | This is a very difficult class. |
| ___ | ___ | ___ | I don't work hard enough in this class. |
| ___ | ___ | ___ | I lack the ability to do well in this class. |
| ___ | ___ | ___ | I am acquiring valuable skills and knowledge in this class. |
| ___ | ___ | ___ | My instructor is very good. |
| ___ | ___ | ___ | My instructor gives too many assignments. |
| ___ | ___ | ___ | My instructor's lectures are difficult to understand. |
| ___ | ___ | ___ | My instructor assumes students know more than they do. |
| ___ | ___ | ___ | My instructor's exams reflect what we were taught. |
| ___ | ___ | ___ | My instructor's exams are graded fairly. |
| ___ | ___ | ___ | My instructor is very knowledgeable about course material. |
| ___ | ___ | ___ | I do not want to take a class again with this instructor. |
| ___ | ___ | ___ | This class makes me want to take more Computer Science courses. |
| ___ | ___ | ___ | Other students in this class are too competitive. |
| ___ | ___ | ___ | I have less experience with computers than my fellow students in this class. |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| strongly disagree | | | neutral | | | strongly agree |

Computer Science class:

| #1 | #2 | #3 | |
|---|---|---|---|
| ___ | ___ | ___ | I feel overwhelmed by the work in this class. |
| ___ | ___ | ___ | I am doing well in this class. |
| ___ | ___ | ___ | This is a very difficult class. |
| ___ | ___ | ___ | I don't work hard enough in this class. |
| ___ | ___ | ___ | I lack the ability to do well in this class. |
| ___ | ___ | ___ | I am acquiring valuable skills and knowledge in this class. |
| ___ | ___ | ___ | My instructor is very good. |
| ___ | ___ | ___ | My instructor gives too many assignments. |
| ___ | ___ | ___ | My instructor's lectures are difficult to understand. |
| ___ | ___ | ___ | My instructor assumes students know more than they do. |
| ___ | ___ | ___ | My instructor's exams reflect what we were taught. |
| ___ | ___ | ___ | My instructor's exams are graded fairly. |
| ___ | ___ | ___ | My instructor is very knowledgeable about course material. |
| ___ | ___ | ___ | I do not want to take a class again with this instructor. |
| ___ | ___ | ___ | This class makes me want to take more Computer Science courses. |
| ___ | ___ | ___ | Other students in this class are too competitive. |
| ___ | ___ | ___ | I have less experience with computers than my fellow students in this class. |

19. From the following list, please **check** the **TOP 3** statements that best describe what you would like to achieve with your college education. I want to:

___ Meet people
___ Make a lot of money
___ Make my parents proud
___ Feel good about myself
___ Get an interesting job
___ Learn new and interesting things
___ Be prepared for graduate school
___ Do what is expected of me

20. Using the following scale, rate your responses to **each** of the following statements.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly disagree | | | | Strongly agree |

Computer Science is a better career choice than most other careers because one can:

___ Quickly advance on the career ladder.
___ Help people.
___ Master challenging tasks.
___ Be in a low-stress career.
___ Be more employable.
___ Discover, develop, and design new things.
___ Other (fill in) ___________
___ Be admired and respected.
___ Have a feeling of accomplishment.
___ Supervise others.
___ Have very flexible work hours.
___ Work with frontiers in technology.
___ Earn a lot of money.

21. Using the scale below, rate how typical each trait is of the average student majoring in Computer Science:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| not at all typical | | | | | | very typical |

___ Enjoys socializing
___ Interesting
___ Nerdy
___ Enjoys reading
___ Hard-working
___ Caring
___ Enjoys athletic activities
___ Enjoys games like chess
___ Creative
___ Good at math and science
___ Intelligent

22. Using the scale below, please rate each of the following statements **regarding their importance in your decision to choose a career**.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| unimportant | | | | very important |

__ Opportunities to be helpful to others or society.
__ Chance to work with people rather than things.
__ Opportunity to earn a high salary.
__ Having a position that is looked up to by others.
__ Belief that the job will be interesting to me.
__ Opportunities to use my special abilities to the fullest.
___ Challenge of difficult work.
___ Ability to combine career and family.
___ Belief that I am able to do the job well.
___ Many job openings in the field.
___ Belief that I will enjoy the job.

23. Please answer the following questions using the scale below:

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| strongly disagree | | | strongly agree |

___ I feel that I do not have any close personal relationships with other people
___ There are people who depend to me for help
___ There are people who enjoy the same social activities I do
___ Other people do not view me as competent
___ I feel personally responsible for the well-being of another person
___ I feel part of a group of people who share my attitudes and beliefs
___ I do not think other people respect my skills and abilities
___ I have close relationships that provide me with a sense of emotional security and well-being
___ I have relationships where my competence and skill are recognized
___ There is no one who shares my interests and concerns
___ There is no one who really relies on me for their well-being
___ I feel a strong emotional bond with at least one other person
___ There are people who admire my talents and abilities
___ I lack a feeling of intimacy with another person
___ There is no one who likes to do the things I do
___ No one needs me to care for them anymore).

24. Using the scale below, rate your responses to the following statements.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Disagree very much | | Disagree a little | Agree a little | | Agree very much |

___ I feel that I am a person of worth, at least on an equal basis with others.
___ I feel that I have a number of good qualities.
___ All in all, I am inclined to feel that I am a failure.
___ I am able to do things as well as most other people.
___ I feel that I do not have much to be proud of.
___ I take a positive attitude toward myself.
___ On the whole, I am satisfied with myself.
___ I wish I could have more respect for myself.
___ I certainly feel useless at times.
___At times I think I am no good at all.
___You have a certain amount of intelligence, and you can’t really do much to change it.
___Your intelligence is something about you that you can’t change very much.
___To be honest, you can’t really change how intelligent you are.
___You can learn new things, but you can’t really change your basic intelligence.
___When I get new work in school, I’m usually sure I will be able to learn it.
___I’m not very confident about my intellectual ability.

25. For **each** of the majors listed below, please rate how much **ability** you believe you have.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very low ability | | | | | | Very high ability |

___ Biology ___ Business ___ Computer Science
___ English ___ Mathematics ___ Nursing
___ Psychology

26. Using the scale below, please rate your responses to the following statements.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| strongly disagree | | | | | | strongly agree |

___ My close relationships are an important reflection of who I am.
___ When I feel very close to someone, I feel like that person is an important part of who I am.
___ I usually feel a strong sense of pride when someone close to me has an important achievement.
___ When I think of myself, I often think of my close friends or family also.
___ In general, my close relationships are an important part of my self-image.
___ Overall, my close relationships have very little to do with how I feel about myself.
___ I could be happy without having a career.
___ My career will give meaning to my life.
___ I would never let my career take priority over my family.
___ I would be very satisfied to devote all of my time to my home and family.
___ To me, having a career is more important than having a family.
___ I intend to have children and a successful career.
___ It is very difficult for a woman to combine a career as a computer scientist with a family life.
___ If a woman computer scientist takes time away from her career to have children, she will never catch up again.
___ A woman who is considering a career as a computer scientist should probably plan not to have children.
___ Computer Science is one of the most demanding and difficult careers.
___ A person pursuing a Computer Science career does not have to make any more sacrifices than a person pursuing any other professional career.
___ People who choose careers in Computer Science usually enjoy being around other people.
___ Computer scientists lead lonely lives.
___ Most computer scientists are more interested in numbers than people.
___ Most computer scientists spend as much time working with other people as they do alone in front of their computers.
___ Doing well in Computer Science courses enhances job/career opportunities.
___ The rewards of a degree in a computer-related field are worth all the sacrifices.
___ It is difficult to pursue a computer-related major and still have a social life.
___ Computer-related majors do not allow enough time for electives in college.
___ I am very interested in Computer Science.
___ I intend to take more mathematics courses in the future.
___ I intend to take more science courses in the future.
___ I intend to take a Computer Science course in the future.
___ Computers are useful tools.
___ The overuse of computers may be harmful and damaging to humans.
___ Using computers is fun.
___ Females have as much ability as males when learning to use computers.
___ It would not bother me at all to take a computer course.
___ I would feel at ease in a computer class.
___ I could get good grades in a computer class.
___ I do not think I could handle a computer course.

___ I am sure I could learn a computer language.
___ I do not feel threatened when others talk about computers.
___ I am no good with computers.
___ I have lots of self-confidence when it comes to working with computers.
___ I get a sinking feeling when trying to use a computer.
___ I feel tense about my computer science assignments.
___ Computers are dehumanizing to society.
___ The career opportunities of Computer Science majors are excellent.

27. Using the following scale, report on your feelings and thoughts **during the last month**.

| 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| never | almost never | sometimes | fairly often | very often |

**In the last month, how often have you**:

___ been upset because of something that happened unexpectedly?
___ felt that you were unable to control the important things in your life?
___ felt nervous and "stressed"?
___ dealt successfully with irritating life hassles?
___ felt that you were effectively coping with important changes that were occurring in your life?
___ felt confident about your ability to handle your personal problems?
___ felt that things were going your way?
___ found that you could not cope with all the things that you had to do?
___ been able to control irritations in your life?
___ felt that you were on top of things?
___ been angered because of things that happened that were outside of your control?
___ found yourself thinking about things that you have to accomplish?
___ been able to control the way you spend your time?
___ felt difficulties were piling up so high that you could not overcome them?

28. Rank **all** of the following majors In order of interest to you; 1 being MOST interesting to 7 being LEAST interesting.

___ Biology ___ Business ___ Computer Science
___ English ___ Mathematics ___ Nursing
___ Psychology

29. For **each** of the majors listed below, please rate how **easy** each major is.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very easy | | | | | | Very difficult |

___ Biology ___ Business ___ Computer Science
___ English ___ Mathematics ___ Nursing
___ Psychology

30. For each item, rate yourself on the following scale:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| never or almost never true | | | | | | always or almost always true |

I see myself as someone who (is):
____ Likes to reflect, play with ideas ____ Eager to soothe hurt feelings ____ Yielding

____ Worries a lot
____ Defends own beliefs
____ Has an active imagination
____ Independent
____ Tends to be lazy
____ Original, comes up with new ideas
____ Emotionally stable, not easily upset
____ Assertive
____ Inventive
____ Strong personality
____ Perseveres until the task is finished
____ Forceful
____ Can be moody
____ Curious about many different things
____ Sympathetic
____ Values artistic, aesthetic experiences
____ Sensitive to the needs of others
____ Sophisticated in art, music, orlit.
____ Prefers work that is routine
____ Gets nervous easily
____ Makes decisions easily
____ Tends to be disorganized
____ Does a thorough job
____ Soft-spoken
____ Depressed, blue
____ Warm
____ Willing to take a stand
____ Athletic
____ Can be some what careless
____ Gullible
____ Remain scalm in tense situations
____ Childlike
____ Relaxed, hand less tress well
____ Does not use harsh language
____ Competitive
____ Analytical
____ A reliable worker
____ Has leadership abilities
____ Does things efficiently
____ Willing to take risks
____ Makes plans and follow sthru
____ Ingenious, a deep thinker
____ Has few artistic interests
____ Dominant
____ Cheerful
____ Masculine
____ Shy
____ Affectionate
____ Tender
____ Aggressive
____ Flatterable
____ Acts as leader
____ Loyal
____ Individualistic
____ Feminine
____ Self-sufficient
____ Loves children
____ Ambitious
____ Gentle
____ Can be tense
____ Understanding
____ Compassionate
____ Self-reliant
____ Distractable

31. Have you declared your major?
Yes What is your major? ______________________ .
No What major are you currently most interested in? ____________________.

32. From the following choices, rank the **top three** sources of your educational funding by placing a 1 (most), 2, or 3 on the line next to your choice. **Use each number only once.** If your education is being paid for by only one source, use 1 for that source and leave the rest blank.

____ Parents (including parent loans) ____ Employer ____ Military benefits
____ Spouse/significant other ____ Other (specify) _________________

33. When do you intend to graduate from your current college program of study? (MM/YY) __/__

34. What is the highest level of education you intend to complete?
College degree Some graduate school
Master's degree Doctoral or professional degree (for example, Ph.D., M.D., Psy.D.)

35. Are you currently employed?
Yes How many hours do you work each week during the semester? ____ hours
No

36. Circle on the scale below how important receiving financial aid was to your decision to attend college.

1 2 3 4 5

Not at all important Very important

37. Using the following scale, please circle how certain you are that you will have enough money to complete your college education.

1 2 3 4 5
Not at all certain Very certain

38. What is your birthdate? ____/____/____ (MM/DD/YY)

39. What are the **LAST** 4 digits of your social security number: ______

40. What is your sex? ___ Female Male

41. Do you have any children?
No **Please go to question 42.**
Yes Please indicate the number of children you have in each of the following age groups:

____ Currently expecting ____ 0-4 years ____ 5-17 years ____ 18 and over

Which adult spends the most time with your children during the day?
____ Self ____ Spouse/other parent
____ Child care provider ____ Other (specify): _________

42. Circle the number below that best describes your family's economic status during your childhood.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| low income | | | average | | | well-off |

43. What is the highest level of education your parents completed? Please check one box for your father and one for your mother.

| Father | Mother | |
|---|---|---|
| ___ | ___ | Less than high school |
| ___ | ___ | Some high school |
| ___ | ___ | High school diploma/GED |
| ___ | ___ | Some college |
| ___ | ___ | College degree |
| ___ | ___ | Some graduate school |
| ___ | ___ | Master's degree |
| ___ | ___ | Doctoral or professional degree (for example, Ph.D., M.D., Psy.D.) |
| ___ | ___ | I don't know |

Thank you for your time. We appreciate your help very much. If you have additional comments or if you would like to tell us something about the questionnaire itself please do so below.