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Seminal Barriers to Female High School Students' Choice of Information Technology as a Career Alternative

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Seminal Barriers to Female High School Students' Choice of Information Technology as a Career Alternative

By

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Abstract

The under-representation of women in the IT profession is a well-known Information Systems phenomenon. Unlike the other sciences and mathematics, where the percentage of women receiving bachelor's degrees has increased over the past two decades, the percentage of women obtaining degrees in technology has decreased. Information Technology started strong in 1984 with 37.06% women receiving bachelor's degrees; however, 2004 brought a decrease to a low of 25.05%, near the level of three decades earlier. The consequences of this under-representation include non-diverse IT solutions, a predicted IT workforce shortage, and the United States losing its ability to participate as a fervent technological contributor in a global arena. Despite the importance of this issue, previous research has yielded isolated and often conflicting results. Past researchers have concentrated on small subsets rather than examining the complete breadth of barriers to the recruitment and retention of women in the IT field. This research consisted of seven major activities. First, a four-staged IT Career Lifecycle model was developed which advances the work of prior research. Second, it was determined that the specific scope and focus of this research would consist of Stage I of the IT Career Lifecycle model at a point where high school girls are considering college majors. Third, a literature review was conducted to establish a comprehensive list of Stage I barriers that have been identified by previous researchers. Fourth, a second new model was established that identifies and classifies all of the Stage I barriers identified by the literature. As part of this model's development process, fourteen barriers were analyzed, summarized, and categorized into three sources: the girls, the IT community, and the societal influencers. Fifth, fourteen hypotheses were developed to validate the Stage I Barriers Model. Sixth, a survey was conducted to validate the Stage I model, determine the most prevalent barriers, identify new barriers, and capture the attitudes and perceptions of high school

girls regarding the IT profession and its workers. The survey was administered to 417 female junior and senior girls in four high schools in the Chicago metropolitan area. Seventh, the Stage I model was reconstructed to incorporate the knowledge gained from the survey. Thus, through the process of this research, the reconstructed Barrier Model was grounded in research literature and validated through the “real world” view of high school girls’ attitudes, perceptions, and interests in computers and IT careers.

Although the goal of the survey was to examine barriers to high school girls’ entry into the Information Technology field of study, findings went beyond that, falling into three main categories: barriers, enablers, and predictors. As expected, some of the findings identified significant barriers that were incorporated into a reconstructed Barrier Model. However, some results uncovered factors that were clearly, not identified as barriers by the participants. Consequently, some originally proposed barriers were reclassified as enablers and others as predictors of IT majors. Still other factors were recognized as having the potential to be classified in more than one way, barriers, enablers, or predictors. Since the original scope of the research incorporated barriers only, a framework did not exist to capture significant findings on enablers or predictors. Therefore, two additional models were developed, the IT Career Enabler and the IT Career Predictor. Additionally, this research created a new Pre-College IT Career framework to contain the three models, embracing factors that may influence high school girls in their potential pursuit of IT careers.

Chapter One – Introduction

This chapter begins with an overview and provides a historical perspective of the declining percentages of women receiving bachelor's degrees in technology. The second section presents the goal of the research: to examine the seminal barriers that perpetuate the disinterest of high school girls in Information Technology Careers. The final section explains the significance of the research and the implications of the under-representation of women in the IT profession.

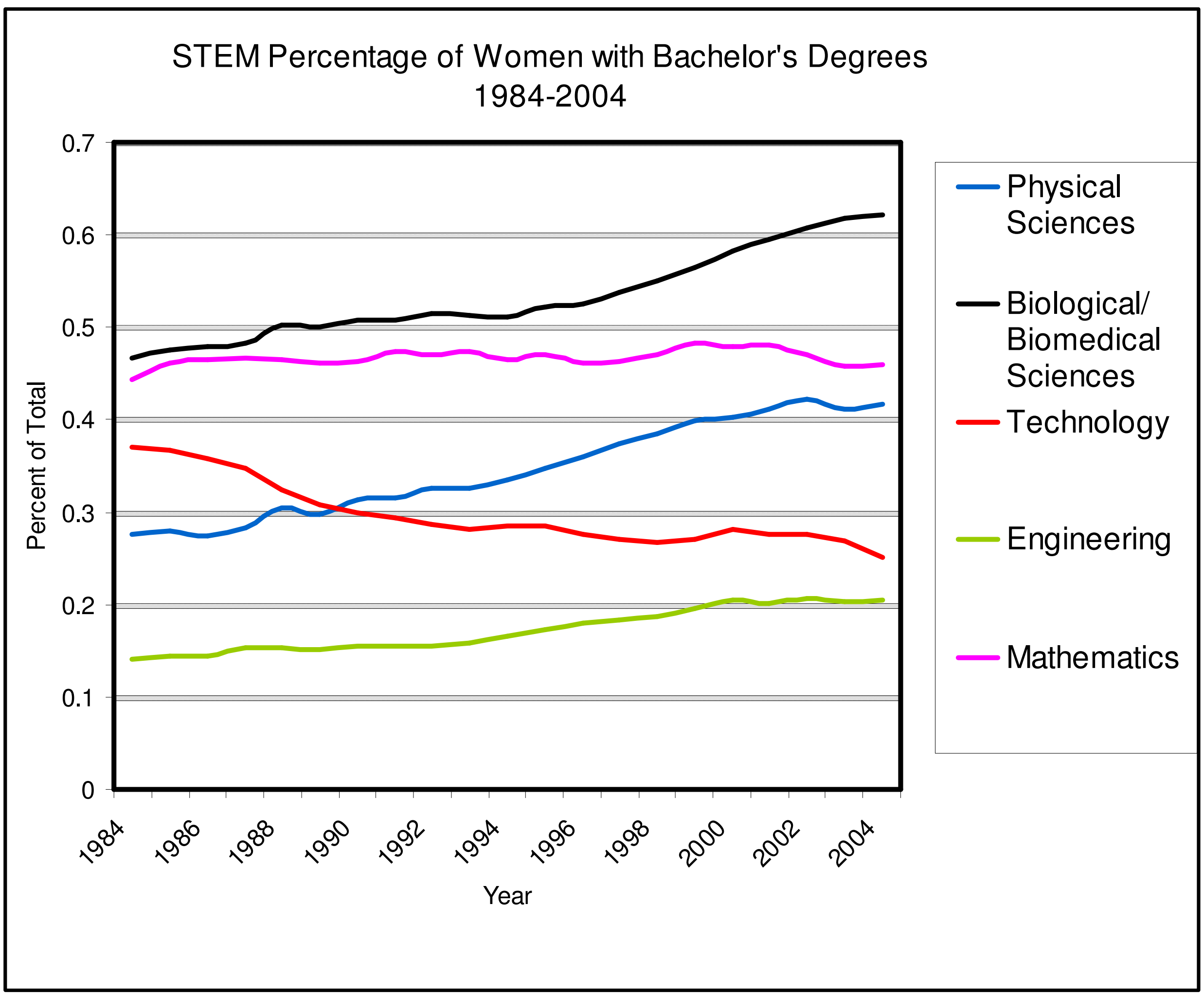
Overview

During the past two decades, numerous researchers have reported on the shrinking pipeline of women in Information Technology (IT) and the possible barriers that affect women's choice of IT as a career. In this research, Information Technology is defined as the broad subject concerned with all aspects of accessing, managing, processing, and transmitting information, especially within a large organization or company. IT careers consist of occupations that require designing, developing, and implementing software and hardware systems, providing technical support for software and hardware systems, as well as creating and maintaining network or database systems (Creamer et al., 2004).

Camp (1997) states, "The ratio of women involved in computer science from high school to graduate school has been dwindling at a startling pace over the past decade. Is there hope in sight?" (p. 103). According to the American Association of University Women report (2000), it is essential to attract more girls into the IT careers "pipeline." The Computing Research Association reports that women's interest in computer science was already low to begin with and continues to spiral downward. In 2000 women received 19 % of the undergraduate computer science degrees and in 2004, only 17 % (Carlson, 2006). This percent has fallen to levels that have not existed since the early 1970s (Vegso, 2005) . Anita Borg (2002) states a change must transpire in the lack of diversity in the IT field. "At the moment, it is white, prosperous, technologically educated men who make most of the decisions about the nature of technology, and this defines how technology affects the entire world population" (p. 13). This nation is at a critical crossroads where we must eradicate the barriers and develop programs to encourage women to enter into the IT industry and thereby ensuring a world-class IT workforce for the United States.

From 1984 to 2004, the percentage of women receiving bachelor's degrees in all disciplines has increased from 50.65% to 57.45% (National Center for Educational Statistics, 2005). In contrast, the percentage of women obtaining degrees in technology has decreased. The National Science Foundation, founded in 1950, was created by Congress to promote the progress of Science, Technology, Engineering, and Mathematics (STEM) disciplines. The percentage of women in the STEM disciplines has increased in every category from 1984 – 2004 except Technology (See Figure 1). The Science categories displayed in the figure below consists of two disciplines: 1) Physical Sciences and 2) Biological/Biomedical Sciences. From 1984 to 2004, the percentages of women in the Physical Sciences ranged from 27.63% to 41.74% and Biological/Biomedical Sciences from 46.68% to 62.20%. Technology started strong in 1984 with 37.06% women receiving bachelor's degrees with an expected continued increase; however, 2004 brought a decrease to a low of 25.05%, near the level of three decades ago. Engineering, the most underrepresented STEM category, has increased from 14.09% to 20.46%. Women's academic achievement of bachelor's degrees in Mathematics has been strong over the years and has ranged from 44.30% in 1984 to 45.95% in 2004. The proliferation of computers in our society, businesses, schools, and homes would have suggested an increase in the participation of women with bachelor's degrees in IT, but instead we are faced with facts that indicate a clear and continuing decline. Finally, the increase of women obtaining bachelor's degrees in all disciplines and the decrease of women obtaining technology degrees suggests a latent opportunity to secure untapped IT talent.

Figure 1: Women with Bachelor's Degrees from 1984 – 2004 in Science, Technology, Engineering, and Mathematics



Goal of Research

The under-representation of women in the IT industry is a well-known Information Systems phenomenon. Prior work on the under-representation of women in IT has yielded isolated and often conflicting results. Past researchers have concentrated on small subsets rather than examining the complete breadth of barriers to the recruitment and retention of women to the IT industry. The goal of this research was to examine the seminal barriers that foster the desolate interest of high school girls in Information Technology Careers. This research investigated the following questions:

- Which barriers are cited in the research?
- Which barriers do high school girls identify to be the most significant?
- What are the differences between the two groups of barriers?

This research produced a comprehensive model to probe and dissect these barriers. By deepening our understanding of the barriers that discourage high school girls from selecting IT careers, this research enables the IT community to identify potential policies and programs to alleviate the continued diminishing interest of girls from becoming IT professionals.

Importance of Research

The under-representation of women in the Information Technology (IT) industry is a perpetual occurrence that continues to elude IT researchers and practitioners. Research studying girls and the information technology environment is not a novel phenomenon; the fact that numerous complex barriers persist justifies the importance of maintaining continued intense research of their existence and significance. The spectrum of barriers is not just limited to girls' possible negative perceptions and images of the IT industry, but includes factors that may harmfully penetrate through our educational system and society as a whole. These factors include stereotypes and gender biases that when allowed to persist can stagnate and limit one-half of our population. As a society, why should we be concerned with the barriers perpetuating the under-representation of women in the IT industry? Sanders (2005) states that with the growing role of technology in the world at the beginning of the 21st century – in education, communications, occupations, and entertainment, and as a tool for solving the world's problems – American women's low and decreasing representation is a major concern. The portrayal of the IT environment reveals a prediction of an IT workforce shortage (McGee, 2005) with a resulting concern of the US losing its ability to contribute in the global technological arena (Holzer, 2006), non-diverse solutions (Lazowska, 2002), declining IT enrollments, and the current under-representation of women in the IT industry.

According to Hecker (2005), six of the 30 fastest growing occupations in the period 2004 - 2014 will reside in the IT industry (See Table 1). The total number of projected new jobs in this period is 2.884 million. It is predicted that approximately 27.5% of the fastest-growing jobs – 795,000 new jobs with a growth rate from 31.1 to 54.6 % – will exist in computer-related occupations.

Table 1: Six Fastest Growing IT Occupations from 2004 – 2014

Employment Title	Projected Number Change	Projected % Growth
Six Fastest Growing IT Jobs		
Network systems and data communications analysts	126,000	54.6
Computer software engineers, applications	223,000	48.4
Computer software engineers, systems software	146,000	43.0
Network and computer systems administrators	107,000	38.4
Database administrators	40,000	38.2
Computer systems analysts	153,000	31.4
Six Fastest Growing Subtotal	**795,000**	
Other IT Jobs		
Computer support specialist	119,000	23.0
Computer specialist, all other	28,000	19.0
Computer programmer	9,000	2.0
Computer and information scientists, research	6,000	25.6
Other IT Jobs Subtotal	**162,000**	
Total Number Change	**957, 000**	

Note: Data retrieved from the United States Department of Labor, Bureau of Labor Statistics' website, www.bls.gov.

However, in September 2005, the Society of Information Management (SIM) released a report predicting a shortage of IT professionals due to the soon-to-retire IT baby boomers (McGee, 2005). The United States' inability to produce people with technical skills not only immobilizes a country internally, but also hinders any country's ability to be a partner in the global technological arena. Additionally, a non-diverse workforce further generates a limited array of IT solutions. As Lazowska (2002) stated, "Engineering solutions are enriched and enhanced by the diversity of the engineering teams that create these solutions. A non-diverse engineering workforce inevitably leads to diminished – indeed, improvised – engineering solutions" (p. 11). Technology has become such a ubiquitous component of society. Therefore, for the development of technology solutions to be dominated by one gender both indicates and contributes to social problems (Grant et al., 2006).

Finally, this research is important because of the decline in women enrolling in IT majors. In many universities, the enrollment of women majoring in IT fields has declined significantly. As the enrollment of men in IT programs has dropped in recent years, the enrollment of women has dropped even faster, exacerbating enrollment challenges. With the current predicted IT workforce shortage, the possibility of non-diverse IT solutions, concerns over the ability to function as a global technological partner, and declining enrollment of women in IT majors contributing to already declining IT enrollment, the issue of encouraging women to select IT as a career choice is of critical importance.

Summary

The percentage of women receiving bachelor's degrees has increased in every STEM category except Technology. This continuous downward spiral over the past two decades has raised concerns in the IT community. The predicted future growth of IT jobs in the industry and the historical perpetual decline of women's enrollment in IT majors depicts a tremendous technological resource gap. The results of this research will enable researchers to develop strategies to attract high school girls to the IT industry.

Chapter Two – Review of Literature and Development of Research Framework

Chapter Two provides the detailed description of the initial framework developed to conduct the research. An introduction, including the five major activities accomplished to build the research framework, is presented. Previous research has been analyzed and summarized to establish two new models, the IT Career Lifecycle and the Stage I Barriers models. This chapter concludes with a discussion of the hypotheses used to test and validate the barriers.

Introduction

The under-representation of women in IT permeates multiple stages of a woman's entry, retention, and advancement in the IT industry. Carlson (2006) reports that women who want to pursue a career in IT face barriers as early as grade school, in high school, through college and into the work world. This research establishes a model encompassing all stages where women in information technology may encounter barriers. However, the primary goal of this research is to study the barriers female junior and senior high school students may encounter.

The development of the research framework includes five major activities. First, an IT Career Lifecycle model was developed by advancing the previous research of Ahuja (1995). Second, it was determined that the specific scope and focus of this research would consist of Stage I of the

IT Career Lifecycle model. Third, a literature review was conducted to establish a comprehensive list of Stage I barriers studied by previous researchers. Fourth, a second model for this research was established and entitled the Stage I Barriers to Contemplating Decision of IT Major Model. This model encompassed fourteen barriers that were analyzed, summarized, and categorized according to source: the girls, the IT community, and the societal influencers. Fifth**,** the hypotheses were developed to validate the Stage I Barriers model.

Advancement of Previous Research

The foundation of this research was developed by advancing the work of Ahuja (1995). Ahuja (1995) developed a life-cycle stage model that depicted the factors that constrained the recruitment and retention of women in the IT field. Ahuja's model grouped factors influencing women's professional IT career choice into three stages: 1) Early Educational Stage, 2) Career Choices Stage, and 3) Career Advancement Stage. In Stage I, the Early Educational Stage, Ahuja referred to positive and negative experiences that may have influenced a child's attitude and perception toward computers. Stage II, Career Choices Stage, consisted of factors that influenced the critical career choices women made during their university education experience and initial entry into the job market. Finally, in Stage III, Career Advancement Stage, Ahuja considered factors that impede promotions to higher-level IT careers. Within each stage, Ahuja's model comprised two types of factors: structural and social. Structural factors occur when the organizational design of the institution restricts or inhibits opportunities. Examples of structural factors in Ahuja's model are male-oriented software, hacker-culture, and lack of role models and mentors. Alternatively, social factors are cultural biases. Stereotypes, gender biases, and work-family conflicts are several examples of social factors.

Ahuja's model had several limitations. The model did not account for the fact that young women begin to make their career choices before Stage II. Additionally, the delineation between the university experience and entry into the IT field could have been more distinct. Ahuja's factors included the IT industry and societal impacts, but the model did not include individual personal influence or specific interactions between factors. Ahuja stated that there were combinations of factors that had a cumulative effect on the decision a woman makes to embark on an IT career path and generally explained the interactions between the structural and social barriers in each stage. However, Ahuja did not describe specific individual relationships between barriers within a stage. Furthermore, Ahuja stated that the biggest limitation of her model was that she had difficulty separating external influence from individual freedom. In this research, my model does not separate external influences, but does illustrate the interrelations of an individual's choice of IT as a career, the societal influencers, and the IT community. Ahuja stated she had a concern with the approach of testing the model because the phenomenon operates at a micro as well as a macro level. This research proposes to take a slice of the model and test a stage at a micro level. Additionally, Ahuja's model had two other limitations: it was not comprehensive and it did not have empirical data to support or validate the model. Several factors not included in Ahuja's model were the perceptions of IT workers as asocial and having little opportunity to interact with others. Other factors not included in Ahuja's model were the lack of knowledge of IT careers and the lack of counselor and peer encouragement. The major enhancements to Ahuja's research are:

- expanding the model through the delineation of four stages of IT careers instead of three

- including girls as a source of barriers
- modifying the list of barriers
- validating a stage of the model with an empirical study

All of the limitations of Ahuja's model noted here are addressed in the development of the IT Career Lifecycle model in this research.

IT Career Lifecycle Model

Since women encounter barriers at various phases of their career development process, Ahuja's lifecycle model (1995) was expanded, as depicted in Table 2, to contain four stages: 1) Stage I - Contemplating Decision of IT major, 2) Stage II - Validate or redefine IT major, 3) Stage III - Initial entry into IT field, 4) Stage IV - Retention and advancement in IT field. Women can enter or exit the IT Career Lifecycle at any stage.

Table 2: Stages in IT Career Lifecycle

	Stage	Description	General Timeframe	
→	I	Contemplating decision of IT major	Early childhood to juniors and seniors in high school	→
→	II	Validate or redefine IT major	College	→
→	III	Initial entry into IT field	One to three years in IT profession	→
→	IV	Retention or advancement in IT field	Three or more years in IT profession	→

The arrows in the IT Career Lifecycle represent the ability for women to enter or exit the model at any stage. The entry arrows illustrate potential barriers in recruitment of women in each of the four stages of the model, whereas the exit arrows illustrate potential barriers in retention. As the model indicates, a female high school student could decide to major in IT in Stage I of the IT Career Lifecycle Model, and leave the IT field during college in Stage II, due to the long hours in the computer lab and the perception of not having sufficient time to have a life outside of school. On the other hand, a woman could major in another discipline and enter into the IT Career Lifecycle in Stage III, as a self-taught IT professional. This same woman could leave her IT career in Stage IV due to a lack of opportunities for advancement. A consideration of prior studies in each stage portrays the importance of targeting research to a specific stage of the IT Career Lifecycle.

Relating Previous Research to the IT Career Lifecycle Model

Stage I consists of the barriers a young girl may encounter from her early childhood years to the later years of her high school experiences. The American Association of University Women Educational Foundation report (2000) stated that many girls have a concern with the computer culture and express a "we can, but I don't want to attitude toward computer technology" (p.7). Jepson and Perl (2002) surveyed 652 high school students. Their study revealed several reasons why girls did not choose IT careers: lack of role models in the IT field, other interests, lack of knowledge of the industry, limited opportunity or access to computers, and the image of IT people as nerdy. The University of Maryland, Baltimore County's Center for Women and Information Technology (CWIT) has established seven K-12 initiatives to encourage more girls to study computer-related disciplines and become IT professionals (Center for Women and Information Technology, 2007). The goals of the CWIT initiatives are to motivate more girls to pursue IT careers, to communicate information on IT careers, and to conduct research on gender and IT. Bleeker (2006) studied 460 high school students and concluded that the boys surveyed reported a significantly higher expected level of interest in IT careers than the girls did. The barriers that create this IT disinterest for girls must be examined to obliterate pipeline leakage in the beginning of the career lifecycle.

In Stage II, a young woman who has decided to major in an IT discipline may encounter barriers while she is validating her major during her college experience. Pearl et al. (1990) focused on the shrinkage of women in the IT pipeline from the pre-college level through graduate school; however, their primary focus was at the college level. Pearl et al. determined three primary barriers for women attempting to enter the field: “difficulties with self-esteem, lack of role models and gender discrimination.” Cuny and Aspray (2002) reported on a workshop that developed 20 intervention strategies to increase women’s participation in IT graduate programs across the United States. Margolis and Fisher (2002) conducted a study at Carnegie Mellon to investigate computer science education and the experiences of computer science students at the university level. As a result of their research, Margolis and Fisher discovered various differences in computer career decisions, interests, attitudes, and experiences of men and women at Carnegie Mellon. The goal of their research was to understand the differences and develop strategies to increase the participation and retention of women in IT.

Stage III barriers could restrict a young woman’s growth and development of her IT career during her initial years in the IT industry. The Information Technology Association of America has conducted studies in 1998, 2003 and 2005. The purpose of their research was to explore women and minorities in the IT workforce to determine the progress of diversity, to address the barriers for entry into the IT profession, and to recommend solutions to overcome the barriers (Information Technology Association of America, 2005a). Additionally, the Anita Borg Institute for Women and Technology has developed a program entitled TechLeaders to promote a community of technical women who are involved in the motivation and growth of other technical women (Computing Research Association, 2006). The goal of TechLeaders is to evolve new female technical leaders through building an infrastructure to foster the ability to network, develop resources, receive guidance and mentoring, and attend workshops to learn new skills.

During Stage IV, an experienced IT professional woman may encounter barriers in the industry that impede her opportunity to advance her career. Teague (2000) studied 15 IT women professionals to explore their reasons for entering the IT industry, what they liked about the industry, and their concerns regarding the industry. Some of their concerns regarding the industry were the male-dominated environment, lack of mentors, and discrimination in salaries. Additionally, Trauth conducted research on women in the information technology workforce. Trauth's research (2006a) examined the "Individual Differences Theory of Gender and IT." This Individual Differences Theory depicts the variation of how IT professional women from different backgrounds perceive and respond to the IT environment, computing culture and societal influences. Further, Trauth's (2006b) *Encyclopedia of Gender and Information Technology* is an international compilation of over 200 articles highlighting the emerging research and trends on men and women in IT.

As illustrated in the relating key studies, a variety of research strategies should be developed and the resultant findings implemented to attract and retain women in the IT industry. Thus, the IT Career Lifecycle model facilitates the ability of the IT community to concentrate and focus research in a specific stage. The IT Career Lifecycle model also exposes at what point, girls/women encounter barriers in their careers and target intervention recommendations toward either recruitment strategies, retention strategies or both.

Stage I Barriers to Contemplating Decision of IT Major Model

While the IT Career Lifecycle model depicts four stages, the principal focus of this research was Stage I, where young women are contemplating their future career decisions. Scragg and Smith (1998) suggest that the most effective solution to mitigate the under-representation of women in IT is to focus on recruitment, especially outreach programs. Young women are concerned with the current computer culture. Girls are concerned with utilizing the computer as a valuable tool in today's society; yet, "they dislike narrowly and technically focused programming classes" (AAUW, 2000, p. ix). Additionally, the AAUW report (2000) suggested that girls are opting out of IT careers. The report stated that girls do not believe that IT careers are too challenging or demanding; however, they do believe that IT careers are boring, tedious, and lack interaction with other people. The AAUW report (2000) recommended, "We need a more inclusive computer culture that embraces multiple interests and backgrounds and reflects the current ubiquity of technology in all aspects of life". This inclusive computer culture can be developed through analyzing and eliminating the barriers girls encounter when contemplating a career in IT.

A literature review was conducted to develop a comprehensive list of the major Stage I barriers. Previous researchers have cited a number of plausible explanations for the under-representation of women in IT. However, previous research has not produced a comprehensive, experimentally supported list. Numerous researchers have indicated that societal influencers such as stereotypes and gender bias have a significant impact on girls' decisions not to choose IT as their major in college. According to Teague (2000), many girls do not view information technology as a plausible career alternative. Kadijevich (2000) found that males showed a more positive attitude toward computers than females. Rowell et al. (2003) report "…enjoyment and interest have been shown to be a major reason students select a career…" (p. 54). Their research illustrated that males were 17.0% more likely to have a career interest in IT.

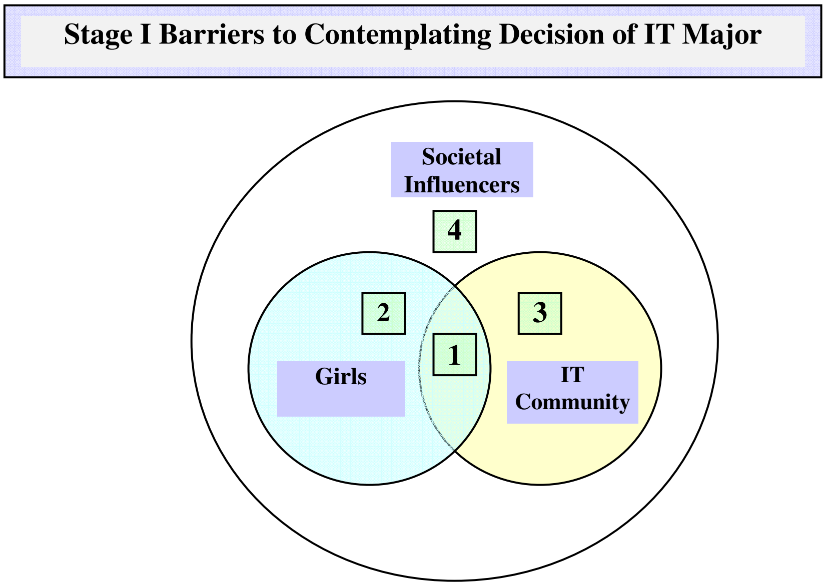
Additionally, there can be subtle but devastating gender biases that women encounter in educational, home and community environments. Boys may be expected and encouraged to use computers both at home and at school, more than girls (Ahuja, 1995), and media may continue to perpetuate a "geeky" male-dominated IT community. Hazzan and Levy (2006) identified a "geeky" and loner image as one of three factors discouraging women from IT careers, positing that women are more likely to be interested in careers involving more interaction with people. Girls may have the misconception that the fundamental IT career involves being a programmer, a social loner, sitting in a dark room glaring at a computer all day (Beyer et al., 2004). Girls usually do not identify themselves as "hackers" or "computer geeks," and due to social gender stereotyping, the computer has been labeled as a "boy's activity" (Kiesler et al., 1985; Margolis & Fisher, 1997; Moorman & Johnson, 2003). Girls who are attracted to the IT field are so outnumbered that there is a severe "sense of isolation" (Frenkel, 1990; Katz et al., 2003;

Weinberger, 2004). As if this sense of isolation were not enough, boys' compelling attraction to computers and gender stereotyping facilitate the crippling perception of some parents and teachers that "boys and men, not girls and women will excel in and enjoy computing" (Margolis & Fisher, 2002, p. 16). Margolis and Fisher (2002) state in their research of undergraduate computer technology students, "while most of the male students describe an early and persistent magnetic attraction between themselves and computers, women much more frequently link their computer science interest to a larger societal framework."

Furthermore, one of the most cited research concerns regarding the under-representation of women in IT is the view that girls and women do not have sufficient female IT mentors and role models (Cohoon, 2002; Spertus, 1991; Townsend, 2002). As a result, the computer culture is an alienating and difficult environment for girls to succeed (Pearl et al., 1990). Pearl et al, (1990) focused on the shrinkage of women in the IT pipeline and determined three primary barriers for women attempting to enter the field: "difficulties with self-esteem, lack of role models and gender discrimination." Additionally, researchers have reported that some women who have considered a major in IT feel less self-confident in their computer capabilities (Beyer et al., 2004; O'Lander, 1996, Shashaani, 1994). Thus, the barriers identified in previous research are complex and multi-faceted, and before this research, no study included a model that incorporated the comprehensive breadth of barriers.

This research has developed a comprehensive model of barriers that serves as a foundation for exploring the rationale supporting high school girls' disinterest in the IT profession. In the Stage I Barriers to Contemplating Decision of IT Major model depicted in Figure 2, the sources of barriers are grouped into the following three categories: Girls, the IT Community, and Societal Influencers. The category labeled “Girls” refers to females who have the aptitude to pursue a career in IT. The IT Community consists of all people and organizations in the IT field, including high school IT teachers, IT practitioners, IT researchers, IT faculty, etc. Societal Influencers include all people, institutions, and societal norms outside of the IT community that may affect girls’ decisions on considering IT careers. Societal Influencers in my model include parents, counselors, media, friends, stereotypes, gender biases, etc. Since Girls and the IT community sit inside of society, whenever a barrier has a source from the Girls or the IT community, it will also be influenced by society. My model includes four intersections. Intersection 1 is a combination of all three sources, Girls, IT Community and Societal Influencers. Intersection 2 is a combination of Girls and Societal Influencers, while Intersection 3 is a combination of IT community and Societal Influencers. Intersection 4 is predominant when the primary source of the barrier is one or more of the Societal Influencers. This research validates the intersections and the relationship of the barriers inside one intersection and across intersections.

Figure 2: Stage I Model



Intersection	Barriers
1	*Negative perception of Information Technology (IT) careers*
1	*Negative image of people who work in IT fields*
1	*Perception that all IT careers are programming*
1	*Perception that all IT careers require strong mathematical background*
1	*Lack of knowledge of IT careers*
2	*Lack of confidence in IT skills*
2	*Lack of early exposure to computers*
3	*Lack of sufficient IT role models*
3	*IT is a male dominated environment (i.e. Boys Club)*
4	*Stereotypes and gender biases*
4	*Lack of parental encouragement of IT careers*
4	*Lack of teacher encouragement of IT careers*
4	*Lack of counselor encouragement of IT careers*
4	*Lack of peer encouragement*

Description of Barriers in Stage I Model

The Stage I model consists of 14 barriers that were summarized from barriers identified in previous research and categorized in their appropriate intersection in Figure 2.

Intersection 1 Barriers (Girls, IT Community, and Societal Influencers):

- The negative perception of IT careers barrier was subdivided into nine factors. Girls may perceive the following barriers as potential characteristics of IT careers:
    1) inability to balance work and family (Ahuja, 1995; Beyer et al., 2004)
    2) challenging work that is so intense there is little time to have a life outside of school/work (Weinberger, 2004)
    3) limited opportunity to interact with people (Beyer et al., 2004, Teague & Clarke, 1993)
    4) limited opportunity to help people (Clayton & Lynch, 2002)
    5) limited opportunity to improve the community/society (Clayton & Lynch, 2002)
    6) limited flexible work hours (Weinberger, 2004)
    7) unpleasant working environment (Frenkel, 1990; Weinberger, 2004)
    8) limited opportunity to use creative skills (Beyer et al., 2004)
    9) limited opportunity to solve interesting problems (Weinberger, 2004)
- The negative image of IT professionals was examined – This study examined whether the participants perceive IT workers as being geeky, anti-social, likely to be male, obsessed with computers or some combination. (Ahuja, 1995; Beyer et al., 2004; Clayton & Lynch, 2002; Pollock et al., 2004; Teague, 2000; Thomas & Allen, 2006)
- Perception that all IT careers are programming – This study examined whether the participants believe that IT jobs have a primary emphasis in computer programming (Beyer et al., 2004).

- Perception that all IT careers require strong mathematical background – This study explored if women are deterred by the supposed need for mathematics in IT careers. (Clayton & Lynch, 2002; Teague, 2000)
- Lack of knowledge of IT – This study proposed that girls have little knowledge of the variety and scope of jobs in the IT field (Rodger, 1996: Sheard & Markham, 2002). Teague (2000) reported that girls lack the understanding of the true nature of IT careers, believing that computing is accomplished in isolation, sitting alone at a computer all day.

Intersection 2 Barriers (Girls and Societal Influencers):

- Lack of confidence in IT skills was explored in this study to determine its impact on girls' interest in IT. Numerous researchers have reported that some women feel significantly less confident than men do in their computer abilities (Beyer et al., 2004; Margolis & Fisher, 2002; Shashaani, 1994; Teague, 2000).
- The lack of early exposure to computers was examined by determining the age most girls started using the computer. Other computer exposure factors examined included: determining whether the girls have taken computer courses, whether girls have access to computers at home, how often girls use computers in all environments (i.e., school, home, library, etc.), how often girls play computer games, and what other activities they perform while using the computer.

Intersection 3 Barriers (IT community and Societal Influencers):

- Lack of sufficient IT role models – A prominent research issue regarding the under-representation of women in IT is that women do not have adequate IT mentors and role models (Cohoon, 2002; Klawe & Leveson, 1995; Pollock et al., 2004; Roberts et al., 2002; Spertus, 1991; Townsend, 2002).
- IT is a male-dominated environment - Women who may have an interest in an IT career have an intense "sense of isolation" (Frenkel, 1990). Consequently, the current male dominated environment is alienating and uncomfortable for girls and women (Kiesler et al., 1985; Pearl et al., 1990).

Intersection 4 Barriers (Societal Influencers):

- Stereotypes and gender bias were explored for the numerous issues that girls identified as reasons they are disinterested in computers, computer courses and IT careers. The AAUW report (1992) states "by stereotyping women's roles, popular culture plays a role in shortchanging girls by limiting their horizons and expectations."
- Lack of encouragement from parents, teachers, counselors, and peers - In the AAUW (2000) study, girls said that teachers and counselors gave them very little information about careers in IT. Klawe and Leveson (1995) report that "the majority of social cues discourage them (girls) from taking math and computer courses and tell them they are not qualified to be scientists" (p. 30). Stereotypes and gender biases assist to perpetuate the expectation of parents, teachers, and their fellow peers that "boys and men, not girls and women will excel in and enjoy computing" (Margolis & Fisher, 2002, p. 16).

HYPOTHESES

The purpose of developing the hypotheses for this research was to test and validate the fourteen barriers identified in the Stage I Barrier model. Four hundred female high school juniors and seniors were surveyed to determine their plans to pursue a career in IT. Based on the downward trend of young women achieving bachelor's degrees, the primary hypothesis of this research was that few women would identify an IT major as a potential career choice. (See H1 in Table 3). The majority of hypotheses in Table 3 were derived from prior literature.

Table 3: Hypothetical Statements

No.	Hypothetical Statements
H1	Girls will be less likely to choose IT as their majors and careers than other disciplines
H2	A majority of the girls will identify the career choice factors as important; however, only a minority of them will believe that IT jobs have these characteristics.
H3	Girls who plan to major in IT will identify different career factors that they feel are important and different factors that characterize IT jobs than girls who do not plan to major in IT.
H4	A majority of girls think IT careers have a primary emphasis in computer programming.
H5	A majority of girls think all careers in IT require a strong background in mathematics
H6	A majority of girls do not have an accurate perception of what people in the IT field do.
H7	A majority of girls have a negative image of people who work in IT fields.
H8*	**A majority of girls have computers in their homes with access when they want it; furthermore, they like using computers, and spend a considerable amount of time on them.**
H9	A majority of girls have not taken and do not plan to take a computer course
H10	Girls receive little encouragement from parents, teachers, counselors or peers regarding IT careers.
H11	A majority of girls do not have access to role models or family/friends who work in IT.
H12	A majority of girls feel uncomfortable in considering a male-dominated occupation.
H13*	**Girls will not identify stereotypes or gender bias as reasons why they dislike computers, computer courses or IT careers.**

No.	Hypothetical Statements
H14*	**A majority of girls will feel they have the ability to be successful in IT careers.**

Note*: Hypothesis developed is different from prior research

The detailed hypothetical statements suggest that many girls have a misconception of IT careers and IT workers. This study further proposes that few girls would have taken the initiative to enroll in a computer science course. Further, it suggests that girls receive very little, if any, encouragement from parents, teachers, counselors, or peers to pursue an IT career, have diminutive access to role models and family friends in the IT field, and believe that they would feel uncomfortable in a male-dominated occupation.

However, in three instances – Hypothesis 8, 13, 14 – the hypotheses proposed are different from prior research. Hypothesis 8 stated that a majority of girls have computers in their homes with access when they want it; furthermore, they like using computers, and spend a considerable amount of time on them. Additionally, Hypothesis 13 stated that the participants would not identify stereotypes as the explanations for their disinterest in computers, IT courses, and IT careers. Contrary to prior research, it is proposed in this research that many participants have computers at home and even if they did not have computers at home, they had access at school and at the library. Margolis and Fisher (2002) stated that boys have a "magnetic attraction" to the computer. They feel that the computer is "added to the list of blocks, cars, chess sets, and other things that boys play with most and is absent from the list of girls' favorites" (p. 16). Contrary to their belief, this research propositions that boys and fathers no longer monopolize the computers at home. Further, the idea that computers are toys for boys is no longer as prevalent as it was four years ago. The researchers believe that the ubiquitous use of computers and technology in the United States has initiated a transformation of the image of computing culture (Grant et al., 2007). Thus, the researchers proposed that the participants would not identify stereotypes as disadvantages of IT careers.

Hypothesis 14 stated that the participants are confident in their technology skills and feel they could be successful in IT career. The researcher in this study has observed girls to be confident with their technological skills. Grant (2004) developed and managed a technology camp named Girls with Engineering Mindz (GEMz) that served over 100 high school girls for three years. GEMz was a highly structured technology program developed to provide inner city high school females with a well-rounded exposure to technology and basic life skills. The vision of the GEMz program is to encourage female high school students to discover an interest in computer technology and inspire them to seek an undergraduate degree in computer science or an IT related field. During several interviews and surveys with the girls, Grant discovered that computer usage, access, and confidence in computer skills did not appear to be a concern to the girls in her technology camp. Grant (2004) acknowledged the following about her GEMz campers, “Computer access did not appear to be an issue; 94% of the participants had a computer at home. The participants were also asked how many hours did they spend on the computer in one week, 62.5% said they spent 15 hours or more on the computer. Furthermore, when asked how they felt about the computer, 93.75% said they liked it or loved it (p. 206). ” Grant also observed that many of the GEMz participants displayed confidence during the technology lectures and were secure with their technology skills. Consequently, three hypotheses developed from prior research, were modified (H8, H13, and H14) to reflect the experiences of the researcher resulting from the development and management of a technology camp for high school girls.

Summary

Two significant models were developed by advancing the work of previous researchers, the IT Career Lifecycle model, which identifies all stages where women encounter IT career barriers, and the Stage I Barriers model, which specifically focuses on the stage when high school girls encounter barriers while contemplating their college major. Five major activities were accomplished to develop these models. First, Ahuja's (1995) model was enhanced to include initial career making decisions in the early stages of a child's life, long before the university experience. Additionally, a clear distinction between the university experience and the initial entry into the job market was developed. These modifications allow researchers to deliberate and focus their research and intervention strategies. Second, it was determined that the focus of this study would be barriers to contemplating a decision to major in IT; hence, the Stage I model with 14 barriers and three sources of the barriers (i.e., Girls, IT Community, and Societal Influencers) and their respective intersections were developed. Third, a comprehensive list of barriers was developed through conducting a review of past literature. Fourth, detailed hypotheses were proposed. The hypotheses suggest that girls have a misconception of IT careers and workers. This study further proposes that most girls have access to computers at home when they want it and like using computers; however, few would have taken the initiative to enroll in a computer science course. Fifth, this study anticipates that girls received very little, if any, encouragement from parents, teachers, counselors, or peers to pursue an IT career, have diminutive access to role models and family friends in the IT field and believe that they would feel uncomfortable in a male-dominated occupation. The purpose of this research is to test these propositions as potential barriers and explore their significance. Chapter Three presents the research instrument to explore the problematic barriers that young women encounter in their pursuit of an IT career.

Chapter Three – Research Methodology

Introduction

This chapter begins by presenting the research methodology. The creation and design of the research instrument serves to validate the Stage I Barrier model and to discover new barriers. Additionally, the survey administration process and pilot tests are described. Finally, this chapter concludes with a description of the data analysis plan. The next chapter, Chapter Four, reports the findings to validate and reconstruct the original Stage I model.

Research Instrument Methodology

The research methodology utilized a survey as the instrument to collect quantitative and qualitative data. A survey is a system for collecting information about people to describe, compare, or explain their knowledge, attitudes, perceptions, and behaviors. A survey was conducted in this research to serve as an instrument to validate the Stage I model, to determine the most prevalent barriers, to explore new barriers, and to capture the attitudes and perceptions of high school girls regarding the IT profession and its workers. The survey was administered to over 400 female junior and senior students in four high schools in the Chicago metropolitan area. Additionally, the Stage I model was reconstructed to incorporate the knowledge gained from the survey. The reconstructed Barrier model includes the significance of the barriers validated by the participants. This study also includes recommendations for programs and procedures to mitigate the barriers and explore new implementation strategies to attract high school girls to IT careers.

Advancement of Previous Instrument

The research instrument for this study was derived from a survey created by Creamer et al. (2004) for a National Science Foundation funded project at Virginia Tech. Creamer et al. developed a survey to study the factors that attract women to the IT field. Creamer et al. (2004) compared and analyzed differences among women who were likely to take a computer course, their reason for taking the course, their attitudes about IT workers, and their interest in IT careers. Their subsequent research studied the key factors that predict high school and college women's interest and choice in IT careers (Creamer et al., 2005a).

Creamer et al.'s survey was comprised of five sections, containing 118 items with 436 respondents, of which, 318 were women, and 118 men. Of the 318 women, 116 were in high school, 86 in community college, and 116 in a four-year university. Creamer et al. (2004) stated, "When compared to national norms an unusually high percentage of college students responding to the survey indicated that they were enrolled in computer-related programs of study (p. 69)." Creamer et al. also reported "that because of the title of the project, the local contacts at each site selected classes or groups of students to complete the survey that had stronger interest in IT than might be found in most classrooms" (p. 69). In this research, all junior and senior female students in the targeted high schools were asked to participate, not selected classes or groups. In addition to addressing the limitation of Creamer et al.'s work, the research instrument for this work was modified to identify the barriers that female high school students encounter, rather than factors that predict interest and choice in IT careers. The modifications of this research instrument included accessibility to IT role models, computing in a societal framework, sources from which high school girls obtain information on IT careers, and the girls' opinions regarding the advantages and disadvantages in working in an IT field. (See Appendix B for a copy of the research instrument for this study, which displays the new items highlighted in yellow). Computing in a Societal framework is similar to Margolis and Fisher's concept (2002) of "Computing with a purpose." Margolis and Fisher propose, "Computing can be taught in an interdisciplinary setting, honoring the goal of solving the world's problems" (p.60). While some of Creamer et al.'s facilitating elements display the flip side of some of this study's barriers, additional barriers were identified. Further, once this study is complete, Creamer et al.'s facilitating elements may be combined with this study's barriers to produce a more complete picture of how to encourage high school women into the IT field.

Research Instrument

As noted earlier, this study identified 14 significant barriers in the Stage I model. The Barrier model was validated by surveying 417 junior and senior high school girls in four high schools in the Chicago area. The instrument has nine major sections: 1) basic demographic information, 2) general career questions 3) questions regarding computer courses, 4) computer access and use, 5) attitudes about people who work in IT fields, 6) knowledge about IT careers, 7) sources of information on IT careers, 8) familiarity with and interest in IT careers and 9) attitudes about IT careers. The research instrument for this study has 80 items, of which 38 are new or modified from Creamer et al.'s survey, primarily to shift the focus from facilitators to barriers. The instrument was structured utilizing a combination of a Likert scale and open-ended questions. The four-point Likert scale was retained from the original instrument for the majority of the questions to discourage the participant from choosing the middle or the average response. As a result of one of the pilot tests, the “don’t know” choice was added to one question to create a five-point scale to overcome the problem of random guessing and to help mitigate low reliability. It was decided that determining if the student really did not know the answer for this section of questions was more informative than the student not answering and having missing data or guessing. Another concern of this research was that prior research had not identified all of the participants’ significant barriers. To address this concern, the survey was designed to capture additional barriers with six open-ended questions. Additionally, the open-ended questions were included to obtain rich, detailed information on the girls’ attitudes and perspectives of computers, computer courses and IT careers.

Upon completion of the development of the survey, approval was obtained from the university’s Institutional Review Board (IRB). The purpose of the IRB is to review all projects to assure that the planned research activities were performed in a rigorous, ethical manner and the rights of the participants were protected according to federal regulations (Depaul IRB, 2006). (The Participant Assent form can be found in Appendix C)

One of the major risks of administering the survey was the possibility of a low return rate. In order to alleviate this risk the survey administration process included a passive parental consent procedure. In a passive parental consent procedure, a letter is sent home to the parents of the participants with an option of calling, mailing, or emailing the researchers if they did not want their daughter to participate in the study. In an active procedure, a form is sent to the parent, the parent indicates on the form whether the child can participate, signs the form, and returns it to the researcher. Previous literature has concluded that collecting active parental consent forms can be problematic (Ji et al., 2004). Furthermore, having to obtain a consent form could cause an unacceptably low participation rate and sampling bias (Pokorny et al., 2001). Accordingly, the methods adopted in this research to mitigate low participation rates and sampling bias includes:

1. distributing a passive parent consent form in the form of a letter (See Appendix D for sample parent letter)
2. providing incentives to participants (i.e., a raffle, for $20 gift certificates, was conducted for all girls who participated in the survey)
3. providing incentives to the school administrator to encourage recruiting the participants, assisting in administering the survey and acting as a liaison between the students and the researcher
4. attaching the collaboration letter from the school principal with the letter going out to the parents (The Collaboration letter can be found in Appendix E)
5. conducting multiple attempts to remind participants, parents, and school administrators. Ji et al. (2004) report that three is the maximum number of attempts that realizes any significant gains in corresponding to parents and participants.

Since the passive parental consent was a significant strategy to ensure high return rates, it was decided to obtain support from Chicago Public Schools (CPS) headquarters and the participating schools. The CPS Office of Research, Evaluation, and Accountability was contacted to receive their approval of the overall survey administration process, especially the passive consent procedure. (See Appendix F for the final approval letter from CPS.) Additionally, the Office of Specialized Services was contacted to assist in securing the high schools. Finally, the school administrator's support, participation, and follow-through with the survey's administrative tasks were vital to the success of the participation of the students. The school administrator was given a checklist to assist in ensuring that all tasks before and during the survey administration process were completed. (See Appendix G for a sample of the checklist.)

Prior to administering the survey, validity and pilot tests were performed to pretest the research instrument and the survey administration process. There is a common fallacy that if a survey is derived from a validated instrument, the researcher is not required to check the reliability and validity for his/her research instrument. According to Yu (2006), a responsible researcher should still check the instrument's reliability and validity with his/her own participants and make modifications if necessary. Therefore, several tests were conducted to corroborate the reliability and the validity of the research instrument. One of DePaul's experienced Instructional Librarian & Technology Consultants was asked to review the survey to provide suggestions of modifications to enhance clarity and minimize misinterpretations. Furthermore, three DePaul School of Computer Science, Telecommunications and Information Systems (CTI) faculty members, a statistician, a mathematician and a faculty advisor, who is an Associate Dean with a research concentration in IS, thoroughly reviewed the research instrument for the appropriateness of the questions, potential sources of measurement error, potential sources of missing data and content validity. Content validity is a measure of how appropriate questions or scales appear to a set of reviewers who have some knowledge of the topic area (Litwin, 2003). Two individuals were also asked to conduct a face validity test. Face Validity is conducted by showing the survey to untrained reviewers to determine if the survey makes sense. Two pilot tests were conducted to uncover the possible need to redesign questions in the research instrument and determine if the survey would be completed within the 30-minute objective. The first pilot test was conducted with six female undergraduate students from HerCTI. HerCTI is an organization in CTI for women to meet on a weekly basis that provides opportunities to network and receive tutoring (Besana & Dettori, 2004). The second pilot test was conducted with four female senior high school students. For both tests, the participants were asked to complete the survey as if they were real participants and note any typographical mistakes, questions, and potential problems. At the conclusion of the pilot tests, a debriefing discussion was held to review the research instrument. As a result of the validity and pilot tests, the research instrument was modified six times until the final version was solidified.

The surveys were distributed to 417 female students in four high schools in the Chicago metropolitan area over the months of April and May. During the survey process, all female juniors and seniors in each school were encouraged to participate in the survey to ensure a cross-section of girls with different backgrounds and career plans. Three of the four high schools were part of the Chicago Public School system and the other school was from the private Catholic School system.

The Chicago Public School system consists of 115 high schools with 110,000 students. The Chicago Public School system has an ethnicity profile that consists of 85.2% African-American and Hispanic students with sub-components of 48.6% and 37.6% respectively. Additionally, there are 40 Catholic High Schools in the Archdiocese of Chicago consisting of 28,000 students with a predominately White student population of 61.9% (See Table 4 for ethnic profiles for Chicago Public High Schools and Chicago Catholic High Schools).

Table 4: Ethnicity Profiles

	Chicago Public High Schools (Total Students)	**Catholic High Schools** (Total Students)
High School Student Population	110,000	28,000
Ethnicity		
African-American	48.6%	12.9%
Hispanic/Latina	37.6%	17.6%
White	8.1%	61.9%
Asian/Pacific Islander	3.2%	3.7%
Multi-racial/Other	2.4%	3.8%
Native American	.1%	.1%

The selection of high schools for this research was developed to reflect a blend of the ethnic profiles from both the Chicago public and Catholic school systems and incorporate all ethnic categories. To achieve this goal, three diverse schools were chosen from the public school system, Kelvyn Park, Kenwood, and Whitney Young, and one from the private Catholic school system, Queen of Peace.

Table 5 provides a summary of the high school ethnicity profiles. Kelvyn Park is a predominately Hispanic general high school, which is open to all students living in the neighborhood. Kelvyn Park is located on Chicago's west side and serves the communities of Hermosa and Logan square (Chicago Public Schools, 2006). Kenwood is a predominately African-American general neighborhood school that is "located in the racially and economically diverse neighborhood of Hyde Park and offers a rigorous college preparatory curriculum and an accelerated magnet program in partnership with the University of Chicago" (Chicago Public Schools, 2006). Queen of Peace is an all-girls Catholic Sinsinawa Dominican high school with a strong college preparatory curriculum (Queen of Peace, 2006). Queen of Peace has the following racial/ethic breakdown in percentages: 56% White, 27% Hispanic, 13% African American, and 4% Other (Queen of Peace, 2006). Whitney Young is a selective enrollment high school with a mixed racial/ethnic background of 24% White, 19.8% Hispanic, 37.5% African American, and 18.6% Asian Pacific Islander. As stated on the CPS website, “selective enrollment high schools are designed to meet the needs of Chicago’s most academically advanced students” (Chicago Public Schools, 2006). Admission into Whitney Young is highly competitive and requires an entrance exam. The CPS website reports this about Whitney Young, “the school is technologically-rich with a student-to-computer ratio of less than four to 1” (Chicago Public Schools, 2006).

Table 5: Profiles for High Schools Participating in the Survey

High School	Type of High School	% White	% Hispanic / Latina	%African American	%Asian/ Pacific Islander	% Native American	% Other
Kelvyn Park	General	1.1%	95.0%	3.5%	.3%	.1%	-
Kenwood	General	3.2%	4.9%	89.3%	2.5%	.1%	-
Queen of Peace	All Girls Catholic	56.0%	27.0%	13.0%	-	-	4.0%
Whitney Young	Selective Enrollment	24.0%	19.8%	37.5%	18.6%	.1%	-

The research goal for the sample size was to collect 75 questionnaires from each high school for a total of 300 surveys. Thus, this research assumes that the diversity of the four schools chosen and the sample size adequately represents the target population for female high school students in the Chicago area.

This research is focused on barriers that female junior and senior high school students may have encountered, so boys were not surveyed. However, all junior and senior female students who attended the targeted four high schools were asked to participate in the survey. Junior and senior girls who expressed an interest in majoring in the IT field were compared to the girls those who did not express an interest in the IT field. Additionally, the factors that the participants identify as important to their career decision were compared to their perceptions of IT career characteristics. Since the research study was on careers, the thoughts and attitudes of juniors and seniors were collected in view of the fact that they are closer to graduating, and the question of career planning was forefront on their minds. Since the survey was administered in April and May 2006 near the end of the school year, many seniors had just completed their post-secondary school plans and many juniors were beginning to consider their future plans. This timeframe may be too early for freshmen and sophomores as their career plans may still be undecided; therefore, freshmen and sophomores girls were excluded.

Data Analysis Plan

This study was conducted using a convenience sample selection. Convenience sampling occurs when the participants are easily available to the researcher and willing to participate. Since the sample was nonrandom, it is not 100% certain that a selection bias has not occurred. As stated by Ott and Longecker (2001), “selection bias exists whenever there is a systematic tendency to over-represent or under-represent some part of the population.” However, since 417 completed surveys were analyzed from four high schools with a diverse demographic profile, most selection bias was minimized, except to the extent that the Institutional Review Board requirement to disclose the IT oriented nature of the survey may have encouraged more prospective IT majors to respond. The plausibility of this as an influence was explored further as the results are discussed.

This research examined 14 hypotheses. The data analysis plan for this research consisted of the following steps: 1) determining the specific data needed to evaluate each hypothesis and asking the appropriate questions in the survey, 2) selecting the appropriate analytical techniques, 3) collecting and cleaning the data, and 4) conducting the analysis. An initial data analysis table, Table 6, was created to document the hypotheses, the data analysis descriptions, the analytical techniques, and the applicable survey sections.

Table 6: Data Analysis Plan

Hypotheses	Variable and Data Analysis Description	Analytical Technique	Survey Number
H1 - Girls will be less likely to choose IT as their majors and careers than other disciplines.	Ask the girls if they plan to major or minor in a computer-related field in college and their career plans.	One-sample proportion test	1.9, 1.10, 2.1
H2 - A majority of the girls will identify the career choice factors as important; however, only a minority of them will believe that IT jobs have these characteristics.	Compare the girls' response to the factors that influence their career choice and their perception of the characteristics of IT jobs. Questions in both categories will be the same but in a different order.	One-sample proportion test	2.2.1 – 2.2.11 3.7.1 – 3.7.11
H3 - Girls who plan to major in IT will identify different career factors that they feel are important and different factors that characterize IT jobs than girls who do not plan to major in IT.	Compare responses for participants who plan to major in IT to responses for non-IT majors regarding the career choice factors and IT characteristics.	Logistic regression analysis – backward elimination technique	2.2.1 – 2.2.11 3.7.1 – 3.7.11
H4 - A majority of girls think IT careers have a primary emphasis in computer programming.	Ask the girls if they think careers in IT are primarily programming jobs.	One-sample proportion test	3.7.12

Hypotheses	Variable and Data Analysis Description	Analytical Technique	Survey Number
H5 - A majority of girls think all careers in IT require a strong background in mathematics.	Ask the girls if they feel IT careers require a strong background in mathematics.	One-sample proportion test	3.7.13
H6 - A majority of girls do not have an accurate perception of what people in the IT field do.	Ask the girls if they have a good idea about what people in IT jobs do.	One-sample proportion test	3.6.1
H7 - A majority of girls have a negative image of people who work in IT fields.	Summarize the girl's image of people who work in computer-related fields. Ask questions such as do you feel people who choose careers in computers are geeks, loners, antisocial, obsessed with computers.	One-sample proportion test	3.3.1 – 3.3.8
H8 - A majority of girls have computers in their homes with access when they want it; furthermore, they like using computers, and spend a considerable amount of time on them.	Determine the girls' exposure to computers, their computer accessibility, and how they use computers. What are the girls' attitudes toward the computer? How many total hours do they use a computer in a week? What activities do the girls perform on the computer? Do girls use the computer for games?	One-sample proportion test Two-sample tests of equality of proportions	3.2.1, 3.2.2, 3.2.4, 3.2.5
H9 - A majority of girls have not taken and do not plan to take a computer course.	Summarize girls' exposure to computer courses – how many girls have taken a computer course.	One-sample proportion test	3.1.1
H10 - Girls receive little encouragement from parents, teachers, counselors or peers regarding IT careers.	Determine the level of encouragement that girls receive from parents, teachers, counselors, and friends regarding IT courses and careers.	Logistic regression analysis – backward elimination technique	3.5.1 - 3.5.7, 3.6.6 - 3.6.8, 3.1.2.4, 3.1.2.5, 3.1.2.8
H11 - A majority of girls do not have access to role models or family/friends who work in IT.	Determine if the girls know someone who works in the IT field and who could be a role model.	One-sample proportion test	3.6.4, 3.6.9

Hypotheses	Variable and Data Analysis Description	Analytical Technique	Survey Number
H12 - A majority of girls feel uncomfortable in considering a male-dominated occupation	Determine if the girls will feel comfortable working a male-dominated environment.	One-sample proportion test	3.6.5
H13 - Girls will not identify stereotypes or gender bias as reasons why they dislike computers, computer courses or IT careers.	For stereotypes and gender bias, review reasons why girls did not like computer courses, why girls did not have access, why girls did not like computers, what they stated as disadvantages to working in the IT field.	Open ended questions were coded and analyzed using a manual technique	3.1.4, 3.2.3, 3.2.6, 3.4.2
H14 - A majority of girls feel they have the ability to be successful in IT careers.	Determine if the girls would feel they would be successful if they chose a career in IT.	One-sample proportion test Two-sample tests of equality of proportions	3.6.3

As stated previously, 417 completed surveys were collected for the data analysis, substantially exceeding the expected goal of 300 surveys. However, six surveys were eliminated in the data cleaning process due to incompleteness. Thus, the total number of surveys analyzed was 411. The data analysis was conducted utilizing the following steps: 1) completing an exploratory data analysis with descriptive statistics using an Excel spreadsheet, 2) filtering and grouping the data were necessary, 3) utilizing the SAS Analyst application to perform logistics regression analyses or proportion tests to evaluate the hypotheses, and 4) examining the results. This study used a p-value of .05 to determine the level of significance. Therefore, if the p-value is < or = .05, then the null hypothesis was rejected; however, if the p-value is > .05, then the null hypothesis was not rejected.

The SAS Analyst application is a tool that provides basic statistical analyses (SAS, 2002). The application includes a wide variety of analytical tasks such as hypothesis testing and regression analysis. The Analyst application was utilized to perform the logistics regression test, the one-sample test for a proportion, and the two-sample test for a proportion.

As shown in Table 6, the logistics regression was performed for Hypotheses 3 and 10. The logistic regression is a type of multiple regression and general linear model (Ott & Longnecker, 2001). Logistic regression is a statistical modeling technique that describes the relationship between a dependent variable and a set of independent variables, predictors. Thus, the logistic regression technique provides the capability to predict the probability of a certain outcome (dependent variable). In this study, the dependent variable was a binary variable with two outcomes. In this research, the dichotomous dependent variable was the Career variable, which took on two values: IT majors and non-IT majors. A detailed discussion of the Career variable is presented in Chapter Four, Hypothesis 1.

As stated by Cody and Smith (2006), "Logistic regression uses a transformation (called logit) that forces the prediction equation to predict probability values between 0 and 1. A logistics regression equation predicts the natural log of the odds for a participant being in one category or another." (p. 301). Thus, the logit is defined as the log base e (log) of the odds. Furthermore, the coefficients of the predictor variable in a logistics regression equation can be used to estimate odds ratios for each of the predictors. The odds ratio as described by Ott & Longnecker (2001) is the odds of an event for two groups. If x is an event and there are two groups, group1 and group2, the odds ratio is as follows:

odds ratio for x = (probability of x for group1/1- probability of x for group1)/
(probability of x for group2/1- probability of x for group2)

The odds ratio is a useful technique to compare two groups. For example, the results of the odds ratio can indicate whether the odds of an event (x) are a higher or lower percentage for group1 than group2.

The logistic regression equation is expressed as follows:

$$\textbf{logit}\left[\theta(\mathbf{x})\right] = \textbf{log}\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i$$

Thus, it is the sum of the intercept and a linear combination of all of the statistically significant predictor variables multiplied by the coefficient of the predictor variables. Where α = intercept, x = the predictor variables, and β = the coefficient of the predictor variables. Maximum likelihood (ML) methods are used to compute estimates for the intercept and the coefficients of the predictor variables. The estimates are called maximum likelihood estimation (MLE) because the parameter values are chosen to maximize the probability (likelihood) of the sample data. In other words, these ML methods find the parameter values that make the observed data most likely. There are several methods to perform MLE; however, many of them follow similar steps. MLE is an iterative process. The algorithm starts with initial estimates of the coefficients. Then it computes the likelihood of the data given these coefficient estimates. Next, the algorithm changes the coefficient estimates slightly and recalculates the likelihood of the data. This iterative process is repeated until there is little change in the estimates (McCullagh & Nelder, 1989).

The logistics regression analysis has several model selection alternatives. The model selection technique utilized for this study was backward elimination. The backward elimination technique begins by including all of the independent variables. Then the variables are deleted from the model one by one. At each step, the variable showing the smallest contribution to the model is deleted. This iterative process continues until all the variables remaining in the model are statistically significant at a given level. As indicated earlier, the level for this study was a p-value less than or equal to .05.

As shown in Table 6, one-sample proportion tests were conducted for 10 of 14 hypotheses tests and two-sample proportion tests were conducted for two of the hypotheses. For example, with Hypothesis 14, a one-sample proportion test was performed to test the null hypothesis that less than or equal to 50% of the participants would think they would be successful in IT careers. Once the test was performed, the results of the p-value and the null hypothesis were reported. Furthermore, on two occasions, Hypothesis 8 and 14, two-sample proportion tests were conducted to determine whether significant differences in the proportions of IT and non-IT majors existed. The final data analysis activity was to examine open-ended responses.

Open-ended questions were observed to explore new potential barriers and to gather free form responses from the participants. The responses for the open-ended questions were coded, analyzed, and summarized using a three-step process. First, the 11 important career choice factors in Questions 2.2.1 - 11 were used to establish the initial categories for the codes. Second, each open-ended response was reviewed to analyze the data to develop additional codes from the participants' responses. Third, the open-ended responses were reviewed a second time to calculate an aggregated total for each code.

The six open-ended questions were:

1) What are the reasons this career interests you? (Question 2.1)

2) If you have already taken a computer course, circle one phrase that best describes how you felt about the course. Disliked, OK, Liked, Loved. Please explain your answer… (Question 3.1.4)
3) If you do not have access when you want it, please explain what limits your access. (Question 3.2.3)
4) Circle one phrase that best describes your feelings about using the computer. I dislike using the computer, using the Computer is OK, I like using the computer, or I love using the computer. Please explain your answer … (Question 3.2.6)
5) What do you see are the advantages of working in a computer or technology related field? (Question 3.4.1)
6) What do you see are the disadvantages of working in a computer or technology related field? (Question 3.4.2)

Summary

An existing survey was modified and utilized as the research instrument to validate the Stage I barriers of the IT Career Lifecycle Model. The research instrument for this study was based in part by the survey created by Elizabeth G. Creamer, Peggy S. Meszaros, and Carol J. Burger (2005b) for a NSF Funded Project at Virginia Tech. Thirty-eight out of eighty-six items were created or modified from the original survey to accomplish the objectives of this research. Prior to conducting the survey, the instrument and the administration process were approved by DePaul University's Institutional Review Board and Chicago Public School's Office of Research, Evaluation, and Accountability. The research instrument was reviewed and pilot tested to ensure its reliability and validity. Over four hundred junior and senior young women from four high schools in the Chicago metropolitan area completed the survey. A data analysis plan was developed to determine the specific data to analyze, to select the appropriate analytical techniques, and to develop the steps to evaluate the hypotheses. During September - December of 2006, the survey data results were analyzed. Chapter Four presents the results of the analyses for the fourteen hypotheses tests.

Chapter Four: Results

Chapter Four provides detailed analysis and results of the data gathered from 411 completed questionnaires. The first section summarizes the participants' demographic information, which provides pertinent data reflecting the participants' ethnicity, high school data, college and career plans, and parents' careers and educational levels. The second section provides an evaluation of the fourteen hypotheses proposed in this study, as well as an elucidation of the tests conducted and the results. The chapter concludes with a comprehensive summary of the results. Chapter Five presents a discussion of the findings and the establishment of the reconstructed Barrier model.

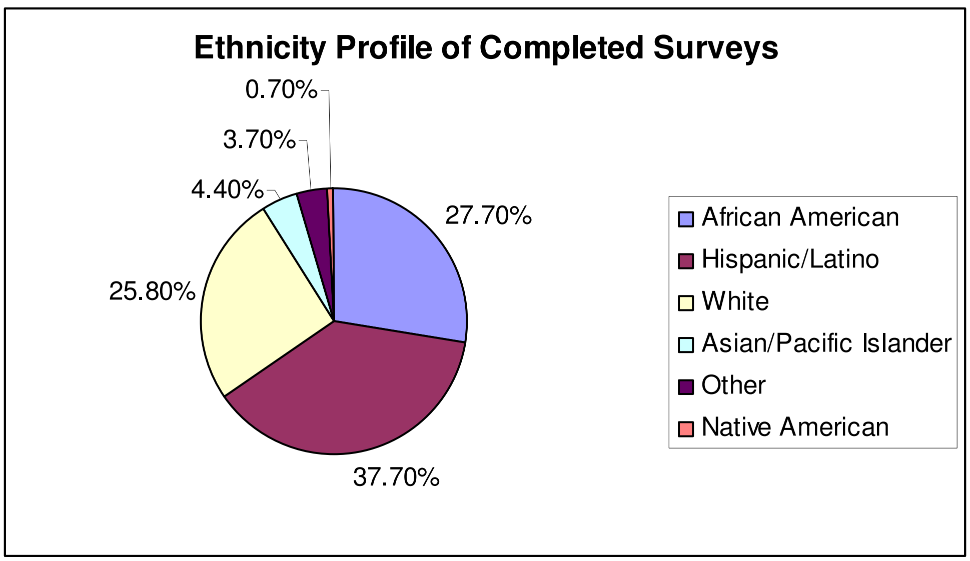
Demographic Analysis of Survey Participants

As previously stated, four high schools were selected to mirror the diverse ethnic backgrounds of girls who attend both Chicago public and Catholic high schools. The original goal was to collect 75 questionnaires from each high school. Four Hundred and eleven questionnaires were analyzed. The breakdown of the 411 questionnaires yielded by school was as follows:

- Kelvyn Park High School - 105 participants
- Kenwood Academy High School - 73 participants
- Whitney Young Magnet High School - 87 participants
- Queen of Peace High School - 146 participants

As shown in Figure 3, the ethnicity profile of the participants involved in this research represents all major ethnic groups in the Chicago Public and Catholic systems. Hispanic/Latina students represented the largest group with 37.7% of the completed questionnaires, while African American and White students were second and third at 27.7% and 25.8%, respectively. Furthermore, the number of juniors and seniors who completed the survey was close to the 50/50 percentage goal with 197 juniors (47.9%) and 214 seniors (52.1%).

Figure 3: Ethnicity Profile of Completed Questionnaires



Overall, the participants had definite plans for college and their future. A grade point average of 3.1 out of a 4.0 scale with a standard deviation of .6 was observed. The vast majority of the participants, 97.3%, plan to go to college. Conversely, as shown in Table 7, only 54.5% and 46.2% of their mothers and fathers, respectively, obtained an educational level higher than a high school degree.

Table 7: Highest Educational Level Completed by Parents

Highest Level of Education Completed	Percentage of Mothers	Percentage of Fathers
Left blank	2.9%	7.1%
Less than high school	15.6%	19.0%
High school or equivalent	27.0%	27.7%
Subtotal for high school level and below	**45.5%**	**53.8%**
High school and some college	21.4%	16.8%
Associates degree	4.1%	4.1%
Bachelor degree	13.4%	10.2%
Masters degree	8.8%	5.6%
Doctorate degree	0.7%	1.2%
Professional degree	2.7%	2.2%
Other	3.4%	6.1%
Subtotal for above high school level	**54.5%**	**46.2%**

Demographic information on career choices was also collected for the participants and their parents. The participants were asked three questions: 1) what career they were most interested in, 2) the career currently held by their mother/female guardian, and 3) the career currently held by their father/male guardian. The responses were categorized according to the U.S. Department of Labor, Bureau of Labor Statistics, List of Standard Occupational Classification Occupations (United States Department of Labor, 2006). The career responses for the three groups were then aggregated, the percent calculated and rank ordered. Unemployed/Left blank was the only category not ranked. As shown in Table 8, the highest ranked occupational category for the participants was the healthcare industry with approximately 31% of the participants identifying their future career aspirations as doctors, nurses, physical therapists, pharmacists, etc. In contrast, Information Technology was ranked as the seventh highest occupation for the participants at 5.8%. With reference to the participants' mothers, Office and Administrative Support, which consists of jobs such as secretaries, receptionists and clerks, represented the highest-ranked occupation (16.1%); yet, no participant chose this occupational category. Information Technology occupations was ranked twelfth (1%) for participants' mothers. With reference to the participants' fathers, Construction and Skilled Trade occupations (15.1%) was the highest ranked career category, while Information Technology occupations ranked eighth (2.7%). Chapter Five provides a contrast of the occupational distribution of this study with statistics gathered from other high school students, examines the discrepancies, and evaluates both groups with the predicted occupational requirements for the future.

Table 8: Expected Career Occupations of the Participants Surveyed and the Actual Career Occupations of Their Parents

Career Occupation Category[1] (Total is 411)	**Participants**	**Percent of Participants (Rank)**	**Mothers**	**Percent of Mothers (Rank)**	**Fathers**	**Percent of Fathers (Rank)**
Healthcare Practitioners, Technical and Support Occupations	127	30.9% (1)	37	9.0% (4)	7	1.7% (10)
Management, Business and Financial Occupations	52	12.7% (2)	41	10.01% (2)	56	13.6% (2)
Arts, Design, Entertainment, Sports and Media Occupations	50	12.2% (3)	3	0.7% (13)	3	0.7% (14)
Life, Physical and Social Science Occupations	37	9.0% (4)	2	0.5% (16)	1	0.2% (18)
Education, Training and Library Occupations	28	6.8% (5)	41	10.0% (2)	3	0.7% (14)
Protective Service Occupations	28	6.8% (5)	11	2.7% (10)	25	6.1% (4)
Information Technology Occupations	**24**	**5.8% (7)**	**4**	**1.0% (12)**	**11**	**2.7% (8)**
Legal Occupations	19	4.6% (8)	3	0.7% (13)	4	1.0% (13)
Food Preparation and Serving Related Occupations	11	2.7% (9)	13	3.2% (8)	13	3.2% (7)
Personal Care and Services Occupations	11	2.7% (10)	19	4.6% (6)	2	0.5% (17)
Architecture and Engineering Occupations	9	2.2% (11)	0	0.0%	5	1.2% (12)
Community and Social Services Occupations	3	0.7% (12)	5	1.2% (11)	3	0.7% (14)

Career Occupation Category[1] (Total is 411)	Participants	Percent of Participants (Rank)	Mothers	Percent of Mothers (Rank)	Fathers	Percent of Fathers (Rank)
Sales and Related Occupations	2	0.5% (13)	19	4.6% (6)	11	2.7% (8)
Office and Administrative Support Occupations	0	0.0%	66	**16.1% (1)**	14	3.4% (6)
Building, Grounds Cleaning and Maintenance Occupations	0	0.0%	20	4.9% (5)	7	1.7% (10)
Production Occupations	0	0.0%	12	2.9% (9)	28	6.8% (3)
Construction and Trade Occupations	0	0.0%	1	0.2% (17)	62	**15.1% (1)**
Transportation and Material Moving Occupations	0	0.0%	3	0.7% (13)	25	6.1% (4)
Left blank/Not employed/Decreased	10	2.4% NA	111	27.0% NA	33	31.80% NA
Note 1: The majority of the occupation categories were derived from the U.S. Department of Labor, Bureau of Labor Statistics, List of Standard Occupational Classifications Occupations						

Evaluation of Hypothesis Testing

This section reports the results of the fourteen hypotheses proposed in the study. For each alternative hypothesis:

- the survey questions to test the hypothesis are stated
- the analytical technique performed is identified
- the determination whether there is sufficient or insufficient evidence to reject the null hypothesis is declared

Finally, a synopsis of all fourteen hypotheses is presented at the end of the section.

Evaluation of Hypothesis 1

H_a1: Girls will be less likely to choose IT as their majors and careers than other disciplines

For this hypothesis, responses to the following three questions were analyzed:

1) Do you expect your college major or minor to be in a computer-related field, such as computer science, web design, information technology, etc? Yes or No (Question 1.9)

2) What do you expect your college major to be? (Fill in the name of your major) (Question 1.10)

3) Please state the career that you are most interested in. (Write in your reply) (Question 2.1)

The participants' responses to these three questions were, in some instances inconsistent or incomplete. For example, one participant responded "Yes" to Question 1.9, did not respond to Question 1.10, however, responded "Technology" to Question 2.1. Consequently, when instances such as these, were encountered, an analysis of the three responses was conducted to establish the participant's intent for a college major and a future career occupation. Furthermore, a new variable was created, Career, to distinguish participants who planned to major in IT and ultimately pursue an IT career. In the Career variable, IT majors were identified as "1" and non-IT majors were identified as "0." Of the 411 participants surveyed, 24 (5.8%) chose IT as their expected college major and future career occupation. The remainder of the 387 participants chose non-IT occupations in 12 other categories. As shown in Table 8, since there were thirteen categories, the null hypothesis maintains that the participants were equally likely to choose IT as a major at 7.7% (100% divided by 13 categories). The one-sample proportion test results were statistically significant with a p-value at <.0001; therefore, the null hypothesis was rejected. Chapter Five addresses the implications of the choice of Information Technology as a career alternative by 5.8% of the participants surveyed.

<u>Evaluation of Hypothesis 2</u>

H_{a2}: A majority of the girls will identify the career choice factors as important; however, only a minority of them will believe that IT jobs have these characteristics.

To evaluate this hypothesis, responses to twenty-two affiliated questions were analyzed. The participants were asked two sets of corresponding questions, which were factors that may influence their career choice and factors that may characterize IT jobs. In the Career Interest section of the survey, the participants were asked to state their planned career occupation followed by 11 factors (Questions 2.2.1 – 2.2.11) that could possibly influence their choice. In this set of questions, the participants were asked whether each factor was completely unimportant, a little important, somewhat important, or very important. For the purposes of this analysis, each career choice factor was aggregated into groups; the responses for very and somewhat were combined, and little and completely unimportant were combined. Later in the survey, the participants were asked a second set of questions (Questions 3.7.1 – 3.7.11) to determine whether they thought these same 11 characteristics were indicative of IT jobs. The second set of questions had a five-point scale to determine if the participants disagreed, slightly disagreed, slightly agreed, agreed, or "did not know" whether the factor was characteristic of IT jobs. The responses for slightly agree and agree were aggregated, as were slightly disagree and disagree. The null hypothesis, H_{o2}, stated a majority of the participants (50% or more) would perceive the factor as important; however, a minority of the participants (50% or less) would agree that the factor is pertinent in IT jobs. A summary of the 11 Career Choice Factors, the 11 IT Job Characteristic Factors, and the response percentages are displayed in Table 9. As shown in Table 9, 74.6% to 95.4% of the participants acknowledged the Career Choice Factors as important, and 56.9% to 86.4% acknowledged that IT jobs have these equivalent characteristics. Thus, since the condition of 50% or less was not observed for the IT Job Characteristic Factors, there is insufficient evidence to reject the null hypothesis. However, there are noteworthy disparities in the Career Choice and the IT Job Characteristic percentages. Four of the 11 factors, work environment, balance work and family, life outside of work, and flexible hours, had differences greater than 30%. A discussion of the disparities depicted in Table 9, the anticipated variations between IT and non-IT majors and the possible implications of these anomalies are addressed in Chapter Five.

Table 9: Participants' Career Choice Factors and IT Job Characteristic Factors

Factors	Career Choice Important Percent	IT Job Characteristic Agree Percent	Absolute Difference
Good Salary	95.4%	76.2%	19.20%
Pleasant Work Environment	95.0%	60.8%	34.20%
Help People	94.9%	73.5%	21.40%
Balance Work & Family	94.2%	62.3%	31.90%
Life Outside Work	92.2%	58.9%	33.30%
Interact w/others	91.7%	67.9%	23.80%
Flexible Hours	91.2%	56.9%	34.30%
Improve community/society	90.5%	70.1%	20.40%
Use Creative Skills	86.8%	86.4%	0.40%
Solve interesting problems	82.0%	82.5%	0.50%
High status/prestige	74.6%	66.4%	8.20%

Evaluation of Hypothesis 3

H_a3: Girls who plan to major in IT will identify different career factors that they feel are important and different factors that characterize IT jobs than girls who do not plan to major in IT.

Five steps were taken to evaluate this hypothesis. First, two sets of logistic regression analyses were performed to describe the relationship between the dichotomous dependent variable, Career, and 22 independent variables. Career, created in hypothesis 1, takes the value "0" for non-IT majors and "1" for IT majors. Second, the 22 independent variables consist of two separate groups discussed in hypothesis 2, Career Choice Factors and IT Job Characteristic Factors. However, for this hypothesis, the factors were not aggregated. As indicated in hypothesis 2, the four possible responses for the 11 Career Choice Factors (Questions 2.2.1 – 2.2.11) were completely unimportant, a little important, somewhat important, or very important. IT Job Characteristics, the second set of factors for this evaluation (Questions 3.7.1 – 3.7.11) had a five-point scale: disagreed, slightly disagreed, slightly agreed, agreed, or "did not know."

Third, both logistic regression analyses were conducted for the Career variable = "1," IT majors. Fourth, each set of factors were analyzed using the backward selection technique. This technique systematically removes the least significant variable from the model until all remaining variables are statistically significant (for this study, p-value $\leq .05$). Fifth, for this hypothesis, the logistics regression analysis was performed twice, once for each set of factors. Thus, each backward selection technique started with 11 factors. If all variables are removed from both logistic regression models, there is no evidence of a significant difference in the response of IT majors and that of non-IT majors as it relates to Career Choice Factors or to IT Job Characteristics. If no variables are removed from the models, the computed results of the logistic regression analyses for this hypothesis consist of two models, one for each set of factors. For those models constructed, the Odds Ratios Estimates for each model are analyzed and discussed. (A detailed description of logistic regression method and the Odds Ratio Estimates was conducted in the Data Analysis Section of Chapter Three, Research Methodology).

The results of the first logistic regression analysis with a backward elimination model selection are displayed in Table 10. (Details of the analysis can be found in Appendix H) As indicated Table 10, the first model was initiated with 11 variables. Nine variables were removed from the model of Career Choice Factors due to insignificant p-values. However, two Career Choice variables were statistically significant: Creativity and Interaction with others.

Table 10: Summary of Logistic Regression - Backward Elimination Model Selection Based on IT Majors and Career Choice Factors and Model Results

Career Choice Factors	Significant p-value <=.05?
Opportunity to improve community or society	No
Solve interesting problems	No
Pleasant work environment	No
Life outside of work	No
Help people	No
Flexible hours	No
High status or prestige	No
Good salary	No
Ability to balance work and family	No
Creativity	**Yes**
Interaction with others	**Yes**

Career Choice Factors	Intercept	Maximum Likelihood Estimates	Odds Ratio Estimates	p-values
Career Choice	-4.7779			
Creativity		1.3253	3.763	.0045
Interaction with others		-.8277	.437	.0061

The Odds Ratio Estimate and p-value in Table 10 were analyzed to indicate the following about the participants and creativity:

> Girls who believe that creative skills are a very important factor (p-value = .0045) in their career decision are 3.76 times more likely to major in IT than girls who do not believe that creative skills are as important. The percent of responses from IT majors and non-IT majors regarding the importance of creativity in their career choices are displayed in Table 11 below.

Table 11: IT and Non-IT Majors' Responses to Importance of Creativity

Creativity is an important factor in career choice	IT majors	Non-IT Majors
Very important	**79.2%**	**54.0%**
Somewhat important	12.5%	32.3%
A little important	8.3%	11.4%
Completely unimportant	0.0%	1.8%
Left blank	0.0%	.5%

The Odds Ratio Estimate and p-value in Table 10 were analyzed to indicate the following about the participants and interaction with others:

> Girls who believe that interaction with others is a very important factor (p-value = .0061) in their career decision are .44 times less likely to major in IT than girls who believe interaction with others is less important. The percent of responses from IT majors and non-IT majors regarding the importance of interaction with others in their career choices are displayed in Table 12 below.

Table 12: IT and Non-IT Majors' Responses to the Importance of Interaction with Others

Interaction with others is an important factor in career choice	**IT majors**	**Non-IT Majors**
Very important	37.5%	**58.7%**
Somewhat important	**54.2%**	33.1%
A little important	4.2%	6.2%
Completely unimportant	4.2%	1.8%
Left blank	0.0%	0.2%

The Intercept and the Maximum Likelihood Estimates shown in Table 10 were analyzed to display the model for Career Choice Factors. The model equation for Career Choice Factors can be written as follows:

Logit (θ_{ic}) = -4.7779 - .8277(InteractionWithOthers) + 1.3253(Creativity)

The results of the second logistic regression analysis are displayed in Table 13. (Details of the analysis can be found in Appendix I) This model was initiated with the second set of 11 variables. Ten variables were removed from the model of IT Job Characteristics due to insignificant p-values. However, one IT Job Characteristic Factor was statistically significant, IT Pleasant Work Environment.

Table 13: Summary of Logistic Regression - Backward Elimination Model Selection Based on IT Majors and IT Job Characteristic Factors and Model Results

IT Job Characteristic Factors	Significant p-value <=.05?
IT Improve Community or Society	No
IT Life outside of work	No
IT Help People	No
IT High Status or Prestige	No
IT Flexible Hours	No
IT Ability to Balance work and family	No
IT Good Salary	No
IT Interesting Problems	No
IT Interaction with others	No
IT Creativity	No
IT Pleasant Work Environment	**Yes**

IT Job Characteristic Factor	Intercept	Maximum Likelihood Estimates	Odds Ratio Estimates	p-value
Pleasant work environment	-4.7977	.4917	1.635	.0375

The Odds Ratio Estimate and p-value in Table 13 was analyzed to indicate the following about the participants and IT Job Characteristic - Pleasant work environment:

> Girls who believe that IT jobs have a pleasant work environment (p-value = .0375) are 1.64 times more likely to major in IT than girls who do not believe that IT jobs have a pleasant work environment. The percent responses from IT majors and non-IT majors regarding the IT work environment are displayed in Table 14 below.

Table 14: IT and Non-IT Majors' Responses to an IT Pleasant Work Environment

Pleasant work environment is characteristic of IT jobs	IT majors	Non-IT Majors
Agree	50.0%	35.1%
Slightly agree	33.3%	24.3%
Slightly disagree	0.0%	9.6%
Disagree	0.0%	2.8%
Don't know	16.7%	27.9%
Left blank	0.0%	.3%

The Intercept and the Maximum Likelihood Estimates shown in Table 13 were analyzed to display the model for IT Job Characteristic Factors. The model equation for IT Job Characteristic can be written as follows:

Logit (θ_p) = -4.7977 + - .4917(ITPleasantWorkEnvironment)

The null hypothesis stated that there are no independent variables in either category, Career Choice or IT Job Characteristic. Thus, the null hypothesis was rejected, and there is evidence to indicate a relationship between the participants who plan to major in IT and three factors in the two groups analyzed, Career Choice and IT Job Characteristics.

<u>Evaluation of Hypothesis 4</u>

H_a4: A majority of girls think IT careers have a primary emphasis in computer programming.

To evaluate this hypothesis, the participants were asked whether they thought careers in computers and technology were primarily programming jobs (Question 3.7.12), which also provided the option to answer “Don’t Know.” “Don’t Know” replies were deleted which resulted in the analysis of 288 of 411 responses. The null hypothesis stated that 50% or less of the participants would think IT careers are primarily programming jobs. A one-sample proportion test was conducted with the results indicating that 85.1% of the 288 participants agreeing that IT careers were primarily programming jobs with a p-value < .0001. Thus, there is evidence to reject the null hypothesis. Moreover, 94.1% of the participants who planned to major in IT thought IT careers were primarily programming jobs compared to 84.5% of the non-IT majors.

Evaluation of Hypothesis 5

H_a5: A majority of girls think all careers in IT require a strong background in mathematics.

To evaluate this hypothesis, the participants were asked whether they thought all careers in IT required a strong background in mathematics (Question 3.7.13). Again, the participants were allowed to respond "Don't Know" which resulted in these responses being deleted from this analysis. Therefore, 298 of the 411 responses were analyzed. The null hypothesis stated that 50% or less of the participants would think IT careers required mathematics. A one-sample proportion test was conducted with the results of 75.8% of the 298 participants agreeing that IT careers require a strong background in mathematics with a p-value < .0001. Thus, there is evidence to reject the null hypothesis. Moreover, 66.7% of the participants considering IT majors thought IT careers required a strong background in mathematics compared to 76.4% of the non-IT majors.

Evaluation of Hypothesis 6

H_a6: ***A majority of girls do not have an accurate perception of what people in the IT field do.***

To evaluate this hypothesis the participants were asked whether they had a good idea about what people in computer-related fields do (Question 3.6.1). The null hypotheses stated that 50% or less of the participants do not have an accurate perception of the IT field. A one-sample proportion test was conducted with the results of 44.7% (183 answered disagree, 226 answered agree, two left the answer blank) of the participants replying that they did not have an accurate perception with a p-value of .9833. Thus, there was insufficient evidence to reject the null hypothesis. The participants think they have an accurate perception of the IT field; however, Chapter Five reveals that many participants identified a lack of knowledge of several IT job characteristics.

<u>Evaluation of Hypothesis 7</u>

H_a7: A majority of girls have a negative image of people who work in IT fields.

There were eight questions on the survey to identify participants' attitudes toward IT workers (Questions 3.3.1 – 3.3.8). The questions were *I think people who choose careers in computers are: 1) Geeks, 2) Interesting, 3) Smart, 4) Loners/antisocial, 5) Likely to be male, 6) Creative, 7) Hardworking, and 8) Obsessed with Computers.* The participants were asked whether they disagree, slightly disagree, slightly agree, or agree with these statements. To test this hypothesis, eight one-sample tests of proportion were conducted. Two sets of null hypotheses were considered. For the attributes interesting, smart, creative, and hardworking, the null hypotheses were that 50% or less of the participants disagreed with these statements. For the attributes geeks, loners/antisocial, likely to be male, and obsessed, the null hypotheses were that 50% or less of the participants agreed with these statements. The results of the eight proportion tests shown in Table 15 indicate that one attribute, obsessed with computers, has a statistically significant p-value of .03; therefore, the null hypothesis was rejected. Consequently, there is evidence to suggest that a majority of the participants surveyed believe IT workers are obsessed with computers. Interestingly, a higher percentage of the participants who plan to major in IT, 66.7%, think IT workers are obsessed with computers than non-IT majors at 53.9%. A more detailed discussion of the participants' image and perception of IT workers are presented in Chapter Five.

Table 15: Summary of Eight Proportion Tests Conducted on the Participants' Attitudes Toward IT Workers

IT worker attribute	Level of Interest	Actual Proportion	p-value
Interesting	Disagree	16.3%	1.00
Smart	Disagree	8.3%	1.00
Creative	Disagree	11.9%	1.00
Hardworking	Disagree	13.4%	1.00
Geeks	Agree	19.0%	1.00
Loners/antisocial	Agree	18.8%	1.00
Likely to be male	Agree	32.1%	1.00
Obsessed	**Agree**	**54.6%**	**.03**

__Evaluation of Hypothesis 8__

H_a8: A majority of girls have computers in their homes with access when they want it; furthermore, they like using computers, and spend a considerable amount of time on them.

H_a8a: Girls have computers in their homes

H_a8b: Girls have access to the computer when they want to use it

H_a8c: Girls like using the computer

H_a8d: Girls spend a considerable amount of time on the computer

The original main hypothesis H_a8 was divided into four components, H_a8a, H_a8b, H_a8c, and H_a8d. Four questions in the survey were analyzed to evaluate the participants' computer use and access. The questions were:

1) Is there a computer in your home (Question 3.2.1)?
2) Do you generally have access to the computer in your home when you want to use it (Question 3.2.2)?
3) Circle the total number of hours you use any computer (for example, home, school, work, library) in an average week: 0-6 hours, 7-14 hours, 15-22 hours, and over 22 hours (Question 3.2.4).
4) Circle one phrase that best describes your feelings about using the computer: I dislike using the computer, using the computer is OK, I like using the computer, and I love using the computer (Question 3.2.5).

Four one-sample proportion tests were performed. The null hypothesis for the questions above is: 50% or less of the participants will have a computer at home, have access to the computer when they want to use it, like or love using the computer and use the computer more than 6 hours a day. As shown in Table 16, the results were highly significant (p-value <.0001) for three of the four questions, computer in home, access to computer, and like/love using computer with the following percentages respectively, 93.4%, 89.0%, and 87.8%. Thus, the null hypothesis can be rejected for H_a8a, H_a8b, and H_a8c. Conversely, the total number of hours used did not result in a significant p-value, and the null hypothesis for H_a8d cannot be rejected.

Table 16: Summary of One-sample Proportion Tests Conducted on Participants' Computer Use and Access

Computer Use and Access	Level of Interest	Actual Proportion	p-value
Computer in home	**Yes**	**93.4%**	**<.0001**
Access to computer	**Yes**	**89.0%**	**<.0001**
Feelings about using computer	**Like/Love**	**87.8%**	**<.0001**
Total number of hours used	More than 6	47.0%	.88

In addition, four two-sample tests of equality of proportions were conducted for the same questions to determine if there was a significant difference in the proportions of the participants who planned to major in IT and the non-IT participants. Table 17 indicates only one of the two-sample test results in a significant difference in the two groups. Substantially fewer IT majors have computers at home, 83.3%, than non-IT participants at 94.1% with a p-value = .04. A discussion of contrasting activities performed on the computer by IT and non-IT majors are presented in Chapter Five.

Table 17: Summary of Two-sample Proportion Tests Conducted on IT and Non-IT Participants' Computer Use and Access

Computer Use and Access	Level of Interest	IT Proportion	Non-IT Proportion	p-value
Computer in Home	**Yes**	**83.3%**	**94.1%**	**.04**
Access to Computer	Yes	87.5%	89.1%	.80
Feelings About Using Computer	Like/Love	91.7%	87.5%	.55
Total Number of hours used	More than 6	54.2%	46.6%	.47

Evaluation of Hypothesis 9

H_a9: ***A majority of girls have not taken and do not plan to take a computer course.***

To evaluate this hypothesis, the participants were asked whether they had already taken or planned to take a computer course in high school (Question 3.1.1). The null hypothesis would be that 50% or less of the participants would not have taken a computer course. A one-sample proportion test was conducted with the results indicating that 27.9% (114 answered no, 295 answered yes, and 2 left the answer blank) of the participants answered no with a p-value of 1.000. Thus, there is insufficient evidence to reject the null hypothesis. Moreover, only 12.5% of IT majors had not taken a computer course as compared to 28.8% of the non-IT majors. A detailed discussion of how the participants felt about the computer courses and the reasons they took the courses is presented in Chapter Five.

Evaluation of Hypothesis 10

H_a10a: *Girls receive* ***little information*** *from parents, teachers, counselors or peers regarding IT careers.*

H_a10b: *Parents, teachers, counselors, or friends* ***do not consider IT as a good career choice*** *for the girls.*

H_a10c: P*arents, teachers, counselors, or peers* ***will not recommend that the girls take a computer course.***

The H_a10 was divided into three components, H_a10a, H_a10b, and H_a10c. Thirteen questions were analyzed to evaluate these hypotheses. The questions are segmented into three main categories:

1) sources where the participants may have obtained IT career information
2) categorically, who would consider an IT career a good career choice for the participants
3) who recommended that the participants take a computer course

For the category regarding career information, the participants were asked to respond to seven questions (Questions 3.5.1 - 3.5.7) on how often the following people: mothers, fathers, teachers, counselors, male friends, female friends, and other family members discussed IT career options with them. The participants could respond: never, once or twice, several times or many times. For this hypothesis, a logistic regression analysis was conducted. A logistics regression backward elimination model selection was performed to determine if a relationship exists and a model can be derived from any of the seven sources and the career variable that identifies if the participants plan to major in IT. The null hypothesis for H_a10a would indicate a positive relationship from one of the sources of IT career information. As shown in Table 18, the model began with seven variables and ended with one source, mother/female guardian, which resulted in a significant p-value of .0022 (Details of the analysis can be found in Appendix J).

Table 18: Summary of Logistic Regression - Backward Elimination Model Selection Based on IT Majors with Sources of IT Career Information and Model Results

Sources of Information on IT Careers	Significant p-value <=.05?
SourceTeacher	No
SourceFemale friends	No
SourceCounselor	No
SourceOther family members	No
SourceMale friends	No
SourceFather	No
SourceMother	Yes

Sources of Information on IT Careers	Intercept	Maximum Likelihood Estimates	Odds Ratio Estimates	p-value
SourceMother	-4.1594	0.6098	1.840	0.0022

Upon examining the odds ratio and the p-value, one can predict: Participants who receive IT career information from their mother/female guardian (p-value = .0022) are 1.84 times more likely to major in IT than participants who do not receive IT career information from their mother/female guardian. Additionally, the model equation for Source of IT information can be written as follows:

Logit (θ_s) = -4.1594 + .6098(SourceMother)

Thus, the null hypothesis for H_a10a cannot be rejected.

The second category included three questions (Questions 3.6.6 - 3.6.8) regarding the participants beliefs of whether the following groups (teachers/counselors, parents, and friends) would regard an IT career as a good choice for them. For this category, three groups were analyzed - parents, teachers/counselors, and friends - to determine if one of the groups would consider an IT career as a good choice for the participants. A logistic regression - backward elimination model selection analysis was conducted for this hypothesis. The null hypothesis for H_a10b would be a positive relationship between one of the groups and the career variable that identifies if the participants plan to major in IT. Table 19 illustrates the result of one group, parents, with a significant p-value of < .0001 (Details of the analysis can be found in Appendix K).

Table 19: Summary of Logistic Regression - Backward Elimination Model Selection Based on IT Majors with Groups that Might Consider IT as a Good Career Choice and Model Results

IT as a good career choice	Significant p-value <=.05?
Teachers/counselors	No
Friends	No
Parents	**Yes**

IT as a good career choice	Intercept	Maximum Likelihood Estimates	Odds Ratio Estimates	p-value
Parents	-6.3575	1.2188	3.383	<.0001

Upon examining the Odds Ratio Estimate and the p-value, the following prediction can be stated: Participants who feel their parents would consider IT as a good career choice for them (p-value < .0001) are 3.383 times more likely to major in IT than participants who do not feel that their parents would consider IT as a good career for them. The model equation for Source of IT information can be written as follows:

Logit (θ_s) = -6.3575 + 1.2188 (Parents)

Thus, the null hypothesis for H_a10b cannot be rejected.

The third and final category included three questions (Questions 3.1.2.4, 3.1.2.5, 3.1.2.8). This category allowed the participants to indicate multiple reasons why they took a computer course; included in those reasons were recommended by teachers/counselors, recommended by parents, and recommended by friends. For this category, the survey responses were analyzed to determine if a specific group would recommend that the participants take a computer course. Two hundred and ninety-five participants had taken a computer course. There were eight selections the participants could choose to explain why they took a computer course. The null hypothesis for H_a10c would be a positive relationship between one of the groups who would recommend a computer course to the participants and the career variable. Table 20 summarizes the results of the logistic regression backward elimination analysis and indicates that no group shows evidence of a significant relationship (Details of the analysis can be found in Appendix L). Thus, the result of this test indicates the probability of an insignificant relationship between one of these groups recommending a computer course and the career variable. Therefore, there is evidence to reject the null hypothesis for H_a10c.

Table 20: Summary of Logistic Regression - Backward Elimination Model Selection Based on IT Majors and Groups that Might Recommend Participants to Take Computer Courses

Recommended taking a computer course	Significant <=.05? (p-value)
Parents	No
Friends	No
Teachers/counselors	No

The study found no support for teachers, counselors, and friends for IT career information, encouragement in choice of IT career, and recommendation of computer courses; however, the study did observe that parents' encouragement could influence participants' IT career choice and mothers are a source of IT career information. A detailed discussion on girls and encouragement in IT careers and the implications to majoring in IT are discussed in Chapter Five.

Evaluation of Hypothesis 11

H_a11: A majority of girls do not have access to role models or family/friends who work in IT.

To evaluate this hypothesis, two factors were analyzed. The participants were asked two questions:

1) whether the participants had family and/or friends who work in a computer-related job (Question 3.6.9)

2) whether they know someone in the IT industry that could be a role model for them (Question 3.6.4).

The null hypothesis to analyze both questions would be 50% or less of the participants will not have family or friends who work in the IT industry and will not be role models. Two one-sample proportion tests were conducted. The results shown in Table 21 indicate that neither test has a significant p-value. Therefore, there is insufficient evidence to reject the null hypothesis.

Table 21: Summary of Proportion Tests Conducted on Participants' Access to Family and Friends Who Work in IT and Role Models

	Level of Interest	Actual Proportion	p-value
Access to family/friends who work in IT	Disagree	40.3%	1.000
Access to IT role models	Disagree	47.4%	.8505

<u>Evaluation of Hypothesis 12</u>

H_a12: ***A majority of girls feel uncomfortable in considering a male-dominated occupation.***

To evaluate this hypothesis, the participants were asked whether they would be comfortable working in a male-dominated occupation (Question 3.6.5). The null hypothesis would be that 50% or less of the participants would feel uncomfortable. A one-sample proportion test was conducted with the results of 36.7% (150 answered no, 258 answered yes, 3 left the answer blank) of the participants answering yes; thus, there is insufficient evidence (p-value = 1.000) to reject the null hypothesis.

Evaluation of Hypothesis 13

H_a13: Girls will not identify stereotypes or gender bias as reasons why they dislike computers, computer courses or IT careers.

In addition to hypothesis seven, where the participants were asked their perception of people who work in IT, this hypothesis addresses whether participants identify stereotypes or gender-biases in four open-ended questions. A stereotype is described as an assumed generalization of a characteristic or imposed image of a group's culture, habits, or beliefs (Merriam-Webster, 2006). Stereotypes portray ideas about a person based solely on being a member of that group and can be beneficial or harmful. This research study addresses stereotypes of workers in the IT field or characteristics of the IT profession. Gender bias in this study is defined as discrimination or prejudice of one sex over the other in reference to computer use, computer access, inequity in the computer classroom, and knowledge of or encouragement in IT careers (An Educator's Guide to Gender Bias Issues, 1999). Four open-ended questions were analyzed to evaluate this hypothesis. The questions were:

1) Explain your answer to the question that best describes how you felt about your computer course (Question 3.1.4).
2) If you do not have access to the computer when you want it, explain what limits your access (Question 3.2.3).
3) Explain your answer to the question that best describes your feelings about using the computer (Question 3.2.6).
4) What do you see are the disadvantages of working in a computer or technology related field (Question 3.4.2)?

The participants did not identify gender biases or stereotypes for open-ended Questions 3.1.4, 3.2.3, or 3.2.6. However, gender and stereotypes were identified in Question 3.4.2. For this question, participants listed their perceptions of the disadvantages of working in the IT field. The summary of the potential stereotypes for this question are displayed in Table 22. The participants revealed several common stereotypical disadvantages of working in the IT field such as:

- the perception of being considered a nerd or geek
- the idea that IT workers are obsessed with computers
- the IT field is boring and does not involve working with other people

In addition, numerous other responses refer to the stereotype of IT professionals as working late nights and long hours. Participants stated the following disadvantages of IT careers: time-consuming, no time for a social life, and inability to balance family and work. Furthermore, two participants stated a gender bias where women might be concerned with working in a male-dominated environment.

The null hypothesis would be that girls will identify stereotypes or gender bias as reasons for disliking computers, computer courses or IT careers. As shown in Table 22, the participants declared 207 potential stereotypical statements regarding disadvantages of working in the IT field. Thus, there is insufficient evidence to reject the null hypothesis. A discussion regarding the implications and possible origins of the stereotypes and gender biases and a thorough review of the six open-ended questions is presented in Chapter Five.

Table 22: Summary of Possible Stereotypes and Disadvantages of IT Careers from the Participants' Perspective

	IT Majors (24)	Non-IT Majors (387)	Total (411)	Percent Of Participants
Boring/No fun	1	39	40	9.7%
No interaction with others, mainly work by yourself	0	39	39	9.5%
Becoming obsessed/addicted	5	32	37	9.0%
Time consuming/long hours	0	33	33	8.0%
No life/no social life	3	22	25	6.1%
Hard, difficult, complicated	0	21	21	5.1%
No diversity in job	0	15	15	3.6%
Problem getting or keeping job – reasons were too competitive, little demand, outsourcing	0	10	10	2.4%
Have to deal with stereotypes – terms such as dorks, geeks, nerds	0	8	8	1.9%
Male-dominated	0	3	3	.7%
Have to be smart	0	2	2	.5%
Need to know math	0	2	2	.5%
Not enough time to balance work and family	0	2	2	.5%

Evaluation of Hypothesis 14

H_a14: A majority of girls feel they have the ability to be successful in IT careers.

To evaluate this hypothesis, the participants were asked: if they chose an IT career, would they have the ability to be successful (Question 3.6.3). The null hypothesis would be that 50% or less of the participants would think they would be successful in IT careers. A one-sample proportion test was conducted with the results of 76.8% of the participants answered they agreed that they would be successful in an IT career with a p-value < .0001. Thus, the null hypothesis was rejected.

Furthermore, a two-sample test of equality of proportions was conducted for the same question to determine whether there was a significant difference in the proportions of IT and non-IT majors. The results indicate that the proportion of IT majors who believe they will be successful in IT careers was 95.8%, which is substantially more than the proportion of non-IT majors at 75.6% with a p-value = .02. The participants' perception of their ability to be successful in IT careers is discussed in Chapter Five.

Summary of Hypotheses

This chapter has documented the results of the fourteen hypotheses tested for this research study. Table 23 summarizes the results of the hypothesis tests completed. Additionally, the seven highlighted hypotheses indicate when the null hypotheses were rejected. The results suggest seven key findings:

1) fewer participants chose IT as a major than many other disciplines
2) participants who plan to major in IT identified three career factors that are different than non-IT majors, creative skills, interaction with others, and IT work environment
3) many participants feel that IT jobs are primarily programming and require strong math skills
4) many participants have a computer at home, have access when they want to, and like using it
5) parents may play an important role in participants choosing IT careers
6) many participants believe that IT professionals are obsessed with computers
7) many participants feel confident in their ability to be successful if they chose an IT career.

Table 23: Summary of Hypothesis Testing

Hypothesis	# Questions analyzed	H_o Result	Variables of Interest	p-value
H1 - Girls will be less likely to choose IT as their major than other disciplines	**1**	**Reject Null**	**Career**	**<.0001**
H2 - A majority of the girls will identify the career choice factors as important; however, only a minority of them will believe that IT jobs have these characteristics.	**22**	**Cannot Reject Null**		
H3 - Girls who plan to major in IT will identify different career factors that they feel are important and different factors that characterize IT jobs than girls who do not plan to major in IT.	**22**	**Reject Null**	**Creative skills Interact with others IT Work environment**	**.0045 .0061 .0375**
H4 - Girls think IT careers have a primary emphasis in computer programming.	**1**	**Reject Null**	**Primarily programming**	**<.0001**
H5 - Girls think all careers in IT require a strong background in mathematics.	**1**	**Reject Null**	**Requires mathematics**	**<.0001**
H6 - Girls do not have an accurate perception of the IT field.	14	Cannot Reject Null		
H7 - Girls have a negative image of people who work in IT fields.	**8**	**Reject Null**	**Obsessed with Computers**	**.03**
H8 - Girls do have computers in their homes with access when they want it; they like using computers and spend a considerable amount of time on them.	4	Cannot Reject Null for number of hours	Computer in Home Access to Computer Feeling about computer Number of hours	<.0001 <.0001 <.0001 .88
H9 - Girls have not taken and do not plan to take a computer course.	1	Cannot Reject Null		
H10 - Girls receive little encouragement from parents, teachers, counselors, or peers regarding IT careers.	13	Cannot Reject Null for parents	IT Career Source Mother Good Career Choice -Parents	0.0022 <.0001
H11 - Girls do not have access to role models or family/friends who work in IT.	2	Cannot Reject Null		
H12 - Girls feel uncomfortable in considering a male-dominated occupation.	1	Cannot Reject Null		
H13 - Girls do not identify stereotypes or gender bias as reasons why they dislike computers, computer courses or IT careers.	6	Cannot Reject Null		
H14- Girls will feel they have the ability to be successful in an IT career.	**1**	**Reject Null**	**Ability to be successful in IT**	**<.0001**

Chapter Five reveals the in-depth implications of the hypotheses results and depicts how the results effect the Stage I model developed earlier in this study. Thus, Chapter Five presents the transformation of the original model. The original model, created from previous literature, is reconstructed based on the results of the survey. The reconstructed model is grounded in research literature and validated in the “real world” view of high school girls’ attitudes, perceptions, and interests in computers and IT careers.

Chapter Five: Data Analysis and Discussion

Discussion of Results

The results of fourteen hypotheses tests discussed in Chapter Four have revealed several significant findings. The first section of this chapter addresses the participants' career occupations and the disparities between participants who planned to major in IT and non-IT majors. The second section presents a new framework, the Pre-College IT Career model. The third section describes four types of barriers examined in this study, which are identified as:

1) Known - identified through prior literature and recognized as significant by the participants
2) Unknown - factors unfamiliar to the participants
3) New - factors identified by the participants and not pervasive in current literature
4) Removed - factors originally proposed as barriers in prior literature; however, subsequently, unrecognized as barriers by the participants and removed.

The fourth section indicates potential factors that can be used as enablers to attract girls to the IT field. These enablers were combined to establish a new model, the IT Career Enabler model. The fifth section introduces the discussion of a second new model, the IT Career Predictor. The IT Career Predictor model consists of explanatory variables to assist in predicting the probability of participants to majoring in IT. Later, Chapter Six concludes with the presentation of the Pre-College IT Career model framework and provides a synopsis of the three models, reconstructed Barrier, IT Career Enabler, and IT Career Predictor. Chapter Six also summarizes the goals of each model, and suggests implementation strategies to support those goals.

Participants' Career Occupations

The principal premise of this research is that participants are less likely to choose IT as their majors and careers than other disciplines. As noted in Chapter Four, Hypothesis 1, there was evidence to support the disproportionately low interest of participants in IT careers. In this study, only 24 participants (5.8%) plan to major in IT compared to 387 participants (94.2%) who plan to major in other disciplines.

To understand the inequality of IT versus non-IT majors, the career goals of the participants must be compared to last year's 2006 graduating class. In addition, of greater importance, this study's career distribution must be compared to the occupational needs of the future workforce. Table 24 displays a side-by-side comparison of the number and percentage of the participants in this study to the distribution reported by the United States 2014 occupational employment growth projections (Hecker, 2005), and the 2006 graduating high school students who took the ACT college admission exam.

Table 24: Distribution of Participants Planned Occupations, ACT Class of 2006 Planned Majors and Projected Occupation Growth by 2014

Career Occupation Category[1]	Participants Planned Occupations	Percent of Participants Occupations	ACT 2006 Planned Majors	Percent of ACT 2006 Planned Majors	Projected Occupation Growth by 2014	Percent of Occupation Growth by 2014
Healthcare practitioner and technical	127	30.9%	184,912	21.9%	1,756,000	13.7%
Management, business, and financial	52	12.7%	120,328	14.3%	2,155,000	16.8%
Arts, design, sports entertainment, and media	50	12.2%	58,634	6.9%	375,000	2.9%
Life, Physical and Social Science	37	9.0%	129,804	15.4%	216,000	1.7%

Career Occupation Category[1]	Participants Planned Occupations	Percent of Participants Occupations	ACT 2006 Planned Majors	Percent of ACT 2006 Planned Majors	Projected Occupation Growth by 2014	Percent of Occupation Growth by 2014
Education, Training and Library	28	6.8%	70,727	8.4%	1,740,000	13.6%
Protective Service	28	6.8%	28,422	3.4%	440,000	3.4%
Computer and IT	**24**	**5.8%**	**23,426**	**2.8%**	**957,000**	**7.5%**
Legal	19	4.6%	Combined in Social Science	Combined in Social Science	194,000	1.5%
Food Preparation and serving related	11	2.7%	Combined in community and social services	Combined in community and social services	1,714,000	13.4%
Personal care and service	11	2.7%	Combined in community and social services	Combined in community and social services	991,000	7.7%
Architecture and engineering	9	2.2%	90,227	10.7%	315,000	2.5%
Community and Social Services	3	.7%	17,047	2.0%	483,000	3.8%
Sales and Related	2	.5%	7,960	0.9%	1,476,000	11.5%
Undecided	10	2.4%	112,151	13.3%	NA	
Total	411		843,638		12,812,000	
Note 1: The majority of the occupation categories were derived from the U.S. Department of Labor, Bureau of Labor statistics, list of Standard Occupational Classifications Occupations. Not all occupational categories are included in this table. ACT data derived from ACT Planned Educational majors Class 0f 2006. Projected Growth Data from U.S. Department of Labor, Bureau of Labor statistics						

Several activities were performed to develop Table 24. First, the U.S. Bureau of Labor Statistics list of Standard Occupational Classifications was employed as the foundation for the majority of the career occupation categories. Second, not all career occupational categories were included in Table 24. Only the 13 career categories chosen by the participants were used to gather the information for the ACT 2006 Planned Majors information and the Projected Occupation Growth information. For example, none of the participants chose a career in Office and Administrative Support; therefore, this category and the corresponding totals are not included in Table 24. Third, the actual numbers from the specific career occupational categories are the same as the source documents. However, since the total numbers in Table 24 are different from the source documents, the percentages are different. As a result, the totals and the percentages presented in Table 24 consist of only the 13 occupational categories and the undecided category declared by the participants of this study. Fourth, one other distinction should be noted: the participants for this study were all females. The other two groups, the ACT 2006 Planned Majors and the Projected Occupational Growth, include females and males.

Of the 24 participants who planned to major in IT, 15 were seniors and nine were juniors resulting in 3.6% of the total participants (15/411) are members in the class of 2006 and planned to major in IT. Interestingly, the 3.6% represents females only and is slightly higher than the 2.8% reported for IT careers in the ACT Class of 2006, which represents males and females as shown in Table 24. Since the 2.8% in the ACT Class of 2006 represents males and females, it was anticipated that the current study would have even a smaller percentage of participants interested in IT careers. Perhaps, due to the purpose of this research, the survey attracted participants who had a stronger interest in computers. As reported in Chapter Two, there has been a steady decline of girls majoring in IT over the past two decades. Further, even more discerning, the 2006 ACT report states, "Over the past five years, the percentage of ACT-tested students who said they were interested in majoring in computer and information science has dropped steadily from 4.5 percent to 2.9 percent" (ACT, 2006, page 2). The ACT report also states that this decline is at a time when our country needs our best and our most talented students to major in the STEM disciplines. The class of 2006 will enter the IT work force in 2010 or 2011. Therefore, if our future generations continue to maintain a dearth interest in IT careers, the 7.5% occupation growth of 957,000 new jobs by 2014, as displayed in Table 24, will not be achieved. For our nation to reinvigorate the interest of women in the IT field, it is essential for females in the high school graduating classes of 2007 – 2009 to reverse this downward spiral of women in IT careers.

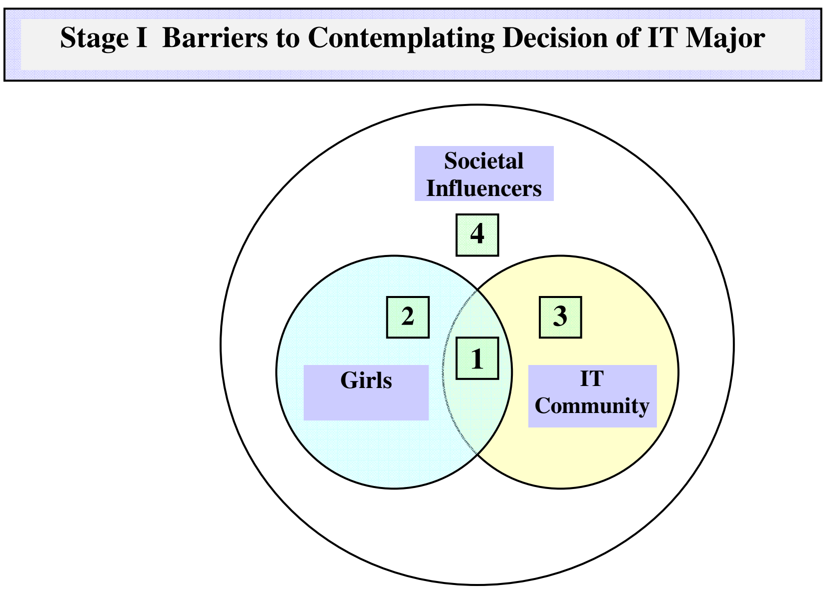
Conversely, girls' interest in the healthcare industry appears to be vigorous. In this study, 127 participants chose healthcare practitioner and technical occupations of which 58 planned to be nurses, 39 doctors/dentists/pharmacists, 15 physical therapists, and 15 healthcare technicians. There were 59 seniors (14.4%) and 68 juniors (16.5%) who expect to choose careers in the healthcare industry. Our participants who are seniors and plan to choose the healthcare industry (16.5%) is lower than the percentage of ACT 2006 planned healthcare workers at (21.9%), yet slightly higher than the projected growth at (13.7%). Overall, girls' interest in healthcare occupations looks promising for the future healthcare workforce. Clearly, both IT and Healthcare occupations are challenging fields. Both require rigorous education. Both fields are STEM disciplines. Additionally, both industries, IT and healthcare, have large numbers of expected growth by 2014, nearly 1 million, and 1.8 million respectively. Yet, the question remains as to why the participants are choosing healthcare occupations over IT careers. Frances Allen, the first woman to win the A.M. Turing award, believes that girls with strong math and science skills are attracted to the healthcare industry because it is perceived as providing, "more social good" (McGee, 2007). Allen states that she hopes that fields like bioinformatics with its technological role in medical research will attract more women to the IT field. The IT career enabler of more social good through helping others and improving society is presented later in this chapter.

The Healthcare industry ranked as the top career occupational category in this study. However, five additional categories were ranked above Computer and IT careers. The top rankings were: 1) Healthcare, 2) Management, Business, and Financial, 3) Arts, Design, Sports, Entertainment and Media, 4) Life, Physical and Social Science, 5) Education, Training, and Library, and 6) Protective Services. Surprisingly, three of these career occupational categories, 1) Arts, Design, Sports, Entertainment and Media, 2) Life, Physical and Social Science, and 3) Protective Services, had higher career occupation percentages reported by the participants at 12.2%, 9.0% and 6.8% respectively, than their corresponding growth rates at 2.9%, 1.7% and 3.4%. Additionally, in the same three categories, ACT 2006 survey participants had higher planned career occupation percentages at 6.9%, 15.4%, and 3.4% than the aforementioned corresponding growth rates. Therefore, a disproportionately high percentage of the next future generation may choose careers where growth rates are not as optimistic, instead of the promising growth rate projected in IT careers. As discussed in Chapter One, IT careers consist of six out of the 30 projected fastest growing occupations in the United States from 2004-2014, as well as an overall growth rate of 7.5%. Furthermore, additional demand for IT jobs is projected to begin in 2011, due to the retirement of IT baby boomers (SIM, 2006). If the future generations' plan to choose other non-high demand careers at a time when the nation's technological innovation and advancement are threatened by an IT workforce shortage, a supply and demand "disconnection" will exist. In this chapter, the reasons the participants chose their careers and the factors that influence their career decisions are presented. Thus, the participants provide insight on the divergence of their career interests.

A New Framework – Pre-College IT Career model

The Stage I model, presented earlier in Chapter Two, was developed from previous research to focus on barriers that female junior and senior high school students may have encountered concerning IT careers. (The Stage I model is reiterated below in Figure 4, for ease of reference).

Figure 4: Stage I Model



Intersection	Barriers
1	*Negative perception of Information Technology (IT) careers*
1	*Negative image of people who work in IT fields*
1	*Perception that all IT careers are programming*
1	*Perception that all IT careers require strong mathematical background*
1	*Lack of knowledge of IT careers*
2	*Lack of confidence in IT skills*
2	*Lack of early exposure to computers*
3	*Lack of sufficient IT role models*
3	*IT is a male dominated environment*
4	*Stereotypes and gender biases*
4	*Lack of parental encouragement of IT careers*
4	*Lack of teacher encouragement of IT careers*
4	*Lack of counselor encouragement of IT careers*
4	*Lack of peer encouragement*

During the analysis and evaluation of the original fourteen barriers in Chapter Four, some barriers' testing results were significant and prominent, while other results had insufficient evidence to derive a conclusion. Alternatively, other results were clearly not recognized as barriers by the participants. Some barriers were reclassified as enablers and others as predictors. Still other factors were recognized as having the potential to be classified in more than one way, barriers, enablers, or predictors. This chapter presents the redeployment of these factors from the original Stage I model to other models. As a result, the original Stage I model of barriers, shown in Figure 2, has been updated as a new reconstructed Barrier model. Further, two new models were developed, IT Career Enabler and IT Career Predictor, to create a new framework incorporating all three models in the Pre-College IT Career model.

Additionally, there are five redeployment strategies implemented in this study. Depending upon the results of the analysis, the original barrier in the Stage I model could be redeployed as follows:

1) Incorporated into the Reconstructed Barrier model
2) Moved to the IT Career Enabler model
3) Moved to the IT Career Predictor model
4) Included in any combination of the three models
5) Removed completely from the Stage I framework

Throughout this chapter, the goals of the three models are established and the factors reassigned to the appropriate models.

Barriers

Fourteen barriers were originally proposed in the Stage I Barriers to Contemplating Decision of IT Major model (Figure 2). The purpose of this research was to validate the Stage I barriers and to identify new barriers. The next four sections in this chapter present the original proposed barriers in the following categories, Known Barriers, Unknown Barriers, New Barriers, and factors not recognized as barriers by the participants. Known Barriers were incorporated into the reconstructed Barrier model. Unknown barriers were also incorporated into the reconstructed Barrier model; however, they were also placed in a new, specialized Unknown category. New barriers were added to the reconstructed Barrier model. Finally, barriers unrecognized by the participants were moved to Stage II, the college experience and remained potential barriers at another level.

Known Barriers

In this study, Known Barriers are obstacles that females may have encountered in their pursuit of an IT career that are grounded in research literature and validated in the "real world" view of the participants' perceptions. As discussed in Chapter Four, Hypothesis 13, Known Barriers may be realities due to the nature of the IT field or stereotypes. Three prominent Known Barriers are presented in the next several sections: interaction with others, work environment, and the perception of IT workers as being obsessed with computers.

Interaction with others

A significant difference was observed between IT and non-IT majors in their perception of interacting with others in their future careers. Perhaps the difference is not whether it is important in their careers, but to what degree it is important. As illustrated earlier in Chapter

Four, Table 12, the majority of non-IT majors (58.7%) feel it is very important to interact with others in their careers as compared to IT majors (37.5%). Conversely, for the same question, the majority of IT majors (54.2%) feel interaction with others is somewhat important as compared to non-IT majors (33.1%). Surprisingly, it was observed that, when aggregated, the very and somewhat important responses for IT majors was 91.7%, almost equivalent to the aggregation for non-IT majors at 91.8%.

However, it is not surprising that the majority of the non-IT majors reported interaction with others as a very important factor in their career decision due to the people-intensive careers that they have chosen. As mentioned earlier, the participants chose six other career occupation categories more often than IT careers. The examination of one of these six categories and the nature of the work as described in the US Department of Labor Occupational Outlook Handbook provides possible insight on the differences in career occupational requirements and intensity of interacting with people.

Healthcare careers were the most prevalent occupations chosen by 127 of the 411 participants (30.9%). Of the healthcare careers, 58 participants chose nursing as their future occupations. The first sentence in the Occupational Outlook Handbook (United States Department of Labor, 2006) describes the nature of work for registered nurses in terms of their interaction with multiple groups of people, including patients, patients' family, and the public. Additionally, the level of interaction is extremely engaging, sometimes intense, and often very personal. The first sentence in the Handbook is as follows:

> "Registered nurses, regardless of specialty or work setting, perform basic duties that include treating patients, educating patients, and the public about

various medical conditions, providing advice and emotional support to patients' family members" (United States Department of Labor, 2006).

Thus, it is conceivable that nurses and other healthcare practitioners report a higher level of interaction with others than do IT professionals.

Throughout the survey responses, IT and non-IT majors continued to differentiate their perspective of interacting with others in their future career aspirations. As described in Chapter Three, six open-ended responses in the survey were analyzed, coded, and summarized. Table 25 depicts a summary of the open-ended questions regarding the participants' explanation for their career choice. Interaction with others was the highest ranked explanation for non-IT majors. Conversely, interaction with others was in a three-way tie for fifth place for IT majors.

Table 25: Reasons to Explain Career Interest

Career Choice Reasons	IT Majors (24)		Non-IT Majors (387)		Total (411)	
	Number	Percent (Rank)	Number	Percent (Rank)	Number	Percent
Like to work with computers	11	45.8% (1)	4	1.0% (11)	15	3.6%
Interaction with others	2	8.3% (5-7)	160	41.3% (1)	162	39.4%
Help others	1	4.2% (8-10)	131	33.8% (2)	132	32.1%
Creative	7	29.2% (2)	32	8.3% (7)	39	9.5%
Good at/believe will be good at	3	12.5% (3-4)	46	11.9% (4)	49	11.9%
Always wanted to be	0	0.0% (11)	45	11.6% (5)	45	10.9%
New things	3	12.5% (3-4)	13	3.4% (9)	16	3.9%
Enjoy/good working environment	1	4.2% (8-10)	49	12.7% (3)	50	12.2%
Good pay	1	4.2% (8-10)	36	9.3% (6)	37	9.0%

Career Choice Reasons	IT Majors (24)		Non-IT Majors (387)		Total (411)	
	Number	Percent (Rank)	Number	Percent (Rank)	Number	Percent
Took class and got interested in	2	8.3% (5-7)	7	1.8% (10)	9	2.2%
Improve community/society	2	8.3% (5-7)	20	5.2% (8)	22	5.3%

A participant who plans to major in business with a concentration in marketing management acknowledged, *"Everyone told me that it suited my personality. I know how to appeal to people. Good with relations/communications. Good pay. Enjoy working with others towards a central goal."* Another participant who plans to major in business stated, *"I like to be busy. I like to work on computers and assist other people."* An interesting observation is both of these statements would also be appropriate if declared by an IT systems analyst or project manager.

Further, to substantiate the different views of IT and non-IT majors on their perception of interaction with others, this study examined how each group perceived interaction with others as a characteristic of IT careers. Table 26 illustrates that more IT majors (87.4%) feel that interaction with others is characteristic of IT careers than non-IT majors (66.7%). Many non-IT majors (27.6%) are convinced that IT jobs have little or no interaction with people.

Table 26: IT Majors and Non-IT Majors' Responses on Interaction with Others as a Characteristic of IT Careers

Interaction with Others as a Characteristic of IT Careers	IT Majors	Non-IT Majors
Agree	87.4%	66.7%
Disagree	8.4%	27.6%
Don't know	4.2%	5.7%

Furthermore, as observed in Table 27, 39 non-IT majors reported no/little interaction with others as a key disadvantage to IT careers. One non-IT major acknowledged, *"There may not be as much human interaction."* A second non-IT major stated, "*The disadvantages I believe are that you don't get to interact with people."* In addition, a third non-IT major stated, "*You're inside a lot. Not really going out or being around people a lot. And I love being around people."* Finally, a fourth non-IT major declared, "*Less interaction with people; career is dependent on a machine."* In contrast to non-IT majors, no IT majors reported lack of interaction with others as a disadvantage.

Table 27: Summary of Participants' Perspectives of Disadvantages of IT Careers

Disadvantages of IT careers	IT Majors Percent and Ranking		Non-IT Majors Percent and Ranking		Total	
Physical health problems	2	8.3% (5)	67	17.3% (1)	69	16.8%
Technical/computer problems	6	25.0% (1)	58	15.0% (2)	64	15.6%
Sitting at desk all the time, little physical movement	4	16.6% (3)	45	11.6% (3)	49	11.9%
Boring/no fun	1	4.2% (6-11)	39	10.1% (4)	40	9.7%
No/little interaction with others	0	0.0%	39	10.1% (5)	39	9.5%
Obsessed/addicting	5	20.8% (2)	32	8.3% (7)	37	9.0%
Time consuming/long hours	0	0.0%	33	8.5% (6)	33	7.3%
No life/no social life	3	12.5% (4)	22	5.7% (8)	25	6.1%
Hard/difficult/complicated	0	0.0%	21	4.9% (9)	21	5.1%
No diversity in the job	0	0.0%	15	3.9%	15	3.6%
Technology is always changing, have to keep current	1	4.2% (6-11)	11	2.8%	12	2.9%
Stressful	1	4.2% (6-11)	10	2.6%	11	2.7%
Problem getting or keeping job	0	0.0%	10	2.6%	10	2.4%

Disadvantages of IT careers	IT Majors Percent and Ranking		Non-IT Majors Percent and Ranking		Total	
Frustrating/aggravating/confusing	0	0.0%	10	2.6%	10	2.4%
Have to deal with stereotypes – dorks, geeks, nerds	0	0.0%	8	2.1%	8	1.9%
Expensive to keep computer up-to-date	1	4.2% (6-11)	6	1.5%	7	1.7%
Male-dominated	0	0.0%	3	.8%	3	.7%
Have to be smart	0	0.0%	2	.5%	2	.5%
Need to know lots of math	0	0.0%	2	.5%	2	.5%
Not enough time to balance work and family	0	0.0%	2	.5%	2	.5%

IT majors were not consistent in their views on interaction with others. When asked directly, the vast majority reported interaction with others as important (91.7%) and declare the opportunity to interact with others does exist in IT careers (87.4%). However, when asked to elaborate in open-ended questions, responses to the importance or existence of interaction with others were minuscule as compared to those of non-IT majors. As depicted earlier in Table 25, 8.3 % of the IT majors reported interaction with people as an explanation for their career choice as compared to 41.3% non-IT majors. Additionally, no IT majors acknowledged communicating or interacting with others as part of their description of advantages of IT careers. In contrast, although relatively small, 12 non-IT majors (3.1%) mentioned interaction with people in their description of advantages of IT careers. An interesting observation was five non-IT majors (1.3%) stated no/little interaction with people as an advantage of IT careers. In listing her perception of advantages to working in the IT field, a participant who was a non-IT major declared, *"The salary is high. Not a lot of people interaction. It's a vast field. There are many jobs available."*

The perception of IT careers as solitary jobs with little or no interaction with people, only the computer, continues to be a barrier for non-IT and IT majors. Regardless of the career, interaction with others was identified as an important factor for the participants. However, due to the different requirements of the job, participants may acknowledge a different level of importance and intensity for interaction with others in their careers. It is understandable that a nurse, psychologist, or teacher may feel interaction with others is more important than a systems analyst does. Yet, whether the level is very or somewhat important, an interesting observation, was that IT majors consciously (when asked directly), felt that interaction with others was a significant aspect of their careers. However, very few IT majors acknowledged interacting with people in their explanations of why they chose their careers or advantages of their field. Thus, there is a question regarding what is occurring subconsciously. Furthermore, numerous non-IT majors strongly affirmed that they do not believe IT careers involve working with other people. The results of this research suggest the perception of a lack of interaction with people is still a major barrier to attracting girls/women to IT careers. Therefore, interaction with others should be incorporated in the Reconstructed Barrier model.

Surprisingly, the perception of a lack of interaction with others in IT careers prevails, while numerous employers seek well-rounded IT professionals who possess a blend of technical and business skills. For instance, employers want to hire IT professionals with technical experience as well as knowledge of skills such as interpersonal, communication, team building, user relationship management, and project management. The Report to Congress from the Secretary of Commerce states, "that employers have placed an increasing emphasis on IT workers' business skills and soft skills, such as the ability to communicate effectively and to work in a collaborative environment" (Evans, 2003, p. 48). The Information Technology Association of America (ITAA) conducts a survey every year to monitor and communicate the market condition and work environment of IT employers and employees (ITAA, 2004). For the 2004 ITAA annual report, IT hiring managers of 500 companies were contacted to participate in telephone interviews. In reference to business skills, the report cited, “interpersonal skills was the highest rated non-technology skill in this year’s survey. Fifty-two percent of the respondents cited this attribute, far more than any other (p. 18).”

To eradicate the image of solitary IT careers, academia should communicate and educate. University faculty members should collaborate with the K-12 educational administrators and IT practitioners to develop outreach material to illustrate examples of IT professionals working with their business colleagues in developing technology solutions. IT professionals and academics need to leave their desks and classrooms, visit high schools, attend career days, and become advocates of the IT profession. Strategies should be developed to educate and prepare future IT professionals to cultivate not only their technical skills, but to enhance their interpersonal and team-building skills. Furthermore, academics should continue to research, examine, and explore the perception that IT careers lack the opportunity to interact with others. The results of continuous research will perpetuate new strategies to educate girls on the realties and advantages of IT careers as it relates to interacting with others in the workplace.

> <u>Reconstructed Barrier Goal:</u> The image of IT professionals as having little/no interaction with others is false, and a barrier for young women. It should be eradicated through communication and education. An image of IT professionals as working with others should be promoted through marketing and advertising. Recruitment strategies should be developed for girls/women through endorsing an image of an IT professional as having a blend of technical and business skills.

Work Environment

An enjoyable overall work environment is an essential factor in the participants' career choice decision. As shown in Chapter Four, Hypothesis 2, a pleasant work environment was the second highest career choice factor with 95.0% of all participants acknowledging its intrinsic value. A compelling majority of IT majors at 95.8% and non-IT majors at 92.5%, agreed to its importance.

However, a disparity in IT and non-IT majors' attitudes toward the work environment was observed in the reasons for their planned career choice. As shown in Table 25, approximately 13% of the non-IT majors expressed a desire to work in their future occupational environment. In contrast, only 4.2% of the IT majors described the IT environment in their career explanations. A participant who plans to major in pre-medicine stated, *"I will really like working in a health care environment. I'm really fascinated with anatomy, and really love working and helping others achieve a state of well being."* The participants who planned to major in IT described their love for the computer or their passion for a specific occupation; however, very few IT majors mentioned what specific industry they were considering. For healthcare practitioners, it is easier to envision a potential work environment, dentists in their office, nurses in hospitals, or pharmacists in drug stores. All healthcare workers are primarily contained in one industry, the healthcare industry. In contrast, IT professionals are employed in numerous industries. In the past, an IT worker identified with a specific IT occupation and was not as concerned with identifying with a specific industry. As stated earlier, with an emphasis on a blend of technical and business skills, more employers want their IT employees to have knowledge of their specific industry. As noted in a white paper written for the Society for Information Management in reference to skills required for the IT workforce, "Business domain skills were the most critical skills to keep-in house in 2005 (SIM, 2006, p. 18)."

Therefore, to obtain successful IT workers, the IT profession should embrace a business/technical blend to identify its workforce. A few examples of this blend are IT degree programs such as bioinformatics, game development, information systems, or digital cinema. Alternatively, perhaps future IT professionals should consider their target industry and explore a minor in that specific business field. For example, for the participant who wanted to work for the CIA, her proposed blend is to major in Computer science and minor in Criminal Justice. Moreover, university faculty and IT practitioners should collaborate to consider and develop blended IT degree programs that are sensible and beneficial for all.

Additionally, work environment was the only IT Job Characteristic revealed in Chapter Four, Hypothesis 3, that statistically distinguished IT and non-IT majors. Participants were given the opportunity to indicate their attitude toward several possible characteristics of IT careers. As indicated in Chapter Four, Table 14, when responses are subtotaled, a majority of the IT majors, 83.3%, agree that IT careers have a pleasant work environment as compared to non-IT majors at 59.4%. Perhaps when responding to the question on IT jobs having a pleasant work environment, many non-IT majors imagined the stereotypes detailed in Chapter Four, Hypothesis 13. One non-IT major confirmed, "*The disadvantages are that you don't really spend a lot of time away from a computer and you don't really work with a lot of people*." Another one stated, *"It seems very boring. Don't communicate with people in person. Long hours, hard work*." A third participant stated the disadvantages of IT jobs are "*lack of flexible hours, taking away time from family. Not* *being off for many holidays.*" Non-IT majors imagine IT workers are staring at a computer all day, for long hours, with no interaction with people and no time available for themselves or their families.

The negative image of the overall IT work environment is clearly depicted when the participants were asked to state disadvantages of working in an IT field. Table 27 illustrates that 33 participants feel IT careers are time-consuming with long hours, 39 participants feel there is no interaction with other people, and 40 participants feel IT careers are boring and no fun. Even more, 49 participants envision IT workers as sitting at their desks all the time with little physical movement. Interestingly, a higher percentage of IT majors, 16.6%, have this perception than non-IT majors at 11.6%. Furthermore, a higher percentage of IT majors cited an additional disadvantage of an IT career as having no social life; 12.5% of IT majors reported this response as compared to only 5.7% of non-IT majors. Finally, more IT majors, 20%, believe that a major disadvantage of IT professionals is an obsession with computers as compared to only 8.3% of non-IT majors. It was surprising to observe that in many instances a higher percentage of IT majors portrayed a negative IT environment than non-IT majors. Perhaps the foundation of IT majors' concerns of the IT environment resides in their perception that IT workers are obsessed with computers. The next section of this research presents a detailed discussion of being obsessed with computers.

Clearly, the IT work environment remains a deterrent for both non-IT and IT majors. The sub-components of the IT work environment barriers are voluminous, which include perceptions such as sitting at the desk all the time; having no life, working long hours, little interacting with others; and obsessing over the computer. Future research should be conducted to define each element, and study its specific pervasiveness and impact. Once the individual IT work environment element is incorporated into the Reconstructed Barrier model, it can be explored and the strategies to eradicate each barrier can be developed.

> Reconstructed Barrier Goal: Research and implementation strategies should be established to change the negative image of the IT work environment to an appealing computer culture. University faculty and IT practitioners should collaborate to define the specific IT work environment elements. Research should be conducted to distinguish the realities of the IT work environments as compared to stereotypes and determine each element's significance and impact. Additionally, the current curricula and degree programs should be examined in connection with future needs of the business environment and the requirements for the technical/business skills blend.

Obsession

According to the Merriam-Webster Dictionary (2006), obsession is defined as a "persistent disturbing preoccupation with an often unreasonable idea or feeling." Obsession can also be viewed as an extreme passion, a love for someone or something that has become uncontrollable. In this study, the uncontrollable love is with a computer. Chapter Four, Hypothesis 8, reported that 87.8% of all participants like/love using the computer and 47.0% of the participants used the computer more than 6 hours a week. However, when the data is further segregated by IT and non-IT majors, as shown in Table 28, the results are more revealing. With regard to computer usage, 58.3% of IT majors love using the computer as compared to 37.8% of non-IT majors. The percentage of participants who used the computer more than 15 hours was similar for IT majors (25%) and non-IT majors (19.4%). Additionally, the percentage of the IT and non-IT majors who responded they loved the computer and used the computer for more than 15 hours was similar at 35.7% and 34.2%, respectively. Thus, a higher percentage of IT majors stated they loved using computers; however, once this was stated, the remainder of the feelings and the usage was parallel between both groups.

Table 28: Participants' Attitudes Regarding Computers and Computer Usage

Feelings about using computer	**IT Majors**	**Non-IT Majors**
Love	58.3%	37.8%
Like	33.3%	49.7%
OK	8.3%	11.7%
Dislike	0.0%	0.8%
Total hours of use (all participants)		
Over 22 hours	8.3%	3.9%
15 - 22 hours	16.7%	15.5%
7 - 14 hours	29.2%	28.2%
0 - 6 hours	45.8%	53.4%
Total hours for participants who "love using computer"		
Over 22 hours	14.3%	8.2%
15 - 22 hours	21.4%	26.0%
7 - 14 hours	28.6%	36.3%
0 - 6 hours	35.7%	29.5%

Once the participants proclaimed their love for using the computer, there was little difference in their comments regarding their feelings. The comments shown below, from IT and non-IT majors, who love using computers and use them more than 15 hours a week, depict strong feelings, a passion for the computer. The comments illustrate that these participants use the computer for everything, not only education, but for entertainment, information, communication, and as a tool for boredom. IT majors mention using the tool to display creativity more often than non-IT majors do, but the intense enthusiasm displayed for the computer seems identical.

IT majors who love using a computer and use it over 15 hours

- *"I just love communicating with others and being creative."*
- *"Like I said before, it's another way I can show my creativity and love to explore with it, it's like a new world."*

- *"I love using the computer because I can do everything with my computer. Homework, check email, etc. It is just easy to use."*
- *"Using the computer allows me to do everything from homework, research, to watching music videos. I love it."*
- *"There are so many things you can do on computers that you never get bored."*

Non-IT majors who love using a computer and use it over 15 hours

- *"I love it because there are many things to do and you find new things everyday."*
- *"Because I am always on it and it's an easy way to find information."*
- *"It allows endless possibilities."*
- *"It's my life with out any contact with other people I'll die."*
- *"There are so many things I can do on my computer from homework to chatting online to listening to music or shop!"*
- *"It is so helpful. I really don't know what I'd do without a computer. It makes everything so much easier."*
- *"I need it to do everything communicate, do work etc."*

Perhaps one concern for the intense enthusiasm, the love for using the computer for everything, of it being your life and a new world, is the idea of the passion becoming uncontrollable and the love transforming into obsession. As shown in Table 27, thirty-seven participants reported obsession as a disadvantage of working in the IT field. However, it was surprising to discover that a higher percentage of IT majors reported obsession as a disadvantage than non-IT majors. For IT majors, obsession was the second highest disadvantage reported for nearly 21% of the IT majors. Conversely, non-IT majors ranked obsession as the seventh disadvantage. As shown below, there were subtle differences in the two perspectives of comments from the IT and non-IT majors regarding obsession and the disadvantages of working in IT field.

Comments regarding obsession from IT majors

- *"Being around computers too much might get addicted to computers."*
- *"You start to trust something that's not human…"*
- *"I think you may grow to depend too much on your computer and not be able to live with out it."*
- *"You might get obsessed with it."*
- *"You could get obsessed with computers and could find many things to do on it."*

Comments regarding obsession from non-IT majors

- *"You become too obsessed."*
- *"You get too addicted to."*
- *"Spend too much time on it."*
- *"You can get obsessed with using the computer, you may want to do everything on the computer and get lazy doing activities."*
- *"Obsession/Don't get out much. No outlets for everyday activities."*
- *"Becoming antisocial, or becoming too obsessed with the job or computer."*

For the IT major, obsession is a future concern; something that needs to be monitored or watched, before it becomes uncontrollable. IT majors used words like may, could, or might get obsessed. Both IT and non-IT majors love using the computer and are using them for everything. Perhaps IT majors think that if the majority of them already love using the computer and they are using it for everything, as IT professionals, they may become lost in it. It is likely at least that some IT majors are already obsessed but reluctant to admit it. Conversely, non-IT majors think that it is a preconceived notion that IT majors will become obsessed. Non-IT majors use words like become and get in their descriptions. Eventually, the IT professional will become addicted; it is an inevitable event. Furthermore, in the comments listed, non-IT majors elevate obsession to the next level. IT professionals "spend too much time on the computer," they are "anti-social," "get lazy," and "do not have outlets for everyday activities."

A further interesting observation as it pertains to obsession, as stated in Chapter Four, Hypothesis 7 and depicted in Table 29 below, when asked directly on the survey "do you think people who chose IT careers are obsessed with computers," more IT majors (66.7%) responded affirmatively than non-IT majors (53.9%).

Table 29: Results of Survey Question regarding IT Workers and Obsession with Computers

Obsessed with Computer	IT Majors	Non-IT Majors
Agree	66.7%	53.9%
Disagree	33.3%	46.1%

Although the majority of both groups, IT majors and non-IT majors, feel that IT professionals are obsessed with computers, there is a slight discrepancy. Perhaps the discrepancy is due to perspective. IT majors are concerned with obsession as a crucial problem in their future careers as illustrated by 20% of the IT majors ranking obsession as the #2 disadvantage of IT careers (See Table 27). It is likely that IT majors have more experience and exposure to computer obsession. Non-IT majors think obsession is a less critical problem – only 8.3% of non-IT majors' ranked obsession as the #7 disadvantage of IT careers. Perhaps non-IT majors think obsession is inherent in IT jobs. Nevertheless, obsession, whether it is viewed as a crucial concern from future IT majors or inherent in the job from non-IT majors, should be viewed as a serious barrier that should be addressed in the Reconstructed Barrier model.

The barrier and perception is that IT workers are obsessed with computers, machines. As one IT major stated, *"You start to trust something that is not human."* To address this concern "the human side" of IT careers should be promoted. Active marketing and awareness of the human side of IT will address components of three of the barriers mentioned thus far, no/little interaction with others, work environment and obsession with computers. In advertising and marketing material, IT professionals should be shown working in teams or in conversations with clients. Admittedly, some IT jobs are more computer-intensive, but all IT jobs involve interaction with other people. Furthermore, many IT occupations are also very people-intensive.

For instance, systems analyst, project managers, and technical support are IT occupations that require countless interactions with colleagues, managers, and possibly external customers.

High school career days and IT career seminars are great opportunities to promote all IT occupations. During school visits and career presentations, the IT people-intensive occupations should be presented along with the programming and network occupations. Furthermore, as indicated earlier, during career presentations the blend of technical and business skills that IT employers are demanding should be emphasized. Finally, the curricula in our universities should be reexamined to ensure that we are not only preparing our future IT professionals with the technical side, but we have also complemented their skill tool set with the human side of IT.

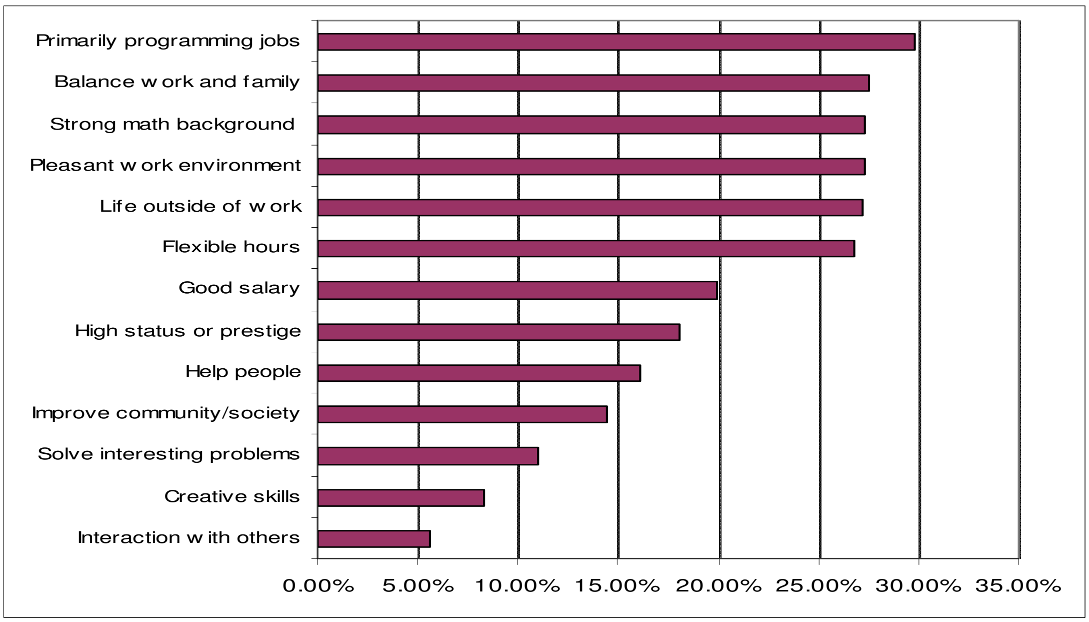
> Reconstructed Barrier Goal: To counteract the image of obsession with computers the human aspects of IT careers should be marketed and promoted. Detailed analysis of the cause and comprehensive impact of the perception of IT professionals as being obsessed with computers should be examined in future studies. Furthermore, future research should be conducted to develop the appropriate corrective strategies.

Unknown Barriers

The Unknown Barrier category was discovered during the research pilot test. Originally, the four-point Likert scale format was retained from Creamer et al.'s (2005b) instrument. However, during the debriefing discussions of pilot tests for this study, the pilot participants said they left several questions in the IT Job Characteristic (Questions 3.7.1 -13) blank because they did not know the answer. Therefore, the "Don't Know" response was added.

Figure 5 illustrates the percentage of participants who answered, "Don't know" to the 13 job characteristics. There are six characteristics where more than one-fourth of the participants indicated that they were unsure if IT careers possessed these characteristics. These characteristics fall into two categories: 1) four characteristics are general career factors that may pertain to the IT work environment and 2) two characteristics are commonly associated to IT careers.

Figure 5: Percentage of Participants who answered, "Don't know" to IT Job Characteristics



The four general career choice factors that were greater than 25% are: 1) ability to balance work and family, 2) pleasant work environment, 3) time to have a life outside of work, and 4) flexible hours. To examine these four characteristics, three components must be analyzed: the importance of the characteristic, the percentage of participants who disagreed that IT careers possess the characteristic, and the percentage of participants who perceived it as unknown. As illustrated by the high percentages, (greater than 91%), in Table 30, clearly, a vast majority of the participants feel that all four factors are important in their career decisions.

Table 30: Career Choice Factors with High Unknown Percentages

Career Choice factor	Are these factors important?		Are these factors characteristic of IT careers?		
	% of Participants Agree		% of Participants Disagree	% of Participants "Don't Know"	% of Participants Disagree and "Don't Know"
Pleasant work environment	95.0%		11.7%	27.3%	39.0%
Ability to balance work and family	94.2%		10.2%	27.5%	37.7%
Time to have a life outside of work	92.2%		13.9%	27.2%	41.1%
Flexible hours	91.2%		16.3%	26.8%	43.1%

Interestingly, these factors are related to each other in terms of the quality of life, internal and external to the job. Perhaps participants feel that in order to have a pleasant work environment, work cannot be so consuming that there is no time for life outside of work. Additionally, participants may perceive the need for flexibility in their future work schedules to enable them to balance work and family obligations.

Participants were also asked if IT careers possess these characteristics. Table 30 reveals that small proportions, 10% to 17%, of the participants perceive IT careers as not having the four work environment/quality of life characteristics. However, the inclusion of the unknown responses has added an entirely new dimension to these characteristics. When the percentages of participants who feel IT careers do not have these characteristics are added to the percentages who do not know, the accumulated total percentages were unexpectedly high. As depicted in Table 30, for these four work environment/quality of life characteristics, if approximately 40% of the participants do not envision, either through known or unknown perceptions, IT careers as giving them the flexibility to have a family and a personal life, they may choose to opt out of the IT career path. The Information Technology Association of America (2005a) report acknowledges, “a new generation of U.S. workers sees work as part of their life, not the same priority as family and a personal life (p. 13).” The lack of knowledge concerning IT careers inadequately conveying a “healthy” balance between the work environment and the personal lives of IT workers is addressed in the Reconstructed Barrier Model. Since these participants have not entered the IT profession, their knowledge should be derived from IT professionals and outreach material. Girls who are interested in IT careers should meet women IT professionals, possibly at their job locations, to discuss and determine that the work/life balance can exist successfully. Furthermore, outreach material provided to potential IT workers should acknowledge the perception of IT professionals’ work/life imbalance and this concern should be addressed and defused.

The second category of unknown characteristics pertained to the lack of knowledge of the variety and types of IT occupations. In Table 27, 15 non-IT majors declared that there was no diversity in IT jobs. The following statements are comments from several of these participants:

- *“Not able to learn information in other fields.”*
- “*You can only be gifted or knowledgeable in one area*.”
- “*Not very diverse field*.”
- *“The only problem is they live their week through the computer. They don't get any hands on experience other than the keyboard.*”
- “*Could get boring doing the same thing with every computer and not a lot of interaction w/ other people.”*

As observed in Chapter Four, Hypotheses 6, 29.8% of the participants are unclear on whether IT careers are primarily programming jobs and 27.3 % do not know if IT careers require a strong background in mathematics. From the perspective of variety or diversity, the barrier develops when participants think of the IT field as narrow, primarily with programming jobs that are repetitive and require strong math skills. When this narrow perspective is added to the unknown category, the lack of knowledge in this area is pervasive. As shown in Table 31, 89.4% of the participants either perceive or do not know if IT jobs are primarily programming. Additionally, 82.3% of the participants either perceive or do not know if IT jobs require strong math skills.

Table 31: Participants' Perceptions on Programming Jobs and Math

IT Job Characteristic	% of Participants Agree	% of Participants Unknown Barrier	% of Participants Disagree	% of Participants Agree and Unknown
Primary emphasis on computer programming jobs	59.6%	29.8%	10.6%	89.4%
Require a strong background in mathematics	55.0%	27.3%	17.6%	82.3%

However, the variety of IT careers is clearly depicted by the choices made by our participants. The participants who chose IT careers are pursuing four occupations, Computer Software Engineering, Computer Graphics, Information Systems, and Digital Media. Moreover, of the participants who chose IT, the greatest number of participants planned to major in either Computer Software Engineering or Graphic Design/Animation with eight in each category. The specific IT disciplines reported by all participants who chose to major in IT is depicted in Table 32.

Table 32: IT Disciplines Reported by Participants Surveyed

IT Majors (24)	Number
Computer Software Engineering	8
Graphic Design/Animation	8
Information Systems	3
Digital/Multimedia	3
Undecided	2

Furthermore, as shown in Table 33, the U.S. Bureau of Labor Statistics reported 14 types of IT and computer occupations (Hecker, 2005). Some jobs are not listed entirely as computer occupations; therefore, they are not included in the table. For example, graphic designers are not included. Nonetheless, purely programming jobs constitute only 11.2% of the IT workforce.

Table 33: Information Technology Workforce in 2004

IT Occupations	Number (2004)	Percentage
Computer and Information Systems Managers	280,000	6.9%
Computer and Information Scientists, research	22,000	0.5%
Computer Programmers	455,000	11.2%
Computer Software Engineers, Application	460,000	11.3%
Computer Software Engineers, Systems	340,000	8.3%
Computer Support Specialist	518,000	12.7%
Computer Systems Analysts	487,000	12%
Database Administrators	104,000	2.5%
Network and computer systems administrators	278,000	6.8%
Network and data communications analysts	231,000	5.7%
Computer Specials, all others	149,000	3.6%
Computer Hardware Engineers	77,000	1.9%
Computer Operators	149,000	3.7%
Data Entry	525,000	12.9%
Source: Data from U.S. Department of Labor, Bureau of Labor statistics		

Several IT occupations may consist of programming activities; however, the occupation includes a variety of other responsibilities. For instance, as stated in the Occupational Outlook handbook, "Software engineers working in applications or systems development analyze users' needs and design, construct, test, and maintain computer applications software or systems (United States

Department of Labor, 2006)." As mentioned earlier, pure programming jobs that are all technical with little business knowledge are artifacts of the past. The variety and diversity of IT occupations should be communicated so that students can make accurate and knowledgeable decisions about their future careers. Furthermore, the perception that the primary emphasis of IT careers is programming jobs with strong math backgrounds is addressed in the reconstructed Barrier model.

> Reconstructed Barrier Goal: Overcome female high school students' lack of knowledge of IT job characteristics. The IT profession should develop a strong and effective marketing campaign using exposure, outreach, knowledge, and education. Marketing strategies should include but not be limited to IT professional career presentations, brochures, and possibly career day visits at specific corporations. Furthermore, IT employers should establish working schedules and environments that are appealing to women.

New Barriers

The participants in this research have acknowledged new barriers that are not pervasive in current literature. As indicated in Table 27, the two highest ranked disadvantages reported by the participants in this study were physical health concerns and technical computer problems. The most cited disadvantage of IT careers in this study was physical health concerns. Sixty-nine participants (16.8%) listed one or more health hazards as it relates to working in the IT field. Participants stated their perspectives on IT jobs and physical health concerns:

- *"It is not a very social job and there are probably long hours involved with it. Being in front of the computer too long may cause health problems such as arthritis, poor vision, and bad posture."*
- *"Not enough exercise. Bad eyes sight, migraines."*
- *"Eye problems, Back problems, wrist problems."*
- *"The amount of hours spent working. May damage your eyes. May give you hand problems."*

Additionally, The US Department of Labor warns us in the Occupational Outlook Handbook that IT professionals are at risk of eye, back and hand problems. The Handbook states, *"Like other workers who spend long periods in front of a computer terminal typing on a keyboard, computer scientists and database administrators are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome or cumulative trauma disorder."*

In this study, the second most reported disadvantage of the IT field was technical problems with the computer. Sixty-four participants (15.6%) reported specific technical problems future IT professionals could encounter. The majority of the technical problems involve slow response times, viruses and computer crashes. The following reported participant statements reflect their perspective on technical computer problems in IT careers:

- *"Some disadvantage are that computers usually catch viruses. It freezes too much and works slow."*
- *"If the computer gets a virus, or is not working well your info can get lost."*
- *"Your computer crashes and you lose all your information. It freezes up. You'll need to buy more memory."*
- *"They have problems; virus; you can lose data."*
- *"Computer viruses. Computer may freeze and lose all data."*
- *"Viruses. Unfixable problems. Aggravating."*

Since the potential new barriers revealed in free form responses (physical health concerns and technical computer problems) were not part of the original scope of this research, a more extensive study should be conducted to examine and validate the new barriers to determine their significance. What is noteworthy about the potential new barriers is their possible association with the participants' personal familiarity and knowledge of computers and their perception of IT careers. Future research should also be conducted to determine if students are internalizing their personal experiences and encapsulating these experiences to develop an image of IT professionals' responsibilities and work environments. If through research exploration it is determined that this encapsulation is occurring, and students' experiences are disparate from the actual responsibilities and work environments of IT jobs, potential barriers for pursuing IT careers could be present. Consequently, physical health concerns and technical computer problems should be included in the Reconstructed Barrier model for further examination.

> Reconstructed Barrier Goal: The initial objective for new barriers in the model is to define, understand, and validate them. A methodology should be developed to evaluate the significance and impact of the perception of physical health concerns and technical computer problems in IT careers. Subsequently, each new potential barrier can then be studied and evaluated as a possible deterrent for girls/women in IT careers.

Barriers Removed from Stage I Model

In Chapter Two, the IT Career Lifecycle was described as having four stages: 1) Stage I - Contemplating Decision of IT major, 2) Stage II - Validate or redefine IT major, 3) Stage III - Initial entry into IT field, and 4) Stage IV - Retention and advancement in IT field. The staged model was developed to allow barriers to be studied and evaluated in each stage or across stages. Thus, each stage allows researchers to target specific participants. For example, Stage I incorporates adolescents from early childhood to juniors and seniors in high school, while Stage II encompasses college students. As mentioned earlier, this study centers on Stage I barriers only.

Fourteen factors were originally proposed as Stage I barriers by the literature; however, the participants' responses did not support all 14 barriers. Therefore, some factors were redeployed to other models in this framework or moved completely out of Stage I. The factors that were redeployed to the IT Career Enabler or the IT Career Predictor models are discussed later. This section will address the factors that were moved from Stage I to later stages.

This study moves three barriers from Stage I to later stages. These barriers are: 1) the perception that IT workers are geeks, 2) the perception that IT workers are loners, and 3) the lack of sufficient IT role models. This section summarizes the responses of the participants reported and discusses the rationale for moving these barriers.

In Hypothesis 7, the participants were asked eight questions regarding their perception of people who work in the IT field. Two of the questions pertained to the perceived image of IT workers as being geeks and loners/antisocial. This study found that a vast majority of the participants disagreed with this image. Surprisingly, 81% of the participants disagreed that IT workers were geeks and 81.2% disagreed that they were loners. Furthermore, very small percentages of the participants described these perceptions as disadvantages to IT careers. In Table 27, only eight participants (1.9%) acknowledged stereotypes like geeks and nerds as a disadvantage. On the other hand, Table 27 illustrates that 25 participants (6.1%) believed that IT workers do not have a social life. However, 20 of these 25 participants attributed the lack of a social life to the job, not the IT workers. A majority of the 25 participants did not think that IT workers were loners or anti-social, but did feel the nature of the job, as mentioned earlier, did not facilitate interaction with other people. As suggested by Grant et al. (2007), perhaps the ubiquitous computer usage of the participants has begun to change the face of computing culture. Furthermore, in their study, Blum and Frieze (2005) revealed a new emerging computer culture that gave the computer science men "the permission to explore their non-geeky characteristics and the women encouragement to be both feminine and computer focused" (p. 114). Perhaps the image of geek and loner has been replaced with the notion of being obsessed with computers. Alternatively, maybe the image of the IT worker is just no longer a pervasive negative image to high school girls. The recommendation of this study is to move the perception of the geek/loner image to later stages to examine its pervasiveness amongst women.

Contrary to popular opinion, the lack of sufficient IT role models was another proposed barrier that the participants did not endorse. In Chapter Four, Hypothesis 11, the results indicated that 59.6% of the participants had family members or friends who worked in the IT field and 52.6% felt that they knew someone who could be a role model. The inaccessibility of role models for women in the IT profession is a well-known perception in the field. The observation that the majority of the participants did not view the inaccessibility of role models as a concern was not anticipated. Perhaps there is a discrepancy in the participants' perception of accessibility to role models and the actuality of it occurring. This study recommends that the lack of role models be moved to later stages so it can be studied in the college and industry environments. In future research, if there is a discrepancy in perception and reality of obtaining role models it would be interesting to explore whether IT majors actually sought role models, whether the role models were beneficial, and whether they perceived that obtaining role models would be a problem.

The purpose of repositioning these three potential barriers, geek, loner, and lack of role models, is to determine in what stage they are appropriate, if they remain barriers at all. The computing environment and culture is constantly changing. Girls' interest and use of computers has changed substantially over the past two decades. Perhaps girls no longer view IT workers as geeks and loners and perhaps they do not foresee a problem with obtaining role models in the field. The effort and expenditure of resources to attack these three barriers might be more valuable in later stages. It is not worth expending resources in Stage I.

In summary, this study evaluated four categories of barriers. Three known barriers were identified in the literature and reported as significant by the participants. The prominent barriers were: interaction with others, work environment, and the perception of IT workers as being obsessed with computers. Six unknown barriers were discovered in this study and identified by the participants as having no/little knowledge of these IT career characteristics. The barriers unfamiliar to the participants were: 1) ability to balance IT career and family, 2) pleasant IT work environment, 3) time to have a life outside of IT career, 4) flexible work hours, 5) variety of IT occupations, and 6) skills needed for IT careers. Two potential new barriers were identified by the participants and discovered in this study. The new barriers were physical health problems and technical computer problems. Three barriers were identified in the literature; however, not recognized as significant by the participants of this study. These barriers were removed from the Stage I Barrier model and suggested as future research in later stages of the IT Career Lifecycle model. The barriers redeployed to later stages were the perception of IT workers as geeks, the perception of IT workers as loners, and the perceived lack of role models. The next section presents factors identified by the participants as IT career enablers.

IT Career Enabler Model

IT career enablers are facilitators that foster girls' interest in Stage I of the IT Career Lifecycle model. The original goal of this research was to study Stage I barriers only; however, enablers emerged surreptitiously as part of this study. Therefore, the new IT Career Enabler model should be examined in future studies to determine whether its specific factors are significant and identify the relationships amongst these factors. However, since the predicted IT workforce shortage and the impeding decline of enrollment of women in IT majors is such a pressing concern for the nation, immediate action is required. This research recommends that the IT Career Enabler model be acted upon in parallel to conducting the research. Perhaps an action research methodology can be developed to expedite the implementation strategies for IT career enablers. According to Baskerville and Myers (2004), action research is a methodology that allows the researcher to make change while simultaneously studying the process. Thus, the fundamental implementation strategies for IT career enablers could be conducting research while concurrently communicating and educating these enablers to high school girls. Nine IT career enablers are presented in this section: creative skills, computer interest, computer usage, encouragement, job opportunities, salary, helping others, improve society, and exposure to technology.

Creative Skills

In the literature, the lack of creativity was originally proposed as a potential barrier (Beyer et al., 2004). In the original Stage I model, lack of creativity is included as one of nine possible factors that constitute a negative perception of IT careers. This study proposed that participants would perceive little opportunity to use creative skills in IT careers. Therefore, the lack of creativity would be recognized as a barrier. However, the results in this study yield creativity as an IT career enabler.

Creativity was observed in eight distinct areas of this study. As indicated, creativity was first proposed as a possible barrier in Hypothesis 2. Subsequent to Hypothesis 2, the participants reported creativity as an important factor that influences their career choice. Creativity was also reported as an explanation for their career interest, as a characteristic of IT careers, as a characteristic of IT workers, as an advantage in IT careers, as an explanation of liking/loving computer courses, and as an explanation for liking/loving computer usage. It is interesting to note that there was usually a diverse response from IT and non-IT majors in these eight creativity areas.

First, in Hypothesis 2, the data was analyzed to determine if creativity was considered one of the factors the participants felt was important in their career choice, but did not feel it was characteristic of IT jobs. Specifically, the evaluation was to determine if the perception of lack of creativity was a barrier to pursuing an IT job. As acknowledged in Hypothesis 2, the results revealed that 86.8% of all participants felt creativity was an important factor in their career choices and 86.4% felt that creativity did exist in IT careers. Consequently, creativity was determined "not" to be an IT career barrier. Second, in Hypothesis 3, it was found that girls who felt creative skills were a very important factor (p-value =.0045) in their career choice, were 3.76 times more likely to major in IT than the girls who did not feel that creative skills were as important. Furthermore, 79.2% of the participants who planned to major in IT identified creativity as very important as compared to only 54.0% of the non-IT majors. Third, the participants were asked to identify reasons for choosing their specific career interest. Table 25 illustrates that creativity was the second highest reason (29.2%) for IT majors as compared to being the seventh highest for non-IT majors (8.3%). One participant who plans to major in computer engineering states her reason for choosing this career: "*I'm interested in computers. It allows me to be creative and innovative while using technology and core engineering skills...*" As predicted, for IT majors, the only reason that rated higher than creativity was the rationale that they "liked working with computers" at 45.8%. Non-IT majors identified six other reasons more frequently for choosing their career than creativity. These reasons were: interact with others (41.3%), help others (33.8%), believed they would be good at what they chose (11.9%), always wanted to be their chosen profession (11.6%), thought they would enjoy their chosen profession (11.1%), and thought their chosen profession would have a good salary (9.3%).

Fourth, participants were asked if they thought there was an opportunity to use creative skills in IT careers. The vast majority of IT majors agreed, 95.8 %, while 85.8% of non-IT majors agreed. Fifth, participants were asked whether they thought people who chose IT careers were creative. IT majors and non-IT majors responded similarly, at 83.3% and 88.3%, respectively. Sixth, as displayed in Table 34, when asked to list advantages of working in the IT field, participants mentioned creativity or creating technology 61 times. In addition, participants listed creativity as the fifth highest factor. Thirty-three percent of the IT majors mentioned creativity as an advantage to IT careers as compared to approximately 14% of the non-IT majors. One participant said, *"Opportunity to invent or create something new and useful in technology."* Another participant said, "*Some advantages include interacting with creative and smart people. Being able to solve or create new programs."*

Table 34: Summary of Participants' Perspectives of Advantages of IT Careers

Advantages of IT careers	IT Majors (24)		Non-IT Majors (387)		Total (411)	
Learn more/know more about computers/technology	8	33.3%	121	31.3%	129	31.4%
Design, create, creativity	8	33.3%	53	13.7%	61	14.8%
Help others	5	20.8%	28	7.2%	33	8.0%
Good salary	5	20.8%	77	19.9%	82	20.0%
New technology, new things	4	16.6%	30	7.7%	34	8.3%
Solve problems/critical thinking	4	16.6%	7	1.8%	11	2.7%
Fun	4	16.6%	6	1.5%	10	2.4%
Job opportunities/job security	3	12.5%	63	16.3%	66	16.1%
Use/update programs or software	3	12.5%	16	4.1%	19	4.6%
Advanced in technology, keep up-to-date, cutting edge	3	12.5%	48	12.4%	51	12.4%
Efficient (make things faster, easier, more organized)	2	8.3%	63	16.3%	65	15.8%
Computers are everywhere, everyone using them, use computers for everything	2	8.3%	39	10.7%	41	10.0%
Improve community or society	2	8.3%	20	5.2%	22	5.4%
Smart/educated	2	8.3%	14	3.6%	16	3.9%
Future, computers are in future, skills are good for future	2	8.3%	12	3.1%	14	3.4%
Learn how to fix computer/virus	0	0.0%	25	6.5%	25	5.4%
Useful/important	1	4.2%	18	4.7%	19	4.6%
Interesting/enjoy	1	4.2%	14	3.6%	15	3.6%
Flexible hours or locations (for example, work at home)	1	4.2%	12	3.1%	13	3.2%
Interaction with others	0	0.0%	12	3.1%	12	2.9%
Gain knowledge of and use the Internet	1	4.2%	9	2.2%	10	2.4%
No/little interaction with others, mainly work by yourself	0	0.0%	5	1.3%	5	1.2%

Seventh, 14 participants, 16.6% of IT majors and 2.6% of non-IT majors, reported they liked or loved using the computer because they can be creative on it. One participant declared, *"The computer is a great source of information … meet new people and be creative..."* Finally, forty-one participants, 33.3% of the IT majors and 8.5% of the non-IT majors, acknowledged they liked or loved a computer course if given the opportunity to use their creative skills. In referencing the computer course, the participant declared, "*I like the computer programming class I was in. I had the chance to be very creative.*" Another participant acknowledged, *"I love working with computers because I can be very creative with whatever project I am assigned."* Throughout this research, participants repeatedly identified the significance of creativity in various aspects of the computer industry including IT career interest, computer usage, computer courses, perceived advantages in IT careers, and characteristics of IT workers. Furthermore, in most instances, IT majors felt stronger than non-IT majors regarding the importance and existence of creativity in the IT profession. Undoubtedly, creativity has an important role to play as an influential factor to encourage girls to the IT profession. Creativity should be utilized as a vital component of the marketing strategy for IT careers. Suggested strategies on integrating creativity in computer courses and technology camps in the IT Career Enabler model is discussed later in this chapter. Furthermore, other enablers are discussed in the next sections to establish the foundation of the IT Career Enabler model.

> <u>IT Career Enabler Goal:</u> Creativity should be used as an essential marketing element to attract girls to the IT field. Furthermore, creativity should be incorporated and integrated in the curricula for high school computer courses and technology camps.

Computer interest and usage

The days of the computer as being toys for boys are gone. A majority of the girls have exposure and access to computers at an early age and like using them. The average age the participants started using a computer was 8.8 years old with a standard deviation of 2.4 years. Additionally, a vast majority of the participants have computers at home (93.5%), have access when they want it (89.0%), and expressed they liked or loved using the computer (87.8%). According to the eMarketer (2007) there are currently more female internet users. In their article, "More Women

Online", eMarketer reports that there are 97.2 million females (51.7%), ages three and older, using the Internet.

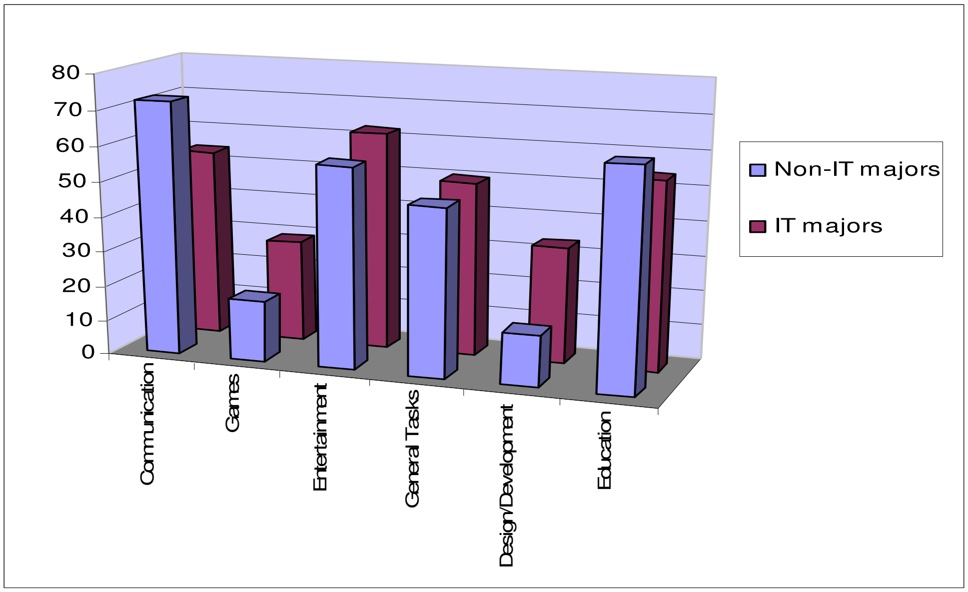
Furthermore, an unexpected result of this research revealed that many of the participants have taken a computer course. When asked why they took the computer course, one hundred and sixty (54.2%) stated they had a general interest in computers, one hundred and forty (47.4%) thought they would need computer skills for their future jobs, and fifty-seven participants (19.3%) acknowledged a passionate interest for computers. Clearly, the participants are interested in using the computer.

Furthermore, many of the participants contemplated a more extensive knowledge of the computer technology and expressed its usefulness and value. Eighty-four participants (20.4%) responded that they expected to major or minor in a computer-related field. Additionally, as illustrated in Table 34, one hundred and twenty-nine participants (31.4%), listed "Learning more about computers/technology" as the highest rated factor in the advantages of working in the IT field. One participant said, *"I think that if you do pursue a computer or technology related field you have an upper hand. Times are changing and technology is important in our everyday lives. If you have computer or technological experience then you have a lot to offer to an employer*." Another participant said, "*Technology is becoming more of a necessity in our society. To be at the forefront of it, you will be very knowledgeable."* Furthermore, a third participant stated, *"The person is able to work well with computers. When a person knows a lot about computers and technology this will open many doors for them because many people really don't know a lot* *about computers*." Seemingly, the participants felt that the greatest advantage in an IT career is the knowledge gained in computers and technology.

Additionally, the participants identified the computer as a valuable part of our everyday lives and that computer knowledge is a necessity in our society. The IT profession should continue to encourage girls to use the computer, which will facilitate their interest, and help them understand the value of computers to our society. Researchers should continue to study ways to facilitate girls' computer interests. Girls should be encouraged to actively use the computer and understand its value to our society; however, this is just a first step.

Although the participants are interested in using computers and like using them, there is a distinct difference between IT and non-IT majors on what activities were performed on computers. As shown in Figure 6, non-IT majors' most frequent use of the computer was for communication. IT majors' most frequent activity on the computer was entertainment. However, the most distinguishable differences for IT majors were their use of the computer for games and design/development. Examples of IT design/development activities were creating web pages, computer graphics, and programming.

Figure 6: Activities Performed on the Computer for IT and Non-IT Majors



Furthermore, as reported in Chapter Four, Hypothesis 14, there was a substantial difference in the responses of whether IT and non-IT majors felt they would be successful in IT careers. Perhaps the potential insecurity in the success of IT skills is associated with lack of exposure or knowledge of IT skills. Since the confidence of being successful and exposure to IT skills is questionable for non-IT majors, these factors were incorporated into the Reconstructed Barriers model for future study.

> <u>IT Career Enabler Goal:</u> Activities performed on the computer should be studied to determine their association and impact on girls' selection of IT majors and careers. Furthermore, the ability to incorporate more IT related skills and activities into the girls' computer experience should be considered. Thus, the association between the girls' computer experience and perception of potential success in the IT field should also be examined in future study.

Encouragement and Support

It was surprising to discover that only one of the parents, of the twenty-four IT majors, has an occupation in the IT field. Yet, the findings of Hypothesis 10 indicate that mothers are a predominant source of IT career information and parents are seemingly very influential in the participants' career choice when considering the IT field. As stated in the results for Hypothesis 10, participants who receive IT career information from their mothers are 1.84 times more likely to major in IT careers than those who do not. Additionally, participants who feel their parents consider IT as a good career choice for them are 3.38 times more likely to major in IT. Consequently, there is evidence to suggest that "Parents matter" concerning girls' encouragement of IT careers. Thus, it would be prudent to educate parents regarding the IT field, so they may encourage their daughters to pursue IT careers. The involvement of parents should be considered in as many implementation strategies as possible. Parents should be viewed as facilitators in the IT Career Enabler model.

However, the burden of encouraging girls to consider an IT career should not reside with parents alone. Teachers, counselors, and society should all have a role to play in fostering girls' IT career interest. Yet, 45% of the participants stated they never received IT career information from counselors and 27% stated they never received IT career information from teachers. All IT stakeholders, researchers, practitioners, counselors, teachers, and society as a whole should encourage girls to pursue IT careers.

Interestingly, fifty participants, who were non-IT majors, reported in their explanations for choosing their careers that they thought they would enjoy their careers; however, very few participants who planned to major in IT acknowledged this enjoyment. Furthermore, forty-five participants who were non-IT majors stated they "always wanted to be" in their chosen profession; yet, no IT major proclaimed this desire. In this study, non-IT majors were seemingly obtaining encouragement and positive reinforcement for their chosen careers.

Encouraging girls to consider the IT profession is not enough with financial and academic support. The problem is more systemic. For instance, as stated earlier, only one parent of all the potential IT majors is in the IT field. Surprisingly, in spite of this, some parents have encouraged their daughters to major in IT. However, as shown in Table 35, 50% or more of these parents are unemployed or employed in low paying jobs.

Table 35: Parents' Occupations of the Participants Who Plan to Major in IT

Occupations	No. of Mothers
Entrepreneur	2
Teacher	3
Neurologist Assistant	1
Trainer	1
Data Entry Clerk	1
US letter carrier	3
Janitor/laborer	3
Waitress	3
Babysitter	1
Unemployed/Left Blank	6

Occupations	No. of Fathers
Entrepreneur	3
Manager	1
Engineer	1
Pastor	1
Firefighters	2
US letter carrier	2
Mechanic	1
Cook	1
Casino worker	1
Unemployed/Left Blank	11

Furthermore, as shown in Table 36, a higher percentage of participants who plan to major in IT are Hispanic/Latina at 6.5% and African American at 7.0%. In contrast, the Caucasian /White percentage was only 3.8%. Additionally, the Asian/Pacific Islander percentage was 11.1%; however, this percentage could be skewed due to the small number of surveys completed for this ethnic group.

Table 36: Ethnicity of the Girls Who Plan to Major in IT

Ethnicity	IT Major	Non-IT Major	Total	IT Major %
Hispanic/Latina	10	145	155	6.5%
African American	8	106	114	7.0%
Caucasian /White	4	102	106	3.8%
Asian/Pacific Islander	2	16	18	11.1%
Native-American	0	3	3	0.0%
Other	0	15	15	0.0%

The percentages of the prospective IT majors from each of the four schools were also analyzed to determine if the difference of the school could account for the different percentages in the ethnic groups. However, as displayed in Table 37, the percentage of prospective IT majors from three of the four schools was similar. The percentage from Kelvyn Park is slightly higher than the other schools. As stated earlier, Kelvyn Park is 95.0% Hispanic. According to ITAA (2005a), Hispanics are the most under-represented ethnic group in the United States IT workforce; yet, their percentage of the IT work force has increased from 5.3% in 1996 to 6.4% in 2004 (ITAA, 2005a). Perhaps, the higher percentage in our study displays a continued interest of Hispanics in IT careers. Furthermore, ITAA (2005a) reports a decline in the African American IT workforce from 9.1% in 1996 to 8.3 % in 2004. During this same period, African American constitutes 10.7% of the entire workforce (ITAA, 2005a). Consequently, the under-representation of Hispanics and African American in the IT field is just as prevalent as the under-representation of women. Furthermore, the majority of the participants pursuing an IT career will be minority women.

Table 37: Percentage of the Girls Who Plan to Major in IT by High School

High School	IT Major	Non-IT Major	Total	IT Major %
Kelvyn Park High School	8	97	105	7.6%
Kenwood Academy High School	4	69	73	5.5%
Queen of Peace High School	7	139	146	4.8%
Whitney Young Magnet High School	5	82	87	5.7%

As stated earlier, the prospective IT majors plan to go to college. Yet, this may not always be financially feasible. If the majority of the participants pursing an IT career are minority women and 50% or more of their parents have low paying jobs, a question for future research consideration may include: are the systems in place to support the success of these potential IT majors financially and academically, throughout four years of college. Retention of female IT majors in the college environment is out of the scope of this research; however, without addressing the barriers in the next stage of the IT Career Lifecycle further computer pipeline leakage will continue for young women in their pursuit of IT careers.

> IT Career Enabler Goal: IT researchers and practitioners should communicate and educate parents, so that they can encourage their daughters to pursue IT careers. Once the students have chosen IT as their major, all IT stakeholders are encouraged to implement strategies to support and retain girls/women throughout their college and professional experiences.

Salary and Job opportunities

There is strong evidence to consider salary as an IT career enabler. As shown in Chapter Four, Table 9, salary was the highest ranked Career Choice factor for all participants in this study at 95.4%. Furthermore, when the importance of salary is segmented by IT and non-IT major the significance is clearly depicted. One hundred percent of IT majors reported salary as important as compared to 95.1% of non-IT majors. Salary was also the second highest ranked advantage reported by the participants in Table 34 above. In Chapter Four, Table 9, 76.2% of the participants responded that a good salary is characteristic of IT careers. Unfortunately, as displayed in Figure 5, approximately 20% of the participants responded that they were unaware of whether IT jobs offered good salaries. Clearly, there is a missed opportunity to promote IT jobs. Salary is the highest ranked factor in career choice, the second highest advantage of IT careers and the majority of the participants who were knowledgeable of IT salaries said they were "good paying jobs"; however, one-fifth of the participants were unaware that most IT jobs pay well. According to US Department of Labor, in 2004 there were 487,000 systems analysts with median salaries of $66,460. Entry-level positions were approximately $51,000 (US Department of Labor, 2005).

Furthermore, in the same year, there were 800,000 computer software engineers who were paid a median salary of $74,980 and starting salaries were approximately $52,500. The IT profession should promote its strengths and communicate to students that upon graduating from college many IT jobs pay over $50,000. As portrayed in Chapter One, Table 1, the predicted growth rates for systems analysts and software engineering are from 31% to 48%. IT profession should educate female high school students on the skills, responsibilities and variety of jobs in the IT field that command these well-paid salaries. As mention earlier, the growth rate and the high demand for IT jobs should also be communicated. While education and communication of IT careers to students is essential, as stated earlier, their parents should be actively involved. It makes sense that parents are usually assisting their daughters with college tuition and would like them to achieve value for their college degree through economic success. Clearly, salary, the diversity of the jobs, and the lucrative demand are advantages for IT careers. These enablers should be utilized to facilitate IT career interest.

IT Career Enabler Goal: A communication strategy should be considered involving students and parents to educate them on the nature of the job, variety of jobs, skills required, salaries, and other benefits.

Help Others and Improve Society

The participants confirmed that helping others is an essential element of their career choice. Three hundred and ninety participants (94.9%) acknowledged helping others as an influential factor in choosing their careers. Additionally, three hundred and seventy-two participants (90.5%) declared that the opportunity to improve their communities and society is another vital consideration in their career decisions. IT majors felt even slightly stronger regarding the need for their future careers to provide a sound societal component with 95.8% acknowledging a need to help others and 91.7% wanting to improve society. Thus, the societal elements of helping others and improving their communities are considered IT career enablers in this study.

Margolis et al. (2002) state in their research that women usually connect their computer science interest to a larger societal framework. When describing the reasons for choosing their careers, our participants also expounded on this connection. As one participant who plans to major in computer science and minor in Criminal Studies states, "*This career interests me because of opportunity to help others. Flexible hours. Opportunity to help community.*" Another participant who wants to be a future biomedical engineer acknowledged, "*I want to help improve people's lives. I know I will be working with technology and research. It's like being a doctor but without being in the hospital. I can invent the next thing that will be helpful in society. I like thinking and conducting experiments.*" As described earlier, the desire to help people and improve society integrates very well with the discussion of marketing the human side of IT. The opportunity to help others and improve society should be communicated in outreach material as a component of a comprehensive message that IT careers consist of a strong human constituent. Developing programs and curricula to facilitate girls exploring IT through a societal framework is discussed in the next section.

> IT Career Enabler Goal**:** Helping others and improving society should be integrated in a comprehensive marketing and communication plan to promote the human component of IT careers.

Exploring Information Technology

One way to foster computer interest and usage is to allow students to explore technology through computer courses and technology camps. As mentioned previously, two hundred and ninety-five of the participants (71.8%) took a computer course. One hundred and sixty-eight of the participants (56.9%) stated they liked or loved the computer course. Further, eighty-five of the participants (28.8%) acknowledged they disliked the course or it was "OK." Exploring information technology can be motivating and stimulating or boring and monotonous. In this sense, exploring information technology could be a barrier or an enabler depending on the participants' perspective. Therefore, this study suggests that the redeployment of exploring information technology as a barrier and an enabler. Thus, both sides of the spectrum were examined to develop an effective, successful curriculum by understanding what elements to avoid as barriers and what elements to endorse as enablers.

The first group of comments, displayed below, was from participants who disliked the computer course or said it was OK. The six critical themes from this group were that the computer courses: 1) did not involve creative skills, 2) involved boring, monotonous, and tedious activities like practice typing, 3) were not fun, 4) were confusing, complicated, and frustrating, 5) did not provide the opportunity to learn new skills, and 6) were taught by boring and unavailable instructors. The second group of comments, displayed below, was from participants who liked or loved their computer course. In contrast, the seven critical themes for computer courses taken by these participants were: 1) learned new material/concepts, 2) designed/created/invented, 3) engaged in fun activities, 4) solved interesting problems, 5) made programs with classmates, 6) understood everything/felt smart, and 7) gained useful skills with computer and business. Clearly, the participants view the second set of themes as more inviting and engaging.

Comments from participants who said computer course was OK or disliked it

- *"Well the class didn't involve much creativity skills, which I want to develop more."*
- *"I found that the information and skills I learned it my business technology class was useful, however, the class was not very intellectually stimulating."*
- *"I liked the class. I just didn't like the typing part."*
- *"The computer course was okay but not very interesting to me. For me to be interested it has to be something fun."*
- *"It was very boring and my teacher wasn't teaching us anything."*
- *"In the beginning I like it. But then it got boring because I already know how to work with a computer."*
- *"The work was monotonous and uninteresting. And the assignments had to be rushed because of time."*
- *"The computer course was ok, but I use my computer everyday so I didn't think it was very beneficial for me."*
- *"The things I learn in the computer course, was things I already knew about."*
- *"The teacher wasn't always available for help when the students need him."*

Comments from participants who said they liked or loved computer course

- *"I like my computer classes because even though they were hard I learned a lot. Also my teacher made it fun for us."*
- *"The course I had taken was computer science and it was fun because we had a chance to design stuff."*
- *"I loved the computer course because it was related with designing. I really love to design something that it has not yet invented."*
- *"It was fun to make programs. And to sit and play them or to see the animation work was exciting for me."*
- *"I liked the computer course I took because the teacher made it interesting and always made sure I understood everything."*

- *"I love working w/ computers because I love working on them, and figuring out problems."*
- *"Because, the wonders that can come out of it are amazing. It another way to show my creativity through technology through the world."*
- *"I love computer science because it's really easy to do and interesting. I like to create programs and learn more things about the computer."*
- *"We did things I didn't know ordinary high school kids could do. It made me feel smart and I got to be very creative and made programs with classmates."*
- *"We had a very hands on teacher who kept the course interesting."*
- *"I liked my computer information technology and business software technology class because I gained useful skills on the computer and with business in them."*

If designed and implemented correctly, allowing students to explore information technology through computer courses and technology camps can also merge the synergies of many of the implementation strategies discussed earlier in this study. Grant (2005) in the development of her technology camp has reported that my placing the creation of technology in a societal framework there is the potential for changing high school girls' perceptions of the IT field. The exploration of information technology in the classroom can turn barriers into enablers, unknown job characteristics into informed career influencers, and stereotypes into positive IT professional images. With the proper themes incorporated in the curriculum, team projects, and placing a technical curriculum into a societal framework, creativity can be leveraged, while presenting the human side of IT through solving interesting, societal problems. Thus, the technical/business skill blend can be achieved. The key is to adopt a more holistic approach to teaching information technology. (Grant et al., 2006).

A holistic approach would include a variety of information technology skills: for instance, not just programming, but analysis, design, problem solving, critical thinking, and project management. Teaching IT in a societal framework would show students how IT solves "real" problems for people. There can be teams with many roles, such as clients, system analysts, programmers, project managers, and business managers. There can be projects and examples from many industries, for example, healthcare, banking, real estate, and entertainment. Students can be asked to document and present their projects, such that oral and written communication skills are practiced. Especially for technology camps, parents can be invited to the students' project presentations. Guest speakers can come from different businesses and industries to explain some of their IT projects and potentially evaluate the students' IT solutions. Furthermore, students can write papers on how technology influences or affects them regarding information obtained from business and industry leaders.

A consortium of universities, practitioners, and high school teachers could develop this holistic approach. Alternatively, university faculty members could work with the Computer Science Teachers Association (CSTA) to develop the program. CSTA is a national organization in the United States to support and promote K-12 computer science education and other computing disciplines (Computer Science Teachers Association, 2005). The goal is clear; however, the implementation strategies to establish the holistic approach to foster girls to explore IT is yet to be developed.

> IT Career Enabler Goal**:** A consortium of university faculty, practitioners, and CSTA should develop a holistic computer science program to encompass a variety of skills to expose students to the breadth of IT profession, its responsibilities, and career opportunities. The primary objective of the holistic approach is to foster the exploration of information technology for high school girls while transforming barriers into enablers, unknown IT job characteristics into informed career influencers, and stereotypes into positive IT professional images.

In summary, the IT Career Enabler model was developed in this research to attract high school girls to IT careers. This research recommends that enablers be incorporated in communication and education strategies developed by a consortium of universities, practitioners, and high school teachers. The consortium's primary goal would be to foster girls' interest in the IT profession. IT career enablers identified in this research are:

- encouragement from teachers, counselors, peers, and especially parents
- opportunity to use creativity to develop technology solutions
- programs and activities that foster interest and usage of IT skills
- knowledge of the variety of IT career opportunities
- knowledge of skills required for IT careers and associated IT salaries
- ability to explore creating information technology through a holistic approach of solving societal problems, working on project teams, and gaining practical business knowledge

The Pre-College IT Career framework developed in this study incorporates barriers, enablers, and predictors. The past two sections have addressed barriers and enablers. The next section will address the development of the IT Career Predictor model.

Beginnings of an IT Career Predictor Model

This section will briefly discuss the beginnings of a second new model, IT Career Predictor. As presented in Chapter Four, Hypothesis 3, several factors emerged that significantly differentiated IT from non-IT majors. Evaluating predictors of girls' interest in IT careers was not in the original scope of this research. Yet, during the data analysis, it became evident that predictors were another vital component of this study. Thus, the Predictor model was the last of the three new models emerging from this research. Since the IT Career Predictor is a new model, its variables must be validated in future research to examine their impact and significance.

To begin to build a model with explanatory variables to predict whether female junior or senior high school students would choose IT as a major, a logistic regression analysis with backward elimination model selection was conducted. Twelve explanatory variables with p-values < .05 were selected from Chapter Four, Table 23. The explanatory variables were: creative skill, interact with others, IT work environment, primarily programming, requires mathematics, obsessed with computers, computer-in-home, access-to-computer, feeling about computer, IT career source from mother, IT is a good career from parents, and ability to be successful in IT. This test resulted in a problem with the validity of the model due to quasi-complete separation of data points, which means that there is a strong correlation between two or more variables. A Pearson correlation test was conducted on computer-in-home and access-to-computer with the results of a positive correlation coefficient of .71. Furthermore, access-to-computer was the first variable eliminated in the backward logistic test. Thus, a second logistic regression analysis with a backward elimination model selection was conducted with 11 factors, without access-to-computer. There was no problem with the validity of the model for this second test. The results of the second logistic regression analysis are displayed in Table 38 (Details of the analysis can be found in Appendix M). Four explanatory variables have significant p-values. These variables are 1) perception of people who choose IT careers are obsessed with computers, 2) creative skills are an important factor in a career choice, 3) interaction with others is a less important career factor, and 4) participants who feel parents would think IT is a good career choice for them.

Table 38: Summary of Logistic Regression Backward Elimination Model Selection with 11 Variables from Table 23 and Model Results

Variables originally taken from Table 23	Significant <=.05?
Thinks IT careers require strong math	No
Feelings about using computer	No
Ability to be successful in IT career	No
Primarily computer programming	No
IT job characteristic as pleasant work environment	No
IT career information source from mother	No
Computer at Home	No
Feel IT workers are obsessed with computers (Obsessed)	**Yes**
Opportunity to use creative skills (Creativity)	**Yes**
Opportunity to interact with others (Interact)	**Yes**
Parents would consider IT a good career choice (Parents)	**Yes**

IT Career Predictor model	Intercept	Maximum Likelihood Estimates	Odds Ratio Estimates	p-values
	-8.5735			
Obsessed		.9847	2.677	.0425
Creativity		.9065	2.476	.0338
Interact		-.7629	.466	.0161
Parents		1.2084	3.348	<.0001

The odds ratio estimates and p-values in Table 38 indicate the following about the participants:

- Girls who believe that people who choose IT careers are obsessed with computers (p-value = .043) are 2.677 times more likely to major in IT than girls who do not believe that people who choose IT careers are obsessed with computers.
- Girls who believe that creative skills are an important factor (p-value = .034) in their career decision are 2.476 times more likely to major in IT than girls who do not believe that creative skills are important.
- Girls who believe that interaction with others is a very important factor (p-value = .016) in their career decision are .46 times less likely to major in IT than girls who believe that interaction with others is less important.
- Girls who believe their parents would consider IT as a good career choice for them (p-value < .0001) are 3.348 times more likely to major in IT than participants who do not believe their parents would consider IT as a good career for them.

The Intercept and the Maximum Likelihood Estimates shown in Table 38 were analyzed to display the IT Career Predictor model. The model equation for IT Career Predictor Factors can be written as follows:

$$\text{Logit}(\theta) = -8.5735 + .9847(\text{Obsessed}) + .9065(\text{Creativity}) - .7629(\text{Interact}) + 1.2084(\text{Parents})$$

The model equation can be used to predict the odds of a person majoring in IT given the values of Obsessed, Creativity, Interact, and Parents. The participants were asked whether they disagreed (value = 1), slightly disagreed (value =2), slightly agreed (value =3) or agreed (value = 4). For example, the person who responded in the following manner would be more likely to major in IT:

1) IT workers are obsessed with computers (Obsessed = 4)

2) creativity is a very important career factor (Creativity = 4)

3) interaction with others is less important (Interaction =1)

4) parents would consider IT as a good career choice (Parents = 4)

$$\text{Logit}(\theta) = -8.5735 + .9847(4) + .9065(4) - .7629(1) + 1.2084(4)$$

$$= -8.5735 + 3.9388 + 3.626 - .7629 + 4.8336 = \exp(3.062)$$

Therefore, the odds of this participant majoring in IT = exp (3.062) = 21.37025. The equation for probability = Odds/ (1 + Odds). Furthermore, the probability of this person majoring in IT is 21.37025/ (1 + 21.37025) = 0.955298. Logistic regression analysis also provides knowledge of the relationships and strengths among the variables. As shown in this example, the predictor variable that parents would consider IT as a good career for the participants is the strongest variable in the model. The strength of the variable provides valuable information when designing the recruitment and retention strategies for prospective female IT majors. Thus, the predictor model can be utilized as an important tool to attract high school girls to the IT profession.

> IT Career Predictor Goal: The IT Career Predictor model is used to examine the characteristics that could be used to differentiate IT from non-IT majors. The predictor model can be used as a monitor, an overseer, to identify factors that could be redeployed in the reconstructed Barrier or IT Career Enabler models. However, the four components of this initial model should be studied and validated before it is used to predict high school girls' choice of IT as a major or a career. Additionally, a future study should be conducted to determine if any additional variables should be included.

Summary

Originally, the goal of this study was to examine barriers, not enablers or predictors of IT careers. However, in the evaluation of the findings, some factors were determined to be significant barriers, some factors were deemed to have insufficient evidence as a barrier, some factors were inconclusive, some factors were deemed as enablers to IT careers, while still others, predictors. Thus, the potential barriers tested in this research were redeployed to one or more of the three models, Barrier model, IT Career Enabler model, and IT Career Predictor model. Table 39 represents a summary of the fourteen barriers proposed in the original Stage I model, a brief description of the findings and a synopsis of the redeployment of the factors to the model(s).

Table 39: Summary of the Fourteen Barriers from Original Stage I Model

Original Stage I barriers	Current Study Results	Model Redeployment Destination
Negative image of people who work in IT fields	Obsessed with computers-barrier Likely to be male- inconclusive Geek and Loner - Not a barrier at this stage	Incorporate in reconstructed Barrier and IT Career Predictor models Incorporate in reconstructed Barrier Move barrier from Stage I to later stages

Original Stage I barriers	Current Study Results	Model Redeployment Destination
Negative perception of Information Technology (IT) careers	Creativity - not a barrier Work environment - barrier Interaction with others - barrier No time for life outside of work No flexible hours Inability to balance work and family - inconclusive No opportunity to solve interesting problems, help people, improve society - not barriers	Move to IT Career Enabler and IT Career Predictor models Incorporate in reconstructed Barrier model as an overall category and as an element in the Unknown category. Incorporate in reconstructed Barrier and IT Career Predictor models Incorporate in reconstructed Barrier model in the Unknown category Move to IT Career Enabler model
Perception that IT careers are programming and require math	Barrier	Incorporate in reconstructed Barrier model
Lack of knowledge of IT careers	Barrier	Incorporate in reconstructed Barrier model as the Unknown category.
Lack of confidence in IT skills	Not a barrier for IT majors. Significant difference between IT and non-IT majors	Incorporate in reconstructed Barrier model to explore if lack of confidence in IT skills is deterrent for non-IT majors and move to IT Career Enabler
Lack of exposure to computers at early age	Not a barrier	Move to IT Career Enabler as computer usage
Lack of exposure to computer courses	Exposure is not a barrier, however attitude may differ depending on participants' perception of computer course and course curriculum	Incorporate in reconstructed Barrier and move to IT Career Enabler
Lack of sufficient IT role models	Not a barrier at this stage	Move barrier from Stage I to later stages
Stereotypes and gender biases	Barrier	Incorporate in reconstructed Barrier model.
Lack of parental encouragement of IT careers	Insufficient evidence as barrier for IT majors.	IT major numbers are still low; therefore, parent encouragement is incorporated in reconstructed Barrier model for further exploration for non-IT majors. Also, incorporate in IT Career Enabler and IT Career Predictor models

Original Stage I barriers	Current Study Results	Model Redeployment Destination
Lack of teacher, counselor and peer encouragement of IT careers	Inconclusive	Incorporate in reconstructed Barrier and IT Career Enabler models.

Additionally, potential new barriers were discovered in this study. These barriers were revealed by the participants in the responses for six open-end questions. As shown in Table 40, since the potential new barriers have not been tested and validated they have been incorporated in reconstructed Barrier model for future research.

Table 40: New Barriers

New Barriers	Current Study Results	Model Destination
Physical health problems	Discovered, not tested	Incorporate in reconstructed barrier model.
Technical computer problems	Discovered, not tested	Incorporate in reconstructed barrier model.

Furthermore, to incorporate the three models into a new framework the Pre-College IT Career model was developed. Chapter Six presents more detail of the three models and the new framework. A description of the new framework is given, each model is presented, the goals for each model are stated, and implementation strategies to achieve the goals are suggested.

Chapter Six: Conclusions and Implications for Future

This chapter begins with an overview of the study. The second section presents the Pre-college IT Career framework and summarizes the implementation strategies suggested based on the major findings. The third section details the limitations of the study. The fourth section describes future research opportunities. The final section provides a summary of the research contribution.

Overview

The goal of this research was to examine the prevalent barriers that cultivate the disinterest of women selecting IT careers. The research is vital due to the prediction of an IT workforce shortage, retirement of baby boomers, reduction of IT enrollments, the US ability to continue to compete in the global technological arena, and the current under-representation of women in the IT profession. As detailed in Chapter Two, women encounter barriers at multiple phases of their pursuit of an IT career. Thus, this research advanced Ahuja's (1995) work to develop a four-staged model entitled the IT Career Lifecycle (The IT Career Lifecycle model is replicated below for ease of reference).

IT Career Lifecycle Model

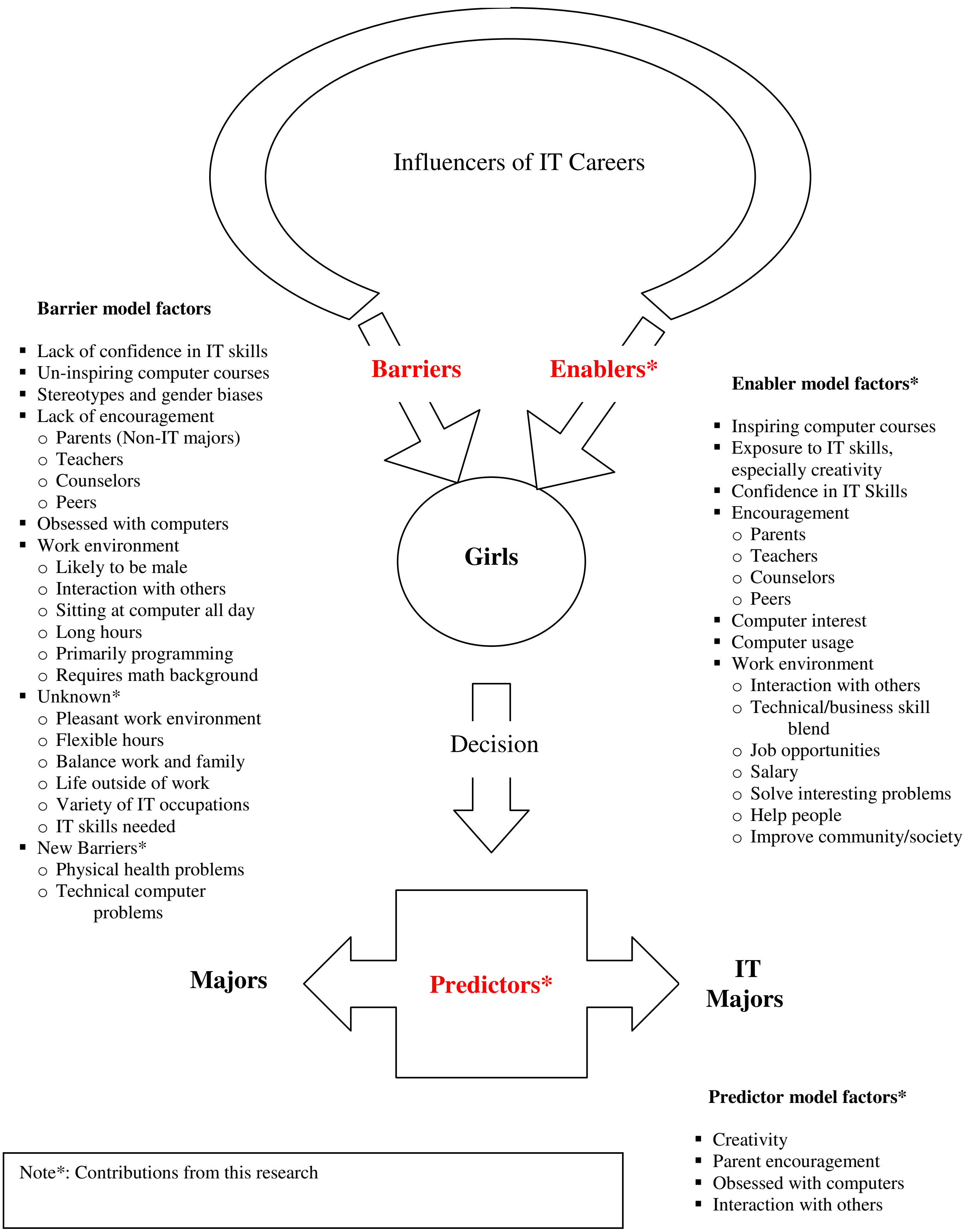
	Stage	Description	General Timeframe	
→	**I**	**Contemplating decision of IT major**	**Early childhood to juniors and seniors in high school**	→
→	II	Validate or redefine IT major	College	→
→	III	Initial entry into IT field	One to three years in IT profession	→
→	IV	Retention or advancement in IT field	Three or more years in IT profession	→

The original focus of this research was the Stage I Barrier model in which high school girls are contemplating their decision of an IT major. Fourteen hypotheses were established from previous literature to validate the Stage I barriers. A research instrument was designed based in part by Creamer et al.'s survey, "2005 Career Decision-Making Survey (Version 4)" (Creamer, 2005b). The objective of the research instrument was to collect the data to test the hypotheses and validate the 14 barriers in the Stage I model. During data analysis, some results identified significant barriers, such as interaction with others. These barriers were incorporated into a reconstructed model. Yet, some results uncovered factors that clearly were not identified as barriers by the participants, such as creativity. Still other results revealed factors as predictors of participants who were considering IT majors, such as encouragement from parents. Alternatively, some results revealed factors that could exist in more than one of the three categories: barrier, enabler, and/or a predictor. Since the original scope of the research was for barriers only, a framework did not exist to capture significant findings on enablers or predictors. Therefore, two additional models were developed, IT Career Enabler and IT Career Predictor. Additionally, this research created a new Pre-College IT Career framework that contains the three models and the factors that may influence high school girls in their possible pursuit of IT careers.

Pre-College IT Career Framework and Implementation Strategies

How do we attract girls to IT majors and eventually IT careers? The current research suggests a holistic three-tiered approach, the Pre-College IT Career framework (See Figure 7). First, the reconstructed Barriers model can be utilized to examine obstacles that may hinder girls' interest and knowledge of IT careers. The results of this model have produced communication and educational implementation strategies to eradicate known and unknown IT career barriers. Second, the IT Career Enabler model was developed to facilitate the fostering of interest and knowledge of IT careers. The IT Career Enabler model possesses factors, goals, and implementation strategies. Furthermore, both models contain factors that can influence girls' decisions on choosing IT careers. Third, once girls have declared IT as their college major, the IT Career Predictor model is used to continue to monitor and evaluate possible differentiators between IT and non-IT majors. An overview of each model developed in this study, its primary goal and suggested implementation strategies, is summarized in the next three sections.

Figure 7: Pre-College IT Career Model



Barriers Model

The major goal of the reconstructed Barrier model was to identify and eliminate barriers for high school girls who may pursue IT careers. The reconstructed Barrier model began with the original Stage I model which was grounded in research literature and validated by the "real world" view of high school girls' attitudes, perceptions, and interests in computers and IT careers. As shown in Figure 7, there are currently 22 barriers in the reconstructed Barrier model with eight major categories: 1) lack of confidence in IT skills, 2) uninspiring computer courses, 3) stereotypes and gender biases, 4) lack of encouragement, 5) being obsessed with computers, 6) IT work environment, 7) unknown barriers, and 8) two new barriers, physical health problems and technical computer problems. The implementation strategies for the reconstructed Barrier model consist of primarily two components: communication and education.

University faculty members should collaborate with K-12 educational administrators and IT practitioners to develop outreach material. The objective of this material is to counteract the negative image of IT careers and market an appealing computer culture. The marketing recruitment strategies should also include information to inform potential IT majors of areas that have been observed as unknown characteristics. The messages should motivate and encourage girls to consider IT careers through portraying an IT work environment that has a healthy work/life balance. The IT work environment should also depict IT professionals interacting with colleagues and providing value to society. In 2006, the Association for Computing Machinery (ACM, 2007) created a website, computingcareers.com., which includes several of the communication messages recommended for the reconstructed Barrier and IT Career Enabler models. The website also provides brochures, which are available for downloading and printing that inform high school students on computing degrees and careers. Thus, all existing material should be reviewed, initially to determine if additional supplemental materials should be developed for a particular targeted audience. Specific communication messages observed for the reconstructed Barrier model could include:

- advocate the need for the best and most talented students to major in the IT field
- endorse the 7.5% occupation growth of 957,000 new IT jobs by 2014
- advertise the prediction of six out of 30 of the projected fastest growing occupations in the United States from 2004-2014 will reside in the IT field
- market the variety of IT occupations and the diverse selection of industries
- illustrate examples of IT professionals working with their business colleagues developing technology solutions
- endorse the human side of IT careers along with the technical side
- promote an appealing culture of computing that includes factors such as interacting with people, project teams, and flexible schedules
- market jobs that are people-intensive, such as systems analysts and project managers
- endorse an image of an IT professional as having a blend of technical and business skills
- promote that a healthy work/life balance can exist successfully in IT careers

The current university curricula and degree programs should be examined regarding the future needs of the business environment and the requirements for the technical/business skills blend. According to Overby (2006), IT professionals "with business skills are most valuable – and the hardest to find" (p. 1). University faculty members and IT practitioners should collaborate to consider and develop technical/business blended IT degree programs. Interestingly, ACM and the Institute of Electrical and Electronics Engineers (IEEE) are currently soliciting input from the IT community, due on June 30, 2007, to review and modify the 2001 Computing Curriculum for Computer Science. The ACM Education Board and the IEEE Computer Society state this request, for input and an interim review, is due in part to declining enrollment of all students in

Computer Science and "criticism of the relevance of the current curriculum to critical job skills" (ACM, 2007).

IT Career Enablers Model

The major goal of the IT Career Enabler model is to examine factors that attract girls to IT careers. The factors in this model operate as facilitators to foster IT career interest, to encourage awareness and knowledge of IT careers, and to promote confidence and exposure of IT skills. Currently, as shown in Figure 7, the IT Career Enabler model has 16 factors. However, the factors in this model have not been validated. Since the original focus of this research was barriers, other enablers may exist and they may be more important than the ones observed. As suggested earlier, the utilization of an action research methodology could expedite the validation of the factors in this model simultaneously with the implementation strategies. Recommendations for implementation strategies for the IT Career Enabler model encompass communication, encouragement/support, and education programs.

Communication vehicles for the IT Career Enabler model should utilize printed material, such as the brochures mentioned earlier and face-to-face strategies. In addition to printed outreach material, girls should be exposed to more women IT professionals through events such as high school career days and IT career seminars. Conceivably, partnerships (mentoring strategies) could be established with university faculty members and IT practitioners to create programs which provide prospective female IT majors the ability to interact with women IT professionals at their respective job locations and thereby obtaining first-hand knowledge of the IT work environment. Specific communication messages for the IT Career Enabler model could include:

- promote the ability for future IT professionals to be creative in their IT careers

- demonstrate how IT careers provide social good to help others and improve society
- market IT salaries and the variety of skills and responsibilities performed to command these salaries

Strategies should also be considered to educate teachers, counselors, and parents on the IT field. This education will assist in fostering interest and encouragement to girls for IT careers. In addition, financial and academic support systems should be considered to facilitate the girls' success as prospective IT majors and to assist in a smooth transition into the college experience.

High school computer course curricula should be reviewed to analyze the learning objectives and the skills being taught. Perhaps a consortium of universities, practitioners, and high school teachers could be formed to develop a holistic approach that teaches technology in a societal framework. Additionally, this framework should allow girls to explore information technology while leveraging other IT career enablers such as creativity, team assignments, and a variety of technical/business blended skills. Technology programs and camps should also be considered to allow girls to explore technology outside of the normal classroom facilities. Furthermore, this study has observed that "parents matter" to the participants who plan to major in IT. Therefore, the involvement of parents should be considered as much as possible in the IT Career Enabler education programs.

IT Career Predictors Model

The major goal of the IT Career Predictor model is to evaluate and monitor the characteristics of prospective IT majors. In this study, four explanatory variables emerged in the IT Career Predictor model as strong factors to distinguish IT and non-IT majors. As shown in Table 36, these factors were creativity, interaction with others, parental encouragement, and perception of obsession with computers. The resulting factors are presented as an initial foundation for the new model. Since the predictor model is conducted after students have chosen their prospective majors, this model can be utilized to evaluate the resulting significant factors that may influence the girls' IT career choice and determine if these factors should also be incorporated in the Barrier and/or Enabler models. Additionally, the predictor model can be used to assist in exploring factors and developing strategies to retain girls in the IT field. However, future research should be conducted to incorporate additional factors as appropriate.

Limitations

Several characteristics in the design and administration of this research may limit the ability to generalize the results. The following limitations are noted:

1) The population for this study was limited to female junior and senior students in four high schools in the Chicago metropolitan area, three Chicago Public High schools and one all girls Catholic high school. Thus, the interpretations of the findings must be considered within the limits of this constraint. Since this study examined a specific subgroup in a specific location, the sample studied is not necessarily representative of all high schools in the United States. However, this research could be utilized as baseline information to conduct similar future studies in other locations.

2) The original intent of this study was to examine the prominent barriers identified in previous literature and to explore new barriers identified by the participants. However, this study has been expanded to include enablers and predictors. Thus, the new models should be studied and evaluated to incorporate additional factors as appropriate.

3) No generalizations are made to the cause of the variables.

4) Males were not included in the study; therefore, gender differences were not explored or examined. The implementation strategies were suggested given the findings of the participants, female high school students. Further research should be conducted if the implementation strategies are considered for all students. For example, the ability to help other people may not be an enabler for male prospective IT majors; thus, an implementation strategy including this factor may not be as applicable for males.

5) The selection criteria conducted was convenience sampling; hence, since random sampling was not used, some selection bias may have occurred.

6) The participants who chose IT majors may have been higher than a random sample of the population due to the requirements of the Institutional Review Board to state the purpose of the study in all marketing material. The title of the research was ambiguous "Young Women and Careers"; however, the purpose of the research did describe exploring their thoughts on careers and computers.

Future Research

Future research for the reconstructed Barrier model should include studying and re-examining the 22 barriers, as well as evaluating the communication and education implementation strategies. Specifically, university faculty members and IT practitioners should collaborate to define the specific barriers in the IT work environment. These barriers should be examined to distinguish the realities of the "true" IT work environment barriers as compared to stereotypes and determine each barrier's significance and impact. Barriers that are "real" and inherent to the IT environment may require structural changes through modifying policies and procedures in the IT profession. Alternatively, barriers that are stereotypes may require additional communication and education strategies to change the perception of the IT field to girls who may consider careers in the IT profession. Furthermore, known versus unknown barriers should be examined to determine if they are truly pervasive and if they require different implementation strategies. The new barriers, physical health and technical computer problems, could be studied to evaluate their validity, impact, significance and influence on hindering girls' interest in IT careers. Implementation strategies can be developed to combat the barriers. Additionally, the notion of the girls internalizing their personal experience with computers and encapsulating these experiences to develop their own images of the IT profession should be studied. Furthermore, since this research was conducted in a metropolitan area of Chicago, future research should be conducted in a rural or suburban area to evaluate the similarities and differences of barriers in other geographical locations. Moreover, future studies could include females and males to explore barriers and implementation strategies as they pertain to gender. The IT profession changes at such a rapid pace that continuous research should be conducted to update, incorporate, or remove factors in the reconstructed Barrier model as shown in this study. Thus, future research studies can be conducted to determine if the attitudes, perceptions, and barriers of high school girls from the Chicago area have changed over time and if the barrier implementation strategies should be modified.

Since this study created two new models, IT Career Enabler and IT Career Predictor, the models' factors should be examined with empirical study. Furthermore, a methodology can be designed to incorporate new factors into the models. Additionally, since factors can be in one, two, or all three models, the associations of factors within and between models should be studied as future research. For example, interacting with others has been identified as a barrier, an enabler, and a predictor. Therefore, interacting with others, its impact, pervasiveness, and influence on girls' career decisions in the IT profession should be examined across all three models.

Additionally, since this research only focused on Stage I, future research can focus on the other three stages of the IT Career Lifecycle model. A research study can be conducted on barriers, enablers, and predictors for young women during their college experience in Stage II, young women in the earlier phases of their IT career in Stage III, or IT professional women advancing their careers in Stage IV. Furthermore, utilizing the four-staged IT Career Lifecycle model, research should be conducted to analyze a specific barrier, enabler, or predictor, and explore how it transforms as it traverses stages.

Summary

Our nation is at a critical crossroad. The Information Technology Association of America (2005b) report summarizes our technological future very succinctly. It states, "The way forward is clear. Without disciplined, purposeful action now, the nation's high tech future, and therefore its economic future, is at risk. To remain globally competitive, America must double the number of Science, Technology, Engineering, and Math (STEM) graduates over the next ten years…" (p. 1). University faculty members together with K-12 administrators and IT practitioners should take an active role in the future of the United States IT workforce. University faculty can no longer stay in classrooms and wait until female IT students come to their college doors. Faculty members should assist in attracting women to IT careers. Due to the IT career pipeline leakage, the United States has already lost too many potential female IT professionals. The entire IT community and society should collaborate to encourage girls to major in IT fields, to keep them interested in IT majors, to prepare them for their future IT careers, and to retain them in the IT profession.

The major contribution of this research is a holistic framework developed to encourage high school girls to pursue an IT career. The current research developed an IT Career Lifecycle model by enhancing Ahuja's model of barriers. The enhancements to Ahuja's model were as follows: 1) moving girls' initial decisions on career choices from Stage II to Stage I, 2) separating the university experience and the entry-level job experience into two separate and distinct stages, 3) validating the model with an empirical study, and 4) including several additional barriers. Five barriers were incorporated in this study that did not exist in Ahuja's model. These barriers were: 1) the perception of lack of interaction with others in IT careers, 2) the belief that IT workers are obsessed with computers, 3) the belief that IT careers are primarily programming jobs, 4) the perception that most IT jobs require a strong mathematical background, and 5) general lack of knowledge of IT careers.

The current study discovered a new category of barriers and identified two new barriers. The new category of barriers discovered was named "unknown barriers." Unknown barriers occur when the participants believed factors were important and influential in their career decision; however, they were unaware of whether these characteristics existed in IT careers. The six factors identified as "unknown barriers" were as follows: 1) ability to balance work and family, 2) pleasant work environment, 3) time to have a life outside of work, 4) flexible hours, 5) IT jobs are primarily programming, and 6) IT jobs require strong math skills. Additionally, this study uncovered two new barriers that are present in prior research. The participants of this study identified IT careers as being: 1) mired with potential physical health problems and 2) hindered by technical computer problems.

As mentioned earlier, the IT Career Enabler model was not part of the original focus of this research. Thus, the factors in this model should be studied in future research to determine their impact and significance. However, this study has identified a group of factors that may be considered as the initial attributes to a holistic approach to teaching computer courses. This holistic approach should be designed to allow high school girls to explore information technology as a human discipline that is technical yet strongly woven in a societal framework. The holistic approach should be designed to solve interesting societal issues while incorporating creativity, team projects, parent involvement in team presentations, and other business skills.

Additionally, the IT Predictor model was not part of the original scope of this research. However, factors have been observed in the research that notably distinguishes IT and non-IT majors. The four factors identified in this study that function as the initial predictors in this model are: parent encouragement, creativity, obsession with computers, and interaction with others. Creamer et al. (2005a) also developed a model to predict women's interest and choice in IT careers. Their research involved 373 high school and college women. Creamer et al.'s research concluded that women who are interested in IT careers had the following characteristics: perceived that their parents support this career choice, used computers frequently and in various ways, viewed the qualities of workers in the IT field positively, and had not discussed career options with a variety of people. Interestingly, both Creamer et al. and the current study found that parental support had a significant impact on the participants' IT career choice. Further, similar to Creamer et al.'s research, IT majors in the current study did not receive career information from a variety of people. As discussed in Chapter Four, Hypothesis 10, the primary source of IT information in this study was received from the participants' mothers. Furthermore, not only did the participants in this study use the computer frequently and loved using it; they also perceived IT workers as being obsessed with computers. Obsession with computers was a significant discovery as a barrier and a predictor. However, the participants of the study also viewed IT workers as being smart, interesting, hardworking, and creative. As discussed in Chapter Five, creativity was so pronounced in this research that it is recognized in eight distinct areas of this study and identified as an IT career enabler and a predictor. In contrast, interaction with others was not identified in Creamer et al.'s research. However, in this study, interacting with others was observed as a significant barrier, enabler, and predictor.

With the integration of all three models into one structure, this study has created a framework that does not exist in current literature. It encompasses barriers, enablers, and predictors that could influence high school girls in their potential pursuit of an IT career in one model. Using this framework, researchers can work with secondary school administrators and IT practitioners to build implementation strategies to increase recruitment of high school girls in IT careers. The components of these implementation strategies combine communication and education programs to identify and eliminate the barriers high school girls encounter, implement enablers to attract them to the IT field, and monitor predictors to foresee the possible characteristics of girls who are attracted to the IT profession.

While this research study focused on high school girls who could be contemplating a major in IT, it is expected that the implementation strategies may also improve opportunities for all students interested in IT careers including boys and minorities. Furthermore, since the Lifecycle model includes three other stages, barriers, enablers, and predictors in the others stages should be developed to address factors from all possible aspects of the computer pipeline leakage for women.

The benefits of this research and future similar studies will remain vital until the under-representation of women is no longer a problem. The ultimate objective is to use the IT Career

Lifecycle Model and the Pre-College IT Career framework to develop information technology career recruitment and retention strategies to attract girls and women to the IT profession.

References

AAUW Report. (1992). How Schools Shortchange Girls. Marlowe & Company, New York, New York.

AAUW Report. (2000). Tech-Savvy: Educating Girls in the New Computer Age. Washington D.C.

Association for Computing Machinery. (2007). Computing Curricula 2001 Computer Science Community Review. Retrieved April 27, 2007, from http://campus.acm.org/public/comments/comments_cc2001.cfm

ACT (2006). Developing the STEM education pipeline. Iowa City. Retrieved April 10, 2007, from http://www.act.org/path/policy/pdf/ACT_STEM_PolicyRpt.pdf

Ahuja, M. K. (1995). Information technology and the gender factor. Paper presented at the Special Interest Group on Computer Research Annual Conference. Proceedings of the 1995 ACM SIGCPR Conference, Nashville, Tennessee, 156 - 166.

An Educator's Guide to Gender Bias Issues. (1999). Retrieved March 21, 2007, from http://lrs.ed.uiuc.edu/wp/access-2002/gender_bias.htm

Baskerville, R. M., Myers, Michael D. (2004). Special issue on action research in Information systems: Making IS research relevant to practice -- forward. MIS Quarterly, 28(3), 329-335.

Besana, G., Dettori, L. (2004) Together is Better: Strengthening The Confidence Of Women In Computer Science, Journal for Computing Sciences in Colleges, 19(5) 130-139.

Beyer, S., Rynes, K., & Haller, S. (2004). Deterrents to women taking computer science courses. IEEE Technology and Society Magazine, 23(1), 21-28.

Bleeker, M. (2006)Gender differences in adolescents' attitudes about IT careers. In E. M. Trauth (Ed.), Encyclopedia of Gender and Information Technology (Vol. 1, pp. 507-513). Hershey: Idea Group Reference.

Blum, L., & Frieze, C. (2005). The evolving culture of computing. Frontiers: A Journal of Women Studies, 26(1), 110-125.

Borg, A. (2002). Computing 2002: Democracy, education, and the future. ACM SIGCSE Bulletin, 34(2), 13-14.

Camp, T. (1997). The incredible shrinking pipeline. Communications of the ACM, 40(10), 103-110.

Carlson, S. (2006). Wanted: female computer-science students. Retrieved February 16, 2006, from www.chronicle.com/free/v52/i19/19a03501.htm

Center for Women and Information Technology. (2007). Retrieved April 5, 2007, from http://www.umbc.edu/cwit/

Chicago Public Schools (2006). Every Child, Every School. Retrieved March 5, 2006, from http://www.cps.k12.il.us/

Clayton, D., & Lynch, T. (2002). Ten years of strategies to increase participation of women in computing programs: the Central Queensland University experience: 1999-2001. ACM SIGCSE Bulletin, 34(2), 89-93.

Cody, R. P., & Smith, J. K. (2006). Applied Statistics and the SAS Programming Language. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Cohoon, J. M. (2002). Recruiting and retaining women in undergraduate computing majors. ACM SIGCSE Bulletin, 34(2), 48-52.

Computer Science Teachers Association (2005). Achieving Change: The CSTA Strategic Plan. Retrieved April 5, 2007 from http://www.csta.acm.org/About/sub/StrategicPlanWeb2.pdf.

Computing Research Association. (2006). Drop in CS bachelor's degree production. Retrieved November 18, 2006, from www.cra.org/CRN/articles/march06/vegso

Creamer, E. G., Burger, C. J., & Meszaros, P. S. (2004). Characteristics of high school and college women interested in information technology. Journal of Women and Minorities in Science and Engineering, 10, 67-78.

Creamer, E. G., Lee, S., Meszaros, P. S., Laughlin, A., & Burger, C. J. (2005a). Predicting women's interest and choice in a career in information technology. Proceeding of the 2005 Oxford Conference Paper.

Creamer, E. G., Meszaros, P. S., & Burger, C. J. (2005b). 2005 career decision making survey, from www.wit.clahs.vt.edu/researchers1/documents/05_V4_survey_0701.pdf

Cuny, J., Aspray, W (2002). Recruitment and retention of women graduate students in computer science and Engineering: results of a workshop organized by the Computer Research Association. ACM SIGCSE Bulletin, 34(2), 168-174.

DePaul University Institutional Review Board (IRB). (2006). Retrieved January 1, 2006, from http://research.depaul.edu/

eMarketer (2007). More women online. Retrieved April 18, 2007, from www.emarketer.com/Article.aspx?1004775

Evans, D. L. (2003). Education and Training for the Information Technology Workforce – Report to Congress from the Secretary of Commerce.

Frenkel, K. A. (1990). Women & computing. Communications of the ACM, 11(11), 34-46.

Grant, D. M. (2004). Girls with engineering mindz. Proceeding of the MBAA International Conference, Chicago, Illinois.

Grant, D. M. (2005). Attracting female students by placing a technical curriculum in a societal framework. Proceedings of the Information Resource Management Association (IRMA) 2005 International Conference.

Grant, D. M., Knight, L. V., & Steinbach, T. A. (2006). Fostering technology interest among high school girls. E. Trauth (Ed.), Encyclopedia of Gender and Information Technology, Idea Group Inc.

Grant, Donna, Knight, Linda V., and Steinbach, Theresa (2007), Young Women's Misinformation Concerning IT Careers: Exchanging One Negative Image for Another" , Informing Science Journal, Volume 10, pages 91-106.

Hazzan, O., & Levy, D. (2006). ACM's attention to women in IT. In E. M. Trauth (Ed.), Encyclopedia of Gender and Information Technology (Vol. I, pp. 7-12). Hershey: Idea Group Inc.

Hecker, D. E. (2005). Occupational employment projections to 2014. Retrieved March 15, 2006, from www.bls.gov/opub/mlr/2005/11/art5full.pdf

Holzer, J. (2006). CEOs fret over America's workforce. Retrieved February 21, 2006, 2006, from www.Forbes.com/2006/02/08

Information Technology Association of America. (2004). Adding value...growing careers: The employment outlook in today's increasingly competitive IT job market. Sept. 2004.

Information Technology Association of America (2005a). Untapped talent: diversity, competition and America's high tech future. June 21, 2005. Arlington, VA.

Information Technology Association of America (2005b). Innovation and a competitive U.S. economy: The case for doubling the number of STEM graduates. September 2005

Jepson, A., & Perl, T. (2002). Priming the Pipeline. ACM SIGCSE Bulletin, 34(2), 36-39.

Ji, P. Y., Pokorny, S. B., & Jason, L. A. (2004). Factors influencing middle and high school's active parental consent return rates. Evaluation Review, 28(6), 578-591.

Kadijevich, D. (2000). Gender differences in Computer Attitude among ninth-grade students. J. Educational Computing Research, 22(2), 145-154.

Katz, S., Aronis, J., Allbritton, D., Wilson, C., & Soffa, M. L. (2003) Gender and race in predicting achievement in computer science, IEEE Technology and Society Magazine, 22(3), 20-27.

Kiesler, S., Sproull, L., & Eccles, J. S. (1985). Pool halls, chips, and war games: women in the culture of computing. Psychology of Women, 9(4), 451-462.

Klawe, M., & Leveson, N. (1995). Women in computing: where are we now? Communications of the ACM, 38(1), 29-35.

Lazowska, E. (2002). Pale and Male: 19th Century Design in a 21st Century World. ACM SIGCSE Bulletin, 34(2), 11-12.

Litwin, M. S. (2003). How to Assess and Interpret Survey Psychometrics (Vol. 8). Thousand Oaks, California: Sage Publications.

Margolis, J., & Fisher, A. (1997). Geek Mythology and Attracting Undergraduate Women in Computer Science. Retrieved November 12, 2002, 2002, from www-2.cs.cmu.edu/~gendergap/papers/wepan97.html

Margolis, J., & Fisher, A. (2002). Unlocking the Clubhouse: Women in Computing. Cambridge, Massachusetts: MIT Press.

McCullagh, P. and Nelder, J.A. (1989) Generalized Linear Models, Second Edition, London: Chapman and Hall.

McGee, M. K. (2005). New program aims to woo more kids into IT careers. Retrieved October 1,2005, 2005, from informationweek.com/story/showArticle.jhtml

McGee, M. K. (2007). There's still a shortage of women in tech, first female turning award winner warns. Retrieved March 19, 2007, from http://www.informationweek.com/showArticle.jhtml;jsessionid=4U3EKQMXWMOBKQSNDLRCKH0CJUNN2JVN?articleID=197008472&queryText=McGee

Merriam-Webster, (2006). Merriam-Webster Online Dictionary. Retrieved March 22, 2006, from www.m-w.com/

Moorman, P., & Johnson, E. (2003). Still a stranger here: attitudes among secondary school students towards computer science. ACM SIGCSE Bulletin, 35(3), 193-197.

National Center for Educational Statistics, (2005). Digest of Education Statistics, Retrieved January 10, 2006, from nces.ed.gov/programs/digest/d05/index.asp

O'Lander, R. (1996). Factors effecting high school student's choice of computer science as a major. Paper presented at the Symposium on Computers and the Quality of Life, Philadelphia, Pennsylvania.

Ott, R. l., & Longnecker, M. (2001). An introduction to statistical methods and data Analysis (Fifth ed.). Pacific Grove, CA: Duxbury, a division Thomson Learning.

Overby, S. (2006). The New IT department:The top three positions you need. CIO Magazine. Retrieved January 10, 2006 from http://www.cio.com/article/116600/

Pearl, A., Pollack, M. E., Riskin, E., Thomas, B., Wolfe, E., & Wu, A. (1990). Becoming a computer scientist. Communications of the ACM, 33(11), 47-57.

Pokorny, S. B., Jason, L. A., Schoney, M. E., Townsend, S. M., & Curie, C. J. (2001). Do participation rates change when active consent procedures replace passive consent. Evaluation Review, 25(5), 567-580.

Pollock, L., McCoy, K., Carberry, S., Hundigopal, N., & You, X. (2004). Increasing high school girls' self confidence and awareness of CS through a positive summer experience. Paper presented at the Technical Symposium on Computer Science Education, Norfolk, Virginia.

Queen of Peace, (2006). Retrieved February 10, 2006, from www.queenofpeacehs.org

Roberts, E. S., Kassianidou, M., & Irani, L. (2002). Encouraging women in computer science. ACM SIGSE Bulletin, 34(2), 84-88.

Rodger, S. H., & Walker, E. L. (1996). Activities to attract high school girls to computer science. Paper presented at the Technical Symposium on Computer Science Education, Philadelphia, Pennsylvania.

Rowell, G. H., Perhac, D. G., Hankins, J. A., Parker, B. C., Pettey, C. C., & Iriarte-Gross, J. M. (2003). Computer-related gender differences. Paper presented at the Technical Symposium on Computer Science Education, Reno, Nevada, USA.

Sanders, J. (2005). Gender and technology in education: a research review. Retrieved February 12, 2006, from www.josanders.com/pdf/gendertech0705.pdf

SAS 9.1.3 Help and Documentation. (Version 5.1.2600) (2002). Cary: SAS Institute Inc.

Scragg, G., & Smith, J. (1998). A study of the barriers to women in undergraduate computer science. Paper presented at the Technical Symposium on Computer Science Education, Atlanta, Georgia.

Shashaani, L. (1994). Gender-differences in computer experience and its influence on computer attitudes. Journal of Educational Computing Research, 11(4), 347-367.

Sheard, J., & Markham, S. (2002). Creating an interest in IT: a gender study. Paper presented at the International Conference on Computers in Education, Auckland, New Zealand.

SIM. (2006) Society for Information Management The information technology workforce: Trends and implications 2005-2008 Report.

Spertus, E. (1991). Why are there so few female computer scientist? Massachusetts Institute of Technology, Cambridge, Massachusetts.

Teague, J. (2000). Women in computing: what brings them to it, what keeps them in it? GATES, 5(1), 45-59.

Teague, G. J., & Clarke, V. A. (1993). Attracting women to tertiary computing courses. Paper presented at the Proceedings of the twenty-fourth ACM SIGCSE technical symposium on Computer science education, Indianapolis, Indiana.

Thomas, T., & Allen, A. (2006). Gender differences in students' perceptions of Information Technology as a career. Journal of Information Technology Education, 5, 165-178.

Townsend, G. C. (2002). People who make a difference: mentors and role models. ACM SIGCSE Bulletin, 34(2), 57-61.

Trauth, E. (2006a). Environmental Context and Women in the IT Workforce. Encyclopedia of Gender and Information Technology. Hershey, PA: Idea Group Reference. 1, 276-281.

Trauth, E. (2006b). Encyclopedia of Gender and Information Technology. Hershey, PA: Idea Group Reference.

United States Department of Labor. (2006). Bureau of Labor Statistics, Occupational Outlook Handbook. Retrieved February 16, 2006, from www.bls.gov/oco/oco2003.htm

Vegso, J. (2005) Interest in CS as a major drops among incoming freshman. Computing Research Association. 17(3) , Retrieved November 18, 2006, from www.cra.org/CRN/articles/may05/vegso

Weinberger, C. J. (2004). Just ask! Why surveyed women did not pursue IT courses or careers. IEEE Technology and Society Magazine, 23(2), 28-35.

Yu, C. H. (2006). Reliability and validity. Retrieved March 7, 2006, 2006, from http://seamonkey.ed.asu.edu/~alex/teaching/assessment/reliability.html

Appendix A: Definition of Terms

Term	Definition	Source
Barrier	Something immaterial that impedes or separates; an obstacle	Merriam-Webster, 2006
Computing in a Societal framework	Similar to Margolis and Fisher's concept (2002) of "Computing with a purpose." Margolis and Fisher propose, "computing can be taught in an interdisciplinary setting, honoring the goal of solving the world's problems"	Margolis & Fisher, 2002, p. 60
High school	A school, especially in the US, usually including grades 9-12.	Merriam-Webster, 2006
Information technology (IT).	The broad subject concerned with all aspects of accessing, managing, processing and transmitting information, especially within a large organization or company	
IT Careers	Consist of occupations that require designing, developing, and implementing software and hardware systems, providing technical support for software and hardware systems and creating and maintaining network and database systems.	Creamer et al., 2004
IT Community	Consist of all people and organizations in the IT field. For example, this group includes high school IT teachers, IT researchers, IT professors in universities and IT practitioners in the industry	Grant, 2006
Societal IT Influencers	People and informal norms in society outside of the IT community who directly or indirectly have an impact on the decisions girls make to choose an IT career (i.e., parents, counselors, other teachers in high school, friends, stereotypes, and gender biases toward girls pursuing an IT careers).	Grant, 2006

Appendix B - Research Instrument with Modifications Highlighted

School ____________________________

2006 Career Survey

SECTION 1: General Information

1.1 What is your class? (Check the one best answer) ☐ Junior ☐ Senior

1.2 What is your cumulative grade point average?______________________ (For example 3.0 out of 4.0)

1.3 What is your race/ethnicity?

☐ African American ☐ Caucasian/White ☐ Hispanic/Latino
☐ Native American ☐ Asian/Pacific Islander ☐ Other __________________ (Please specify)

1.4 What is the highest level of education completed by your **mother/female guardian**?

☐ Less than high school ☐ High school or equivalent ☐ High school and some college
☐ Associates degree ☐ Bachelor degree ☐ Masters degree
☐ Doctorate degree ☐ Professional degree ☐ Other _______________ (Please specify)

1.5 What type of job does your **mother/female guardian** currently hold?

____(Fill in job title or state if she is currently unemployed)

1.6 What is the highest level of education completed by your **father/male guardian**?

☐ Less than high school ☐ High school or equivalent ☐ High school and some college
☐ Associates degree ☐ Bachelor degree ☐ Masters degree
☐ Doctorate degree ☐ Professional degree ☐ Other _______________ (Please specify)

1.7 What type of job does your **father/male guardian** currently hold?

_____________________________________(Fill in job title or state if he is currently unemployed)

1.8 Are you planning to go to college? ☐ Yes ☐ No

1.9 Do you expect your college major or minor to be in a computer-related field, such as computer science, web design, information technology, etc? ☐ Yes ☐ No

1.10 What do you expect your college major to be? ____________________(Fill in the name of your major)

1.11 How old were you when you first started using a computer? ____________(Fill in the approximate age)

Based in part by the survey created by Elizabeth G. Creamer, Peggy S. Meszaros, and Carol J. Burger (2005b) for a NSF Funded Project at Virginia Tech. *2005 Career Decision Making Survey*
http://www.wit.clahs.vt.edu/researchers1/documents/05_V4_survey_0701.pdf

SECTION 2: GENERAL CAREER QUESTIONS

2-1. YOUR CAREER INTERESTS

Please state the career that you are most interested in. ____________________(Write in your reply)
What are the reasons this career interest you? (Please print reasons below)

2-2. IMPORTANT FACTORS IN YOUR CAREER CHOICE

The following questions are about factors that influence career choice. Circle the number that shows how important each item is in your choice of a career.

How important are the following factors in your choice of a career?	**Completely Unimportant**	**A Little Important**	**Somewhat Important**	**Very Important**
1. Opportunity to help people	1	2	3	4
2. Good salary	1	2	3	4
3. Ability to balance work and family	1	2	3	4
4. Opportunity to interact with others	1	2	3	4
5. Time to have a life outside of work	1	2	3	4
6. High status or prestige	1	2	3	4
7. Opportunity to solve interesting problems	1	2	3	4
8. Opportunity to use creative skills	1	2	3	4
9. Pleasant working environment	1	2	3	4
10. Flexible hours	1	2	3	4
11. Opportunity to improve community or society	1	2	3	4

SECTION 3: COMPUTERS AND TECHNOLOGY

DIRECTIONS
For purposes of this survey, the field of information technology includes careers such as computer engineer, programmer, web designer, database administrator, and network administrator. We are interested in your answers regardless of the career you expect to pursue.

3-1. TAKING A COMPUTER COURSE

The following questions are if you **have already taken or plan to take** a computer course.		
1. Have you taken or do you plan to take a computer course?	**Yes**	**No**
2. If yes, please **check all reasons** that help explain why you have taken or plan to take a computer course.		

- ☐ Required for my high school program
- ☐ General interest in computers and technology
- ☐ Possible major or minor
- ☐ Recommended by a counselor or teacher
- ☐ Recommended by a parent/guardian
- ☐ Will be needed to get a good job
- ☐ Passionate interest in computers and technology
- ☐ Recommended by a friend
- ☐ Other_____________________(Please Specify)

3. If you have already taken a computer course circle **one** phrase that best describes how you felt about the course.	**I disliked the computer course**	**The computer course was OK**	**I liked the computer course**	**I loved the computer course**

4. Please explain your answer for question #3. **(Please print)**.

____

____

____

3-2 COMPUTER USE AND ACCESS

The following questions are about whether you have access to a computer and how you use it. Circle only one answer for each question.		
1. Is there a computer in your home?	**Yes**	**No**
2. Do you generally have access to the computer in your home when you want to use it?	**Yes**	**No**

3. If you don't have access when you want it, please explain what limits your access. **(Please Print)**

____

____

4. Circle the total number of hours you use any computer (For example, home, school, work, library) in an average week.	**0-6 hours**	**7-14 hours**	**15-22 hours**	**Over 22 hours**

5. Circle one phrase that best describes your feelings about using the computer.	**I dislike using the computer**	**Using the Computer is OK**	**I like using the computer**	**I love using the computer**

6. Please explain your answer for question #5. **(Please Print)**

____

____

The following questions are about the activities you use on a computer. Circle the number that reflects how often you do each of the following activities.				
How often do you use a computer for the following activities?	**Never**	**Once a month**	**Once a week**	**Several times a week**
7. Communication (such as email, instant messages, or chat rooms)	1	2	3	4
8. Games (any computer-based game)	1	2	3	4
9. General entertainment (such as internet surfing or music downloads)	1	2	3	4
10. General tasks (such as word processing or creation of databases or spread sheets)	1	2	3	4
11. Development or design (such as creating web pages or graphics, programming)	1	2	3	4
12. Educational purposes (such as to conduct research or complete a homework assignment)	1	2	3	4

3-3. ATTITUDES ABOUT PEOPLE WHO WORK IN COMPUTER–RELATED FIELDS

The following questions concern attitudes about the characteristics of workers in computer fields. Circle the number that indicates how much you disagree or agree with each of these statements.				
I think people who choose careers in computers are:	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**
1. Geeks	1	2	3	4
2. Interesting	1	2	3	4
3. Smart	1	2	3	4
4. Loners /antisocial	1	2	3	4
5. Likely to be male	1	2	3	4
6. Creative	1	2	3	4
7. Hard-working	1	2	3	4
8. Obsessed with Computers	1	2	3	4

3-4. KNOWLEDGE ABOUT COMPUTER AND TECHNOLOGY CAREERS

What do you see are the advantages of working in a computer or technology related field?

List as many advantages that you can think of. (Please Print)

____

____

____

____

____

____

What do you see are the disadvantages of working in a computer or technology related field?

List as many disadvantages that you can think of. (Please Print)

____

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____

____

3-5. SOURCES OF INFORMATION ON CAREERS IN COMPUTERS AND TECHNOLOGY

The following questions concern sources of information on careers in computers and technology. Circle the number that shows how often each person has discussed career options in computers and technology with you.

How often has the following person discussed career options in computers and technology with you?	**Never**	**Once or twice**	**Several Times**	**Many Times**
1. Mother/female guardian	1	2	3	4
2. Father/male guardian	1	2	3	4
3. Teacher	1	2	3	4
4. Counselor or advisor	1	2	3	4
5. Other family members	1	2	3	4
6. Male friends	1	2	3	4
7. Female friends	1	2	3	4

3-6. FAMILIARITY WITH AND INTEREST IN COMPUTER-RELATED CAREERS

The following questions are about familiarity and interest in a career in a computer related field. Circle a number that indicates how much you disagree or agree with each statement.				
	Disagree	**Slightly Disagree**	**Slightly Agree**	**Agree**
1. I have a good idea about what people in computer-related fields do in their jobs.	1	2	3	4
2. I feel a sense of satisfaction when I am able to use a computer to solve a problem.	1	2	3	4
3. If I chose to, I probably have the ability to be successful in a job in a computer-related field.	1	2	3	4
4. I know someone in the computer industry who could be a role model for me.	1	2	3	4
5. I would be comfortable working in a male-dominated occupation.	1	2	3	4
6. My teachers/counselors would probably consider a career in a computer-related field a good choice for me.	1	2	3	4
7. My parents would probably consider a career in a computer-related field a good choice for me.	1	2	3	4
8. My friends would probably consider a career in a computer-related field a good choice for me.	1	2	3	4
9. I have family and/or friends who work in a computer-related job.	1	2	3	4

3-7. ATTITUDES ABOUT COMPUTER AND TECHNOLOGY CAREERS

The following questions are attitudes about the characteristics of careers in the computer and technology field. Circle the number that indicates how much you disagree or agree with each of these statements.					
I think careers in computers and technology have the following characteristics:	**Disagree**	**Slightly Disagree**	**Slightly Agree**	**Agree**	**Don't Know**
1. Opportunity to interact with others	1	2	3	4	5
2. High status or prestige	1	2	3	4	5
3. Opportunity to improve community or Society	1	2	3	4	5
4. Flexible hours	1	2	3	4	5
5. Good salary	1	2	3	4	5
6. Pleasant working environments	1	2	3	4	5
7. Time to have a life outside of work	1	2	3	4	5
8. Opportunity to use creative skills	1	2	3	4	5
9. Ability to balance work and family	1	2	3	4	5
10. Opportunity to solve interesting problems	1	2	3	4	5
11. Opportunity to help people	1	2	3	4	5
12. Primary emphasis is on computer programming jobs	1	2	3	4	5
13. Require a strong background in mathematics	1	2	3	4	5

Appendix C: Participant Assent Form

DEPAUL UNIVERSITY

School of Computer Science, Telecommunications and Information Systems
243 South Wabash Avenue
Chicago, Illinois 60604-2301
312/362-8381
FAX: 312/362-6116

ASSENT TO PARTICIPATE IN RESEARCH STUDY

YOUNG WOMEN AND CAREERS

What is the purpose of this research?
We are asking you to be in a research study because we are trying to learn more about your thoughts on careers and computers. This study is being conducted by Donna Grant of DePaul University.

How much time will this take?
This study will take about 30 minutes of your time.

What will I be asked to do if I agree to participate in this study?
If you agree to be in this study, you will be asked to fill out a survey.

What are the risks of being in this study?
This study does not involve any risks other than what you deal with in daily life. For example, you may feel uncomfortable or embarrassed about answering certain questions. If so, you are free to refuse to answer any question that you do not want to answer.

What are the benefits of being in this study?
You will not get any benefit from being in this study. However, giving me your honest opinion about careers and computers might help me to create change. Your participation is very important because it will help researchers and school administrators to provide additional information to other young women regarding career options and alternatives.

Can I decide not to participate? If so, are there other options?
Yes, you can choose not to participate. We have asked your parents to let you be in this study. However, even if your parents have said "yes," you can still decide not to be in the study. Even if you agree to be in the study now, you can change your mind later and leave the room. Nothing bad will happen if you decide not to participate or change your mind later.

How will my privacy be protected?
The records of this study will be kept private. In any report we might make, we will not include any information that will identify you, like your name. Research records will be stored securely, and only researchers will be able to look at the records.

Will I receive any kind of payment for being in this study?
If you decide to complete the survey, you will receive a raffle ticket. Once you have received the raffle ticket, please print your name and your division number, and place the ticket in the raffle container. Dr. Wyatt will draw tickets and prizes will be given. The prizes are $20 gift certificates. The winner does not have to be present for the raffle and Dr. Wyatt will be responsible to ensure that all winners receive their prizes.

Whom can I contact if I have questions?
If you have questions about this study, please contact Donna Grant by email at dgrant@cti.depaul.edu or call at 312-362-7288. If you have questions about your rights as a research subject, you may contact Shay-Ann Heiser Singh, Coordinator of the DePaul University's Institutional Review Board at 312-362-7593 or by email at sheiser@depaul.edu.

You will be given a copy of this information to keep with you.

Statement of Assent:

I have read the above information. I have all my questions answered. I agree to be in this study.

Signature: ______________________________ Date: __________ Grade in School: _______

Guardian/Parent's Name: ________________________

DEPAUL UNIVERSITY

School of Computer Science,
Telecommunications and
Information Systems
243 South Wabash Avenue
Chicago, Illinois 60604-2301
312/362-8381
FAX: 312/362-6116

March 30, 2006

To the Parents of Female Junior and Senior Students,

Whitney M. Young Magnet High School has agreed to work with me, Donna Grant of DePaul University, on a research study regarding young women and careers. I am a Ph.D. student who is conducting research to study girls' attitudes and thoughts about careers and computers. The research study will benefit from your daughter's opinions and thoughts because it will help researchers and school administrators to provide additional information to other young women regarding career options and alternatives.

The school will be administering a survey on Thursday, April 6, 2006. This survey is completely voluntary. **You may choose that your daughter does not participate. To ensure that she does not take the survey you can call me at (312) 362-7288, email me at dgrant@cti.depaul.edu or write me at DePaul University, CTI Center – 4th floor, 243 South Wabash Avenue, Chicago IL 60604.** In the correspondence, please state the school, student's first name, last name, and division number. I will create a "Do Not Participate" list that will be checked before students are allowed to participate. Furthermore, your daughter can also decide not to participate. There are no negative consequences if she decides not to participate.

However, if a student does complete the survey, she will receive a raffle ticket. On April 17, 2006, Ms. Carol Uhl-Alba will draw ten tickets and prizes will be given. The prizes are $20 gift certificates. The winner does not have to be present for the raffle and Ms. Carol Uhl-Alba will be responsible to ensure that all winners receive their prizes.

If anyone has questions regarding the survey, contact me by email at dgrant@cti.depaul.edu or call me at 312-362-7288. If you have questions regarding the rights of participants you may speak to Shay-Ann Heiser Singh, Coordinator of the DePaul University Institutional Review Board at (312) 362-7593.

Thanks for taking the time to read this letter,

Donna M. Grant

Donna M. Grant
DePaul University
CTI Center – 4th floor
243 South Wabash Avenue
Chicago IL 60604-2301

2

Queen of Peace
HIGH SCHOOL *A Catholic Sinsinawa Dominican community educating women of Peace.*

February 22, 2006

To Whom It May Concern:

Queen of Peace High School is pleased to collaborate with Donna M. Grant of DePaul University's School of Computer Science, Telecommunications and Information Systems (CTI) on the study of "Young Women and Careers." Working together with Donna on this project will help us to learn more about our juniors and seniors' thoughts on careers and computers.

By agreeing to collaborate, we understand that we will be conducting a 30-minute survey of junior and senior students who are willing to participate, providing a room to conduct the survey and a coordinator to facilitate the survey announcement and administration. Ms. Grant will provide the material required to announce the survey and the resources required to administer the survey. Upon completion of her research, Ms. Grant will also provide a summary of our school's data to facilitate future discussions of possible strategies to encourage our students to consider a career in Information Technology.

Queen of Peace looks forward to participating in this study. If you have questions or concerns, please fell free to contact me at 708-458-7600 x 220.

Best Regards,

Patricia Nolan-Fitzgerald

Patricia Nolan-
Fitzgerald Principal

A copy of this letter will be sent to:

Donna M. Grant
DePaul University
School of Computer Science, Telecommunications and Information
Systems 243 South Wabash Avenue
Chicago, Illinois 60604-2300

7659 South Linder Burbank, IL 60459 p: 708458.7600 p773.586.7300 f: 708.4585734 www.queenofpeacehs.org

Appendix F: Chicago Public Schools Letter for Approved Research

CHICAGO PUBLIC SCHOOLS

Office of Research, Evaluation, and Accountability
125 South Clark Street, 11th floor • Chicago, Illinois 60603
Telephone: 773/553-2422
Fax: 773/553-2436

April 14, 2006

Ms. Donna Grant
DePaul University
School of Computer Science, Telecommunications and Information Systems
243 South Wabash Avenue
Chicago, Illinois 60604-2300

Dear Ms Grant:

Thank you for your interest in conducting research in the Chicago Public Schools (CPS). The Research Review Group of the Office of Research, Evaluation and Accountability reviewed the materials you resubmitted for the project studying of female high school students' choices regarding technology majors. This group consists of a combination of research professionals from several different project areas in the Chicago Public Schools. We evaluate research requests presented to CPS to insure their compliance with district policies and regulations.

After reviewing your materials, the Group felt that your project met all of our standards for research in CPS. I am happy to report that we have approved this research project for the period of one (1) calendar year and assigned it Project Number: 00080. This means that you have until April 14, 2007 to complete data collection without having to apply for research approval from CPS again.

We ask that at the conclusion of the study we be provided with a copy of any final presentations or documentation of findings. If you should need to make any methodological changes to this study (i.e. increasing the number sites, data collection procedures) we request that you notify us before doing so. In all future correspondence with the Research Review Group please include your project number.

If you have any questions or need anything additional from us please feel free to contact me at 773-553-2438. Again, thank you for your interest in conducting research in the Chicago Public Schools and good luck with your study.

Sincerely,

John F. Loehr

John F. Loehr, Ph.D.
Research Analyst

Every Child, Every School

Appendix G: School Administrator's Checklist

Survey Procedures for Kenwood

Prior to the administering the survey the following activities will occur:

1. A letter will be secured from Chicago Public Schools approving the survey and waiving the need for a parent's signature. Passive permission will be allowed to administer this survey. (Completed)

2. Dr. Wyatt will be contacted to:
   - obtain a signed copy of the letter of collaboration (See attached document for the Letter of Collaboration) (Completed)
   - schedule the dates and time that the survey will be administered (Complete)
   - schedule the date and time for the raffle drawing (Needs to be rescheduled)
   - confirm the raffle prizes
   - secure a room after normal school hours to conduct the survey (Teacher's Lounge)
   - secure a mailing list of all female junior and senior students to send the letter home to the parents notifying them of the study and giving them the opportunity to put their daughters on a "Do Not Participate" List
   - determine how many copies of the parent letter are required (150)
   - determine what date the parent letter will be sent (Complete)
   - identify the contact for the school newsletter to include the study announcement at least one week prior to the survey dates (See the Survey Newsletter)
   - identify the school contact for the flyer to have them posted 2 weeks before the survey begins (See the Survey Flyer).
   - identify the school contact for the school intercomm system to announce the survey on the days it will be administered (See Intercomm Script)

On the day(s) to administer the survey, the following activities will occur:

1. The Principal Investigator, Donna Grant, will bring copies of the Assent form and the survey
2. Donna will bring blank raffle tickets and the raffle container
3. A "Do Not Participate" (DNP) List prepared from the parents' emails and telephone calls will be created for each school as applicable.
4. Dr. Wyatt will check the DNP list and if any students are on the list, Donna will not give distribute the survey to those students
5. Before the survey begins, Donna will distribute the 2 assent forms per student and read the form to the students
6. The students will be given an opportunity to ask questions regarding the research

7. Donna will then ask the students four questions regarding the assent form, ask for a volunteer from the group to answer each question, and discuss the answers to ensure all students understand the correct answer. The questions are as follows:
    a) What is the purpose of the study?
    b) What are the benefits associated with being in the study?
    c) Do you have to participate in this study?
    d) What will happen if you change your mind and want to stop taking the survey?
8. The participants will be asked to sign the assent form, if they wish to participate.
9. Donna will collect the signed forms and the participant will keep the other form for her records.
10. Donna will distribute the survey and the students will be given 30 minutes to complete the survey.
11. Once the participant has completed the survey, she will return it to Donna.
12. Donna will collect the survey and give the student a set of raffle tickets.
13. The student will fill out the one raffle ticket with her name and division number and place it in the raffle container and keep the other ticket to claim her prize.
14. On May 19rd, Dr. Wyatt will pick the winning tickets. The winner does not have to be present for the raffle and Dr. Wyatt will be responsible to ensure that all winners receive their prizes.

Appendix H: Results for Hypothesis 3 – Backward Elimination Logistic Regression for Important Career Factors

H3 – Factors that girls identify as important in their careers

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	CareerImproveComm	1	10	0.0001	0.9911	CareerImproveComm
2	CareerInterestProb	1	9	0.0209	0.8850	CareerInterestProb
3	CareerWorkEnvir	1	8	0.0364	0.8486	CareerWorkEnvir
4	CareerLife	1	7	0.0328	0.8564	CareerLife
5	CareerHelpPeople	1	6	1.1738	0.2786	CareerHelpPeople
6	CareerFlexhrs	1	5	1.2600	0.2616	CareerFlexhrs
7	CareerStatus	1	4	1.2955	0.2550	CareerStatus
8	CareerSalary_num	1	3	1.5299	0.2161	
9	CareerFamily	1	2	1.7983	0.1799	CareerFamily

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.7779	1.7555	7.4080	0.0065
CareerInteract	1	-0.8277	0.3016	7.5338	0.0061
CareerCreatSkil	1	1.3253	0.4667	8.0641	0.0045

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
CareerInteract	0.437	0.242	0.789
CareerCreatSkil	3.763	1.508	9.394

Association of Predicted Probabilities and Observed Responses

Percent Concordant	58.8	Somers' D	0.399
Percent Discordant	18.9	Gamma	0.514
Percent Tied	22.4	Tau-a	0.043
Pairs	8648	c	0.700

Appendix I: Results for Hypothesis 3 – Backward Elimination Logistic Regression for IT Job Characteristics

H3 – Factors that characterize IT jobs

The LOGISTIC Procedure

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq
1	ITImproveComm_recode	1	10	0.0130	0.9094
2	ITLife_recoded	1	9	0.0167	0.8971
3	ITHelpPeople_recoded	1	8	0.0214	0.8838
4	ITStatus_recoded	1	7	0.1207	0.7283
5	ITFlexhrs_recoded	1	6	0.1669	0.6829
6	ITFamily_recoded	1	5	0.2189	0.6399
7	ITSalary_recoded	1	4	1.1858	0.2762
8	ITInterestProb_recod	1	3	1.1088	0.2923
9	ITInteract_recoded	1	2	1.3141	0.2517
10	ITCreatSkil_recoded	1	1	1.8896	0.1692

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.7977	1.0353	21.4772	<.0001
ITWorkEnvir_recoded	1	0.4917	0.2364	4.3257	0.0375

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
ITWorkEnvir_recoded	1.635	1.029	2.599

The LOGISTIC Procedure

Association of Predicted Probabilities and Observed Responses

Percent Concordant	46.9	Somers' D	0.241
Percent Discordant	22.8	Gamma	0.346
Percent Tied	30.3	Tau-a	0.026
Pairs	8671	c	0.621

Appendix J: Results for Hypothesis 10a – Backward Elimination Logistic Regression for Source of IT Career Information

H10a – Sources of IT Career Information

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	SourceTeacher	1	6	0.0136	0.9071	SourceTeacher
2	SourceFemale	1	5	0.0297	0.8631	SourceFemale
3	SourceCounselor	1	4	0.0560	0.8129	SourceCounselor
4	SourceOther	1	3	0.1817	0.6700	SourceOther
5	SourceMale	1	2	0.9362	0.3333	SourceMale
6	SourceFather	1	1	1.1685	0.2797	SourceFather

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.1594	0.5544	56.2805	<.0001
SourceMother	1	0.6098	0.1990	9.3899	0.0022

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
SourceMother	1.840	1.246	2.718

Association of Predicted Probabilities and Observed Responses

Percent Concordant	54.9	Somers' D	0.336
Percent Discordant	21.4	Gamma	0.440
Percent Tied	23.7	Tau-a	0.037
Pairs	9192	c	0.668

Appendix K: Results for Hypothesis 10b – Backward Elimination Logistic Regression for People Who May Think IT is a Good Career Choice for Girls

The LOGISTIC Procedure

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq	Variable Label
1	TeacherChoice	1	2	0.0385	0.8445	TeacherChoice
2	FriendsChoice	1	1	2.8499	0.0914	FriendsChoice

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-6.3575	0.9846	41.6879	<.0001
ParentsChoice	1	1.2188	0.2820	18.6744	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
ParentsChoice	3.383	1.946	5.880

Association of Predicted Probabilities and Observed Responses

Percent Concordant	68.3	Somers' D	0.582
Percent Discordant	10.1	Gamma	0.742
Percent Tied	21.6	Tau-a	0.065
Pairs	9168	c	0.791

Appendix L: Results for Hypothesis 10c – Backward Elimination Logistic Regression for People Who May Recommend a Computer Course to the Participants

The LOGISTIC Procedure

Backward Elimination Procedure

Step 0. The following effects were entered:

Intercept Recommend_Friend_rec Recommend_parent_rec Recommend_Coun_Teach

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

-2 Log L = 151.155

Residual Chi-Square Test

Chi-Square	DF	Pr > ChiSq
2.1004	3	0.5518

NOTE: All effects have been removed from the model.

Appendix M: Results for Backward Elimination Logistic Regression for the Beginnings of a New Model

The LOGISTIC Procedure

Summary of Backward Elimination

Step	Effect Removed	DF	Number In	Wald Chi-Square	Pr > ChiSq
1	FeelaboutComputer_re	1	10	0.0317	0.8586
2	ITMath_recoded	1	9	0.0642	0.7999
3	BeSuccessful_recoded	1	8	0.2807	0.5962
4	ITComputerPgm_recode	1	7	0.7937	0.3730
5	ITWorkEnvir_recoded	1	6	1.3880	0.2387
6	SourceMother	1	5	1.7724	0.1831
7	Computer_at_Home_rec	1	4	2.9392	0.0865

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-8.5735	2.0643	17.2500	<.0001
Obsessed_with_Comput	1	0.9847	0.4854	4.1149	0.0425
CareerInteract	1	-0.7629	0.3169	5.7956	0.0161
CareerCreatSkil	1	0.9065	0.4272	4.5031	0.0338
ParentsChoice	1	1.2084	0.2944	16.8516	<.0001

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Obsessed_with_Comput	2.677	1.034	6.932
CareerInteract	0.466	0.251	0.868
CareerCreatSkil	2.476	1.072	5.718
ParentsChoice	3.348	1.880	5.962

Association of Predicted Probabilities and Observed Responses

Percent Concordant	82.0	Somers' D	0.672
Percent Discordant	14.9	Gamma	0.693
Percent Tied	3.1	Tau-a	0.075
Pairs	9096	c	0.836