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DEDICATION

To my mother, Dee Dee, and my husband, Rick,
for their support and encouragement

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ABSTRACT

There has been much research to suggest that a single-sex college experience for female undergraduate students can increase self-confidence and leadership ability during the college years and beyond. The results of previous studies also suggest that these students achieve in the workforce and enter graduate schools at higher rates than their female peers graduating from coeducational institutions. However, some researchers have questioned these findings, suggesting that it is the selectivity level of the colleges rather than the comprised gender of the students that causes these differences. The purpose of this study was to disentangle the effects of college selectivity and college type (women's or coeducational) on rates of females graduating with degrees in non-traditional fields in order to more fully understand the significance of women's colleges on the success of women in non-traditional fields. The study examined the percentage of physical science, life science, math and computer science, and social science degrees conferred upon females graduating from women's colleges from 1985 - 2001, as compared to those at comparable coeducational colleges. Sampling for this study consisted of 42 liberal arts women's (n = 21) and coeducational (n = 21) colleges. Variables included the type of college, the selectivity level of the college, and the effect of time on the percentage of female graduates. Doubly multivariate repeated measures analysis of variance testing revealed significant main effects for college selectivity on social science graduates and for time on both life science and math and computer science graduates. Significant interaction was also found between the college type and time on social science graduates, as well as the college type, selectivity level, and time on math and computer science graduates. Implications of the results and suggestions for further research are discussed.

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INTRODUCTION

Title IX of the Education Amendment Act of 1972 (20 U. S. C. § 1681) was intended to give females opportunities equal to those of males in educational programs funded by taxpayers. The enactment of Title IX began what has become a more than thirty-year challenge to remove gender barriers for females in many facets of education (National Coalition for Women and Girls in Education, 2002). Though great strides have been made in equalizing access to educational opportunities, the gender gap is still apparent, especially in non-traditional fields for women, such as math, science, and technology.

The largest impact of Title IX on schools has been equalizing access to competitive sports opportunities for females. Mervis (2002) explains that since Title IX's inception in 1972, the number of female high-school students participating in competitive sports has risen by 847%. This tremendous positive impact was brought about by continued monitoring, and the threat of losing federal funding if schools did not provide equal opportunities for both genders (Mervis, 2002). Seeing the success of Title IX in forcing equity in sports, advocates for the equalization of opportunities for females in the fields of science and engineering brought the argument for gender equality back to Congress in 1998. As a result, the Advancement of Women and Minorities in Science, Engineering and Technology Act of 1998 (H.R. 3007) was passed into effect (White, 1998). Recognizing inequality was an important first step. However, women continue to be under-represented in math and the sciences, both at the post-secondary level and in the workforce.

In 2003, the Business and Professional Women's Foundation noted that of the degrees currently conferred, women now earn more than half of all bachelor's degrees, 57% of master's degrees, and 42% of doctoral degrees. However, a closer examination of the bachelor's degrees awarded shows that these impressive statistics are not representative of women across all majors. For example, females made up only 36% of physical science majors, 27% of computer and information science majors, and 17% of engineering majors (Business and Professional Women's Foundation, 2003). While a larger percentage of females now have access to more post-secondary options, the question of equity still arises as females continue to lag behind males in what have been predominately male-dominated academic departments.

This disproportionate number of women in the sciences continues to exist as these graduates enter into the workforce. In 1989, Freckman reported that although women made up 45% of the entire workforce, they only represented 11% of scientists and engineers. Freckman also noted that in academia, men were more likely to get tenure, be promoted, and receive higher salaries than the female science and engineering professors.

Women have slowly become better represented in non-traditional fields such as science, math, engineering, and technology (SME&T). Rothman and Narum (1999) reported a rise in females in the SME&T workforce from 13% in 1980 to 22% in 1995. However, even after the enactment of the Advancement of Women and Minorities in Science, Engineering and Technology Act of 1998, women continued to be outnumbered by males in these career areas. In 2001, men with a science or engineering doctorate made up 74% of the workforce (National Science Foundation, 2004b).

Limited representation of women in math and science fields has concerned feminist advocates. Though there are many feminist theories, liberal feminists have been especially interested in the enactment of legislation that promotes gender equality. While legislation to promote the well-being of women in education and the workforce is important politically, it has also resulted in societal and economic changes for women. It is important to note the impact that majoring in a non-traditional field has on a female's future career status and income.

The U. S. Department of Labor (2003b) reported that even though many more women are entering managerial and professional jobs, almost half of all women in the workforce continue to function in three primary divisions of the workforce: sales, services, and administrative support jobs. Only a fifth of males in the workforce have jobs in sales, service, and administration areas, which traditionally are lower paying careers. In a comparison of earnings for females from 1979 - 2002, the U. S. Department of Labor (2003b) found that as the proportion of women with a college education increased, the number of women in managerial and professional jobs also grew. Though this seemed promising for gender equity in the workplace, a closer look reveals that women were still not only underrepresented in higher paying fields, but also paid less than their male peers in comparable careers.

While highlighting the earnings of women in 2002, the U. S. Department of Labor (2003a) acknowledged that pay inequalities still existed between the genders. Women entered the professional and managerial occupational categories at a higher rate than ever before. Despite this trend, the specific professions they were entering continued to be lower-paying professional jobs, such as teaching, as compared to those on the higher end of the pay scale, such as engineering or mathematical and computer sciences. According to the National Organization of Women (NOW), females continue to remain underrepresented in the fields that lead to greater earning power after graduation (2004a). NOW also noted findings from the U. S. Department of Labor Statistics that, of the data available on the classifications of careers, women were paid less than men in every occupational field recorded (2004a).

In relation to the roles of females in both society and the work force during the past century, women have come a long way. Great strides have been made to give females opportunities equal to those of their male counterparts. Unfortunately, the "glass ceiling" effect remains a reality for many women who are trying to break through to upper levels of management in the workforce, especially in non-traditional fields (Wirth, 2001). There is one group of women, however, that has stood out among America's female leaders.

While women continue to fall short of men in their work status and role in the labor force, graduates of women's colleges seem to be making great strides. The Women's College Coalition (2004), an organization that represents women's colleges nationwide, boasts of the impressive professional achievements of their graduates who in total make up only 2 - 4% of all of today's female graduates. According to the Women's College Coalition, over 20% of the female members of the 107th Congress were women's college graduates, as were 20% of those included on the *1999 Fortune Magazine's List of the 50 Most Powerful Women in American Business*. These women also represented 20% of *Black Enterprise Magazine's Most Powerful African-American Women in Corporate America*, and 30% of *Business Week's 50 Rising Stars of Women in Corporate America* (Women's College Coalition, 2004).

The reason for these graduates' success is unclear, but it is apparent that women who have attended these single-sex institutions seem to be achieving at an impressive level. According to the Women's College Coalition (2004), over 80% of women's college graduates go on to pursue graduate or professional training and almost three-quarters of women's college graduates are currently in the work force. Women graduating from these schools have also crossed gender lines by pursuing traditionally male-dominated jobs at a higher rate (almost 50% within the work force) and actively participating in civic and professional organizations (Women's College Collation, 2004). This outcome is impressive, but an important question remains: why have women's colleges produced a disproportionably higher percentage of women leaders than coeducational schools? More importantly, what is it about these schools that enable their graduates to achieve success at such a high rate, both in postgraduate training and in the workforce? The number of women who choose to attend women's colleges is small, but for many of those attending, their rate of achievement has been much higher and disproportional to that of their peers.

Justification for Study

There has been limited research done on issues relating to women's colleges. One reason for this may be that there are so few of these colleges still in existence. Furthermore, they make up such a small percentage of the overall college population that research on this type of educational environment may be considered of little significance.

However, with the potential that this unique learning environment seems to provide its graduates and the observable decrease in the number of women's colleges, one could argue that research on these schools is of great importance. Limited research on women's colleges also may be attributed to the fact that research itself is a non-traditional field for women. Research has historically been a male-dominated field in which most studies involved male subjects. Historically, the effectiveness of women's colleges may have been of little interest or relevance to most researchers. It is important to note that practically all research on women's colleges has been conducted during the past thirty years, and that most of the researchers have been women, many of whom had attended women's colleges themselves.

At a time when the number of women's colleges is dwindling, the effectiveness of these schools is especially worthy of research. The unusual success of these schools' graduates warrants the need for more studies to justify single-sex education. Researchers questioned earlier studies on women's college graduates because the statistical models of the time did not control for extraneous variables such as school selectivity. Much of the current research on women's colleges focuses on determining differences in student's personality traits. It has focused on specific factors of the women's college experience that may influence students' leadership ability and achievement. If coeducational colleges could explain and duplicate the success women's colleges appear to have in creating leaders, this would have a tremendous impact on educational equity for females.

The study determined whether there was a significant difference between the rate of female physical science, life science, math and computer science, and social science graduates coming from coeducational and single sex schools. This study further investigated whether the selectivity of the schools affected the number of females choosing non-traditional majors. Finally, the study explored whether there have been any changes over time in the percentage of females pursuing these fields. This researcher used feminist theory and Bandura's self-efficacy model to explore differences in female preferences towards math and science careers.

This study served to explain whether greater achievement in non-traditional fields was the result of women's colleges attracting more female students to these majors (resulting in a higher percentage of non-traditional degrees being awarded) or if it is something else about the women's college experience. What is it about women's colleges that impact their graduates to achieve post graduate success at such a high rate?

Statement of Problem

Advocates of Title IX continue to be concerned that women are not equally represented in the career fields of math and science. However, women's colleges have produced a disproportional number of women leaders in these fields. Can a larger pool of women's college graduates in these male-dominated areas of study explain this phenomenon? Have these pools of graduates increased over time? If women's colleges have produced a disproportionate number of graduates in the areas of math and science in the past, why is this? Does college selectivity affect the number of female students pursuing non-traditional degrees?

Statement of Purpose

The purpose of this study was to disentangle the effects of college selectivity and college type (women's or coeducational) on rates of females graduating with degrees in non-traditional fields in order to more fully understand the significance of women's colleges on the success of women in non-traditional fields.

Definitions of Terms

Coeducational college- four-year, undergraduate institution, from which both males and females may obtain a baccalaureate degree.

Women's college- four-year, undergraduate institution, from which only females may obtain a baccalaureate degree.

Physical science degrees- degrees awarded in the major areas of astronomy, chemistry, physics, and other sciences, as grouped by the U. S. Department of Education.

Life science degrees- degrees awarded in the major areas of agricultural sciences, biological sciences, medical sciences, and other life sciences, as grouped by the U. S. Department of Education.

Math and computer science degrees- degrees awarded in the areas of mathematics and statistics, computer science, and other math sciences, as grouped by the U. S. Department of Education.

Social science degrees- degrees awarded in the areas of economics, political science and public administration, sociology, anthropology, linguistics, history of science, area and ethnic studies, and other social sciences, as grouped by the U. S. Department of Education.

First tier colleges- highly selective colleges listed in the top tier of liberal arts schools in the nation, as ranked by *U. S. News and World Report America's Best Colleges 2002*.

Second tier colleges- selective colleges listed in the second tier of liberal arts schools in the nation, as ranked by *U. S. News and World Report America's Best Colleges 2002*.

Third tier colleges- moderately selective colleges listed in the third tier of liberal arts schools in the nation, as ranked by *U. S. News and World Report America's Best Colleges 2002*.

Forth tier colleges- less selective colleges listed in the fourth tier of private liberal arts schools as ranked by *U. S. News and World Report America's Best Colleges 2002*.

Time periods- Time 1 includes 1985-1988; Time 2 includes 1989-1992; Time 3 includes 1993-1996; Time 4 includes 1997-2001 but excludes the 1997-1998 school year, at which time data was not collected on college graduation rates.

Non-traditional career fields- those professions described by the U. S. Department of Labor (2004) as being made up of less than 25% females, such as architects, drafters, engineers, machinist, agricultural, farming, and ranching workers, and supervisors in grounds-keeping, extraction work, protective services, material moving work, and mechanical installation and repairs.

Research Questions

1. Does the type of college (coeducational or single-sex) have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?
2. Does the selectivity of the institution (highly selective, selective, moderately selective, or less selective) have a significant effect on the percentage of degrees

conferred upon females in the areas of physical science, life science, social science, or math and computer science?

3. Does the interaction between the type of college and level of selectivity have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?
4. Does time (Time 1, Time 2, Time 3, or Time 4) have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?
5. Does the interaction between the type of college and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?
6. Does the interaction between school selectivity and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?
7. Does interaction between the type of college, selectivity, and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, and math and computer science?

Theoretical Perspectives

Feminism has played an important role in breaking down barriers for women in both education and the workplace. Over the past thirty years, higher education institutions have attracted feminist faculty and lessened discriminatory policies and social norms. However, sexual discrimination barriers still exist for women at many levels. This study uses liberal feminism theory to explore what forms of sexism exist for women in the non-traditional fields of math and the sciences. The study focuses on liberal feminism to determine the impact that legislation has had on changing accessibility for females entering math and science careers and collegiate programs. This research explored radical feminism to determine the effect that gender separation had on post-secondary education.

Institutional discrimination towards females perusing majors in non-traditional fields was investigated in this study using Bandura's (1977) model of self-efficacy. Bandura's model of self-efficacy was also used to explore female student's beliefs in their personal capabilities. Current studies in self-efficacy suggest the need for future investigation of the "confidence gap" found between the genders in perception of ability in math, science, and technology (Pajares, 2004). Differences found in the academic environment of women's colleges and coeducational colleges could affect female students' self-efficacy. This difference in self-efficacy could result in changes in female students' perception of capability towards math and science courses. Bandura's model of self-efficacy was suggested as an explanation for any differences found in the graduation rates of females attending single-sex colleges as compared to those attending coeducational colleges.

Delimitations

The data used in this study was previously collected data on women's college and coeducational college graduates. The research data obtained on graduation rates was from a public database provided by the U. S. Department of Education. This database relies on the disaggregation of information by individual institutions upon submission of information. This study focused only on four-year private, liberal arts institutions, and did not include any two-year or public institutions.

School selectivity was derived by rankings from the *U. S. News and World Report America's Best Colleges 2002*. Results from this study can be generalized only to liberal arts women's colleges, which are ranked by U. S. News and World Report. The ranking system does not include data from all women's colleges. In addition, the coeducational institutions were matched to the single-sex colleges as a control group, therefore results cannot be generalized to all coeducational colleges.

Limitations

The number of students attending individual institutions and the percentage involved in particular departments of study may vary according to many extraneous factors. For example, individual institutions may differ in the amount of funding and emphasis placed on math and science departments. This variance can affect the reputation of schools, and the individual programs within that institution. In turn, this could affect students' decisions to attend particular institutions or participate in certain programs. Variables such as socioeconomic status and background factors for graduates, as well as transfer rates both in and out of institutions cannot be controlled, but are expected to have some effects on graduation rates. In addition, as technology advances and the needs within the workforce change, new career fields and majors are introduced, such as technology and environmental science. The NCES included data for 313 fields of study in 1980 and this number increased to 442 by 1990 (as cited in Jacobs, 1995). The addition of new fields of study can affect the number of graduates included within a subgroup.

As with the study of any type of college's effect on student behavior or choices, there are many other external factors that cannot be controlled. For example, how likely are the students to become leaders even before exposure to a single-sex environment?

How might these students' family and educational backgrounds differ from students choosing a coeducational college environment? Finding a relationship between factors such as family or educational background and success in and after college is difficult because there are so many facets of the college experience that can affect students' leadership abilities and proclivities.

Assumptions

Schools from four tiers of academic achievement were included to increase the validity of the study and enable exploration into the impact that selectivity of an institution has on preference of majors. It was assumed that all graduates met appropriate entrance and graduation criteria by their respective colleges.

The coeducational colleges included in this study were similar in academic achievement and selectivity, as measured by *U. S. News and World Report America's Best Colleges 2002,* to the group of women's colleges (2001). It was also assumed that controls for initial academic achievement were included in the statistical design of *U. S. News and World Report America's Best Colleges 2002* results and that the schools accurately reported graduation rates.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Feminist Thought

Feminist theory and activism have greatly influenced the advancement of women in society. Today, there are several distinct feminist theories, but all have similar core themes that promote the emancipation of women in a hierarchical society. Though many others exist, radical, social, and liberal feminism are the three most common branches of feminism (Stromquist, 1990). Each theory separately suggests different reasons for the inequality of power between men and women, and each calls for its own unique solution to empower women. However, they can all be described as a combined movement that promotes equality for women in the areas of politics, economics, and society.

According to Stromquist (1990), radical feminism focuses on reproduction issues and advocates for core changes to society. Socialist feminist theory focuses on class issues and social relations, while liberal feminism focuses more on changes in legislation to ensure equal rights for both men and women. In this study, liberal feminism was used to investigate the effect that gender-equity legislation has had on increasing women's pursuit of non-traditional degrees. In addition, radical feminism was used to explore the diverse opinions that today's feminists have concerning the value and role of women's colleges.

Researchers attribute the origin of liberal feminism to the 19th century writings of Mary Wollstonecraft and John Stewart Mill (as cited in Gerson, 2002; Hoffman, 2001;

Kensinger, 1997). However, the views of liberal feminist advocates have changed over time. Betty Friedan is one of liberal feminism's best-known advocates. She was also the founder of the National Organization for Women (NOW), a nationally known, leading organization in liberal feminist issues. Liberal feminism was most popular in the 1950s and 1960s, during the time of the Civil Rights Movement. However, dating back to the 1800s, these activists have always been concerned with promoting equality in education for females (Wendell, 1987). Most liberal feminists believe that the oppression of women is the result of the socialization of females and that legislation promoting equal rights for women can help to equalize power between the genders through equal access to jobs and equitable pay.

Researchers classify liberal feminists into two primary groups: classical and welfare (Wendell, 1987). Classical liberal feminists believe that it is the government's job to protect civil liberties, whereas welfare liberal feminists believe in placing the emphasis on economic justice. For example, welfare feminist advocates support programs such as school loans and Social Security to alleviate inequality within a society. Since the inception of liberal feminism, these feminists have supported issues on education, slavery, and voting rights (Wendell, 1987). However, they have endured criticism for not considering more in-depth race and class discrimination issues.

Radical feminists oppose the ideals of liberal feminism and feel that issues of gender inequity are more deeply rooted in society's core (Hoffman, 2001). They do not believe that legislation is the way to empower women. Rather, they believe in freeing women of the oppression brought about by male domination. They suggest this must be done through changes in society's core belief systems. This group of feminists tends to be more outspoken, which has resulted in much backlash against feminism because of their separatist ideology. They often form groups and institutions that completely exclude males. Mary Daly is one of the best-known advocates of radical feminism.

Along with concerns over health care issues, sexual discrimination, sexual harassment, equity in education, the equalization of pay, and career advancement opportunities are top priorities for women's activist groups. Liberal feminists have always placed importance on the role education plays in the emancipation of females, but their views on single-sex education have changed over time (Wendell, 1987). Radical feminists promote gender exclusion and therefore could have a favorable preference towards single-sex institutions (Hoffman, 2001).

Throughout history, women have overcome obstacles to acquire freedom, including gaining the right to receive an education equitable to their male peers. At the time of their inception, women's colleges were the primary option for females pursuing post-secondary education. This continued to be true as some women began to enter non-traditional career fields. The effect feminism has had on society has also changed the role of women's colleges over time. As Reeves and Marriott (1994) explained, the current revived interest in women's colleges is serving as a division between feminists. Liberal feminists believe that academic inequalities are dealt with best in a coeducational setting. Radical feminists suggest that the exclusivity of the single-sex experience is better for female students. Still, some feminists continue to question whether there are true educational differences between men and women- so much so that academia would need individual programs, curricula, and teaching methods.

Crosby, Allen, Culbertson, Wally, Morith, Hall, et al. (1994) also referred to this division between feminists on the issue of single-sex environments in education. Crosby et al. explained that the number of feminist faculty in colleges and universities was rising and this rise was transforming higher education. This increase in feminism on college campuses resulted in a rising concern that the college experience was primarily a male-experience, with male social norms. Crosby et al. suggest that female students have few opportunities to observe same gender role models respected and recognized by peers. Like Reeves and Marriott (1994), Crosby et al. pointed out the divide between feminists who believe that an environment without males is the best way to educate females and those who believe that this environment is detrimental to the educational experience of females.

Current legislative initiatives have brought gender equity in education into the spotlight again. In February 2003, the Commission on Opportunity in Athletics, appointed by the U.S. Department of Education, issued a report suggesting changes to Title IX (National Coalition for Women and Girls in Education, 2003). Feminist groups ardently opposed the suggestions made by this committee, by citing concerns that these changes would undo 30 years of progress made in gender equality under the watchful eye of Title IX mandates. Liberal feminists believed that some of the suggestions that came from the commission's report were too open-ended and did not provide specific guidelines for demonstrating equity (National Coalition for Women and Girls in Education, 2003). They considered the suggested changes to be vague and subject to interpretation. Likewise, another legislative proposal, initiated just a year prior, began what liberal feminists considered an attempt to dismantle educational equality efforts.

In May 2002, a recommendation from President Bush's administration, through the Department of Education, Office of Civil Rights, suggested allowing public schools the opportunity to create single-sex classes in certain subjects (National Organization for Women, 2004b). This tactic provided a strategy to meet new federal standards set forth by No Child Left Behind legislation. However, when it comes to single-sex education in public schools, some feminists groups, including NOW, oppose gender separation (National Organization for Women, 2004b). This liberal feminist organization expressed concern that allowing K-12 educators to separate classrooms by gender would undermine the results of years of progress made through mandates put in place by Title IX. They believe gender inclusion, rather than exclusion, to be the most effective way to educate young students. They further suggested that females need opportunities to be educated with males in order to change gender stereotyping by both male and female students. NOW explained that this exposure would better enable women by giving them the preparation needed to enter non-traditional career fields. Though their position on postsecondary education is not directly stated, it can be assumed that NOW's liberal feminist views lead them to be in favor of coeducational equalization at the colligate level rather than the alternative of a single-sex environment.

Historical Perspective

Women's colleges were founded around the turn of the 19th century. Though most were finishing schools for teachers or homemakers, they were established to give women the opportunity to obtain a post-secondary education that, at the time, was considered equivalent to that of men (Gordon, 1990). However, the programs were not of the same caliber as those at men's colleges, nor were there as many opportunities for female students outside of traditional women's roles. "Many of these colleges justified their mission to educate women with the social rationale that educated women would become teachers, reformers, and culture bearers, as well as 'better' mothers and wives" (Rice & Hemmings, 1988, p. 547). From their inception, women's colleges have both influenced and been affected by American culture and politics. They have helped to define the changing roles of women in the United States. Women's colleges have also had to make changes to better equip themselves for the changing student body that they have attracted throughout the years.

The purpose and mission of women's colleges has changed greatly over time. Women's colleges were born out of social trends of the mid-1800s, but they were not the first colleges to educate women. As Gordon (1990) explains in her book, *Gender and Higher Education in the Progressive Era*, the private colleges of Oberlin and Antioch actually pioneered postsecondary co-education in the 1830s. However, women did not easily obtain coeducation. Between 1860 and 1890, "women students were ignored, ridiculed, and isolated from campus life. This hostility sometimes extended to the classroom, where male instructors, themselves educated in single-sex schools, had neither experience nor interest in teaching female students" (Gordon, 1990, p. 25).

The Progressive Era, from 1890 to 1920, was a difficult period for women interested in opportunities outside of the home. According to societal leaders of the time, there was some merit in allowing women to be educated (Gordon, 1990). During this era, it was felt that higher education would add to a woman's abilities to be a homemaker, mother, and teacher. Typical women's college curriculums included religion, singing, dancing, and literature, all of which would adequately prepare women to be wives and mothers (Women's College Coalition, 2004). At this time, women, like many other minority groups, had little control over decisions made about their place in society or the rights granted to them.

According to the Women's College Coalition (2004), the earliest recorded post-secondary school for women was Salem Academy in North Carolina, founded in 1772. Salem Academy later became chartered as a college in 1866. Chartered in 1836, Wesleyan College in Georgia granted the first degree to a woman (Women's College Coalition, 2004). In 1926, an elite group of women's colleges founded the Seven College Conference, which included the membership of Vassar, Wellesley, Smith, Barnard, Bryn Mawr, Mt. Holyoke, and Radcliffe (Gordon, 1990). These schools, though in operation for many years prior to the founding of this conference, were termed the Seven Sisters colleges. They became the most prestigious and well-known women's colleges in the United States. In the 1890s, the Seven Sisters "came of age, as they abandoned preparatory departments, attracted a better-educated and more distinguished faculty, set up student self-government associations and honor codes, founded campus branches of settlements and other reform organizations, broadened their perspective on women's careers, and competed with each other in athletics and debate" (Gordon, 1990, p. 8). The Seven Sisters colleges were the first to initiate rigorous curricula that were truly equitable to that of their Ivy League, all-male counterparts of the time such as Harvard and Columbia Universities. They came about at a time when opportunities for women to pursue non-traditional fields were especially limited or non-existent at coeducational schools.

In 1869, the number of women in higher education was approximately 11,000, and of those, 58.9% attended women's colleges (Gordon, 1990). The percentage of females enrolled in women's colleges decreased in each of the following decades, as the total number of women attending college rapidly increased. In 1889, over 84,000 women enrolled in higher education, and only 29.9% of them were at women's colleges. During the 1920s and 1930s, women's college enrollees made up 17 - 18% of the population of female college students. This number further declined to 12% of 806,000 female students in 1949 and 9.6% of female college enrollees in 1957 (Gordon, 1990). Recently, the total number of females attending college has grown significantly; however, only 2% - 4% of female college students attend women's colleges (Women's College Coalition, 2004).

During the Progressive Era, gender separatism served as a paradox to both empower and restrict women's rights. Women's colleges maintained social separatism, yet women could still have all of the opportunities of higher education. Women's colleges of the time offered studies in non-traditional fields, causing women to learn "to think and act like men," and they soon began actively participating in traditionally male oriented activities such as debates, self-government, and journalism (Gordon, 1990, p.190). Some coeducational schools even modeled programs for their female students after the successes observed in women's colleges. As Gordon explains, "separatism functioned creatively; in the absence of male students, women took on leadership roles not available to them elsewhere and enjoyed the full attention of faculty who encouraged graduate study, professional careers, and political activism" (1990, p. 191).

At this time, many women saw themselves as a disenfranchised group without equal rights to that of white males. Women's colleges allowed a gateway for females to begin to participate more fully in society. During the late 1800s and early 1900s, women's colleges were the only places to train women in the traditionally all-male subjects of math, science, law, and philosophy (Women's College Coalition, 2004).

Because of female activism, separatism became obsolete toward the end of the Progressive Era (Gordon, 1990). Feminism of the time promoted individual fulfillment and gender egalitarianism. As women's culture evolved, females began to demand more equality; however, educated women still faced great social barriers both on and off campus. In the early 1900s, suffragists and women's rights advocates were very vocal in society, but they lacked interest in the key issues of female students. Therefore, most female college students and administrators strictly denied any involvement or interest in feminist causes. In the 1910s, feminism became more popular on college campuses as it promoted personal and sexual liberation (Gordon, 1990). Women made great strides during this period to eliminate inequality. Because of the ratification of the 19th Amendment, women gained the right to vote in 1920 and overcame a large barrier to obtaining social equality. However, from 1910 to 1940, as Gordon explains, events such as the Great Depression and World War II overshadowed feminist activism.

The Progressive Era redefined womanhood and trends relating to women changed during this period because of higher education. Gordon (1990) notes that the marriage rate of women graduating from college in the 1880s and 1890s was quite low (50 - 60%). By 1910, a second generation of women had attended college, and the marriage rates for these graduates showed a dramatic increase (90%), as if the idea of female exposure to higher education had become more of a social norm and less of a novelty. These women did not have to choose between marriage and a career as much as the prior generation of women graduates. Interestingly, the number of children produced by these women was exceptionally low, 1.2 children per graduate (Gordon, 1990). Low fertility rates continued for female college graduates until the 1930s. Another distinguishing characteristic between first and second generation female college students was that although many female college graduates in both generations participated in the workforce, second generation graduates, unlike their predecessors, not only continued to work after marriage, but many also returned to work after raising children (Gordon, 1990). This balance of work and family continues to be a struggle for many women in the workforce. Many see the responsibilities of womanhood as a cause for inequity between the genders, especially in better paying, more prestigious managerial and professional positions (National Coalition for Women and Girls in Education, 2002).

After World War II and the development of the atomic bomb, societal interest and appreciation for the sciences peaked (Rotham & Narum, 1999). In 1959, the launching of Sputnik led to a rise in the quality and quantity of math and science programs in both K-12 and higher education. However, these career paths were typically male-dominated and not intended for women. Women's colleges were still the primary place for females interested in these fields, but even these graduates would eventually face sex-based discrimination as they left their nurturing college environments and entered the workforce (Gordon, 1990).

The trend of single-sex post-secondary education continued through more than half of the twentieth century (Gordon, 1990). Since many of the more prestigious schools were still all-male, women interested in non-traditional fields had limited opportunities outside of women's colleges. The development of women's colleges was originally to make women better wives and homemakers; however, over time these schools eventually became the true academic equivalents of their male counterparts. They offered their students a wider range of opportunities unattainable to females in coeducational schools.

In the 1960s, the civil rights movement had a great impact on higher education opportunities for females. Federal cutbacks and constraints, caused by a poor economy, forced many small colleges to close; while others were forced to reduce their budgets and consider alternative ways to fund programs (Rice & Hemmings, 1988). Combined with societal pressures for the integration of minorities, these forces led to major changes in post-secondary education.

The women's movement of the 1970s not only increased the number of women attending college but also brought more women into traditionally all-male fields (Rotham & Narum, 1999). According to Rice and Hemmings (1988), by 1972, the feminist movement had spread throughout higher education institutions, and the doors of all but a few historically all-male schools had opened to women. During this time, many feminists discredited the need for women's colleges. They portrayed single-sex education as a barrier to equal rights, limiting women's post-secondary opportunities and chances for advancement and equality. Many feminists argued that expanding women's college curricula was not the way to ensure equality. Rather, they believed in allowing women all of the same opportunities as men. This included entrance into some of America's most prestigious and elite men's colleges (Rice & Hemmings, 1988).

The advancement of educational equality in the 1960s and 1970s was a major accomplishment for women. However, its effect on the roles and purposes of women's colleges once again led to great changes for these schools. According to Rice and

Hemmings (1988), the new trend at that time was for academically talented women to attend those previously unattainable and more prestigious schools that had recently become coeducational. Although legislation forced the schools to open their enrollment to women, they did not make fundamental changes to their curriculum, faculty make-up, or leadership to allow for the differences that came with integrating women. It was during this transition that the reputation and direction of many women's colleges also changed. They were no longer the primary option for women who were interested in pursuing non-traditional degrees because women could now attend a larger variety of schools.

There was no longer a need for women's colleges to serve as a separate equivalent of male colleges. The governmental policy changes brought about by the Civil Rights Movement of the 1960s and the Women's Movement of the 1970s greatly affected the well-being of America's single-sex colleges (Rice & Hemmings, 1988). Society saw the women's colleges that were still in operation after the 1960s in a new light, and many feminists questioned their purpose. The societal influences of this era changed the direction of the few women's colleges that remained throughout the 1970s. What had, a century before, been a catalyst for feminists wanting to increase educational opportunities for women, was now seen as a burden towards making the rapid strides in gender equality that current feminists wanted.

In a 1975 study, Parelius explored changes in the sex-role attitudes of female students at a women's college from 1969 to 1973. The study measured changes in sex-role attitudes and expectations that had resulted from the Women's Liberation Movement. Parelius found that there was a marked shift in women's attitudes from traditional to feminist orientation. The researcher noted that there had been an increase in the offering of women's issue courses during this time. The study also found that, there was very little change over time in how these women perceived men and male levels of conservativeness. Parelius discussed the possible strains arising because of changes in women's sex-role attitudes that no longer aligned with how they believed males' attitudes would be. The women's liberation movement of the 1970s had a great impact on higher education. Differing views on feminism either led to intense approval or marked distaste for single-sex institutions by societal and political leaders of the time. Once again, the mission of women's colleges would change and bring with it a new generation of prospective enrollees.

Riordan makes note of "the distinction between *forced* separatism (segregation) by a powerful group upon a powerless group, and *voluntary* separatism by *choice* of the historically disadvantaged groups" (1994, p. 505). In the 1970s, women's college administrators now found themselves campaigning towards a new generation of enrollees, those voluntarily choosing separatism. This led to the reputation of women's colleges being finishing schools for young ladies, which in turn, lessened the public's perception of these schools as rigorous alternatives to the previously unattainable, and quite prestigious, men's colleges of the time. Opportunities for women in the fields of math and science were no longer dependent on attendance at a women's college. Female students no longer had to rely on these schools to get an education equivalent to the education of males. The caliber of students interested in a single-sex education changed, and with it, the direction of women's colleges changed.

The number of women's colleges in the United States has dropped significantly over the past thirty years (Riordan, 1994). In 1960, there were 298 women's colleges, and by 1970, only half remained (Rice & Hemmings, 1988). In 1992, this number was down to 84 schools (Smith, et. al, 1995). Now, just over a decade later, only 68 women's colleges remain in the United States (Women's College Coalition, 2004). This number will continue to decrease unless the educational community is able to find substantial benefits in single-sex education. These schools must also be better able to market themselves to a new generation of college bound females.

Recent Trends for Women's Colleges

As the needs of female students who wanted equality in the classroom changed, so did the focus of the women's college. During the 1990s, many women's colleges began to attract more students by focusing on increased technology and the implementation of more competitive programs. There has been a somewhat positive trend in enrollment for women's colleges recently, attributed to the efforts that these schools are making to keep up with societal and cultural changes. After overcoming a slump in enrollment brought about during the 1960s, women's colleges have achieved a slight rise in applicants since the 1970s. In 1994, McCarthy noted a 14% rise in women's college applicants from previous years. In 1997, the Women's College Coalition reported that applications had steadily risen at 85 - 90% of the nation's women's colleges over a period of five years. These increases seemed to imply a new trend in public approval for single-sex institutions. This also brought about greater interest from the media towards the women's college phenomena.

The increasing number of influential women's college graduates brought into the spotlight by today's media may be the cause for a rise in single-sex college applicants during the 1990s. Bryant (1994) points out how women's colleges are trying to sell themselves by boasting of their unusually high achievement rates and influential alumni. Such an example is 1969 Wellesley College graduate, Hillary Rodham Clinton, Congresswoman and former First Lady of the United States. Reeves and Marriott (1994) noted other women's college graduates that are now influential broadcast journalists, including Barbara Walters, Diane Sawyer, Cokie Roberts, and Linda Wertheimer. These women have been a powerful marketing tool, as they put a face on the acclaimed success of women's college graduates. The Women's College Coalition's list of women achievers and "firsts" by women is lengthy and it continues to grow. They are quick to point out that women's college graduates are twice as likely as their peers at coeducational colleges to receive doctorate degrees, enter medical school, and receive doctorates in the natural sciences (Women's College Coalition, 2004; Tidball, 1985; Tidball & Kistiakowsky, 1976).

Another media boost to women's colleges has been their consistently high ratings in national survey rankings, such as *U. S. News and World Report's American Colleges 1997* (as cited in Lawrence, 1997). Lawrence alluded to the fact that the rise in applications to women's colleges may have been brought about by the high ratings these schools had received on the *U. S. News and World Report America's Best Colleges 1997* annual ratings of liberal-arts colleges, in which six of the top tier intuitions were women's colleges.

In the most recent edition of the *U. S. News and World Report America's Best Colleges 2004*, women's colleges made up 9.6% (n = 21) of the total number of liberal-arts schools (N = 217). They comprised 14% of the top tier (7 of the top 50 schools); 10% of the second tier (6 of 60); and 7.8% and 7.2% of the third and fourth tiers (4 of 51 and 4 of 55) respectively (U. S. News, 2003). These trends in the media have helped to promote women's colleges and in turn are attracting a new generation of women to these schools.

The reason for this new interest in women's colleges is unclear, but it may be a reflection of the advantageous outcomes shown by research on these schools. Women's colleges are making changes to keep themselves competitive in the market of higher education. Once again, women's colleges have had to change and restructure to keep up with societal and cultural trends, but in some ways they are on the forefront of development. Many women's colleges are increasing investments in technology as a way of attracting more applicants. For example, in 1999, Sweet Briar College was ranked 79th among America's 100 most-wired colleges, as derived from a survey of 1,300 colleges and universities (Edson, 2000). The school was also ranked sixth among the liberal arts schools compared in the survey. Likewise, the president of Randolph-Macon Women's College suggested that increased scholarship opportunities and paying more attention to their web site, available to perspective applicants via the Internet, had caused growth at that school (Reisberg, 2000).

Some women's colleges, such as Chatham College, have opened continuing education and graduate programs to men as a way of increasing enrollment without having to make undergraduate programs coeducational (Williams-June, 2003). Still others are trying to diversify by adding non-traditional majors to attract students. In 1999, Smith College in Massachusetts reported plans of becoming the first women's college to open an engineering department as an attempt to reinvent the school and attract a more diverse group of women (Bronner, 1999; Smith College Gets, 1999). Though many of these strategies seem to have a positive impact on enrollment, other women's colleges are taking less proactive routes. Cutting tuition costs and lowering the bar on applicant acceptance are two strategies which could seemingly cause long-range problems. However, some women's colleges are finding these tactics to be their only option to keep their doors open (Lawrence, 1997).

Reisberg (2000) suggested smaller women's colleges, unlike their more nationally reputable sisters, were suffering from decreasing endowments and fewer applicants. There was an increase in women's college applicants during the mid-1990s. However, it is the interest of high-school aged female students upon which these colleges base their future enrollment figures. According to the College Board's 1999 SAT survey results, females interested in a women's college had dropped to 4%. Reisberg claimed that over the previous eight years, this was an all-time low. Less interest can lead to fewer applicants, and this uncertainty about future applicants led two more women's colleges, Emmanuel College and Notre Dame College in South Euclid, to admit men as undergraduate enrollees. Even some of the more prestigious and well-known schools have made the move from single-sex to coeducational.

In 1879, Harvard University founded Radcliffe College to keep women out of Harvard's historically all-male institution by serving as a "separate but equal" educational opportunity for women (Pollitt, 1999). Until the late 1970s, Harvard was able to enroll four males to every female accepted, using Radcliffe as its fulfillment for equal opportunity requirements, suggests Pollitt (1999). In 1999, Radcliffe announced that it would be officially turning over its facility to Harvard for use as a coed facility for women and gender studies. Harvard University incorporated the institution as a coed program, and Radcliffe College for women ceased to exist.

Vassar College, another of the reputable Seven Sisters to become coeducational, found that this transition was less than beneficial to its female students. The change to a coeducational institution resulted in fewer full-time female faculty and fewer women in leadership positions on campus (Rice & Hemmings, 1988).

Adding male students to the mix is one solution that many women's colleges have chosen to take. The number of women's colleges that have opted to become coed or have discussed the possibility of admitting men is on the rise, but at what cost to the educational attainment of the women who attend these schools? In a longitudinal study conducted by Canada and Pringle (1995), researchers studied the transition of a women's college going coeducational over a period of five years. Using classroom observations, Canada and Pringle found that both professors' and female students' interactions changed in mixed gender settings. The observers measured invitations to interact and then follow-up interactions made by both the professors and students. Overall, female professors offered significantly more invitations for students to participate in coed settings, whereas male professors offered less. Female students initiated slightly fewer interactions as the class size grew in single-sex classes regardless of the gender of the professor, as did male students in a mixed-sex classroom. However, in the mixed-sex environment, as the size of the class grew there was a significant drop in female student's invitations to interact when the professor was male. When there was a female professor, there was still a slight drop in female student interactions as the coed class size grew, but not as great as when the professor was a male. Canada and Pringle concluded that the interactions initiated by both male and female professors, as well as by female students, changed when male students were present (1995). The interactions of professors decreased as the proportion of males in the class increased. Though the male student's interactions increased as the percentage of males in a classroom-setting rose, professor and female student-initiated interactions decreased.

Canada and Pringle's 1995 study showed that female students and college professors initiate interactions more often with one another in the absence of male students. Perhaps these differences in interaction between faculty and students have lead women's colleges to develop a culture that is more accepting of females in leadership positions. Immersion in an environment that rewards females for being academically talented could affect these student's perceptions of their abilities, as well as influence their view of the roles females should hold in the workforce.

Research on Women's Colleges

Studies on women's colleges are limited, but one of the first people to research the effectiveness of this learning environment was Elizabeth M. Tidball. In 1973, Tidball addressed the effects of affirmative action on women in higher education. Using the data collected from 1,500 women randomly selected from the 1910 - 1960 volumes of Who's Who of American Women, Tidball found a significant difference in the achievement output of the graduates of women's colleges when compared to those of coeducational colleges. Tidball suggested that perhaps some of the talent of young women attending coeducational colleges might be lost because of limited experiences building relationships with other females or increased societal pressure in a coeducational environment to find a mate, marry, and have children (1973).

Tidball's (1973) research also questioned the effect female role models have on women students. She had noted that in 1918, 18% of the faculty at coeducational colleges and over 70% of the faculty at women's colleges were females. This number decreased in both settings, in that by 1970, less than half of the faculty at women's colleges were females, and the number at coeducational schools was down to 14%. Tidball expressed concern about the decreases that had occurred in female faculty, especially among administrators in both coeducational and women's colleges.

In 1973, Tidball suggested that the next step in affirmative action for women's rights in higher education should be to focus on the number of female role models college-aged women had. Using regression to compare the relationship between achiever output and other variables, Tidball's study found that there were twice as many women faculty at the women's colleges for every 1,000 female students, and she deduced that having women role models in faculty positions was a strong influence in women students' performance. The study also tested the effect of male faculty and found no significant correlation between this factor and women achievers. Tidball's study showed a very strong negative correlation between higher levels of male students and women achievers. Tidball's correlation study found that role models positively influenced women achievers, and increases in the number of male students negatively influenced them.

In 1976, Tidball examined the results of a national survey of higher education faculty conducted by the American Council of Education (ACE). In her results, Tidball pointed out that men who taught at women's colleges were more concerned with women's issues. She also noted that although the entire female faculty surveyed compared themselves negatively against their male peers, it was less so at the women's colleges and more so at the coeducational colleges. Tidball again found that women's colleges had a much higher proportion of females on their faculty.

Much of Tidball's research on women's colleges investigated the positive long-term effects that this school environment seemed to have on women's occupational choices and post-college achievement. In 1976, Tidball and Kistiakowsky compared the baccalaureate origins of women entering non-traditional fields, such as the sciences, and found that women who attended women's colleges were more likely to choose a non-traditional career field and more likely to enter a male-dominated profession than female students attending coeducational colleges. Tidball's 1980(b) study investigated the postgraduate tendencies of women who graduated from women's colleges as compared to those attending coeducational schools. Again, Tidball found greater post-secondary achievements made by the women's college graduates when compared to females attending coeducational colleges.

Although Tidball's studies on the career attainment of women's college graduates are classics, they are not without controversy. Many researchers (Oats & Williamson, 1998; Smith, 1990; Crosby et al., 1994) have discussed a factor for which Tidball's research did not control. Some critics question the validity of the studies because much of her research did not account for the selectivity of the schools. From 1910 - 1950, many selective women's colleges offered programs considered equivalent to the all-male Ivy League schools of the time. Therefore, during this time it was common for the more elite and academically talented female college students to attend women's colleges instead of coeducational colleges. With the integration of women into historically all-male schools, the demographics of women attending single-sex institutions has changed over the years. Women have more choices for higher education now than they did in previous generations.

Stoecker and Pascarella suggested that it was not actually the college experience that caused women's college graduates to be more successful; rather, it was the result of more effective recruitment efforts made by these schools (1991). In a longitudinal study spanning from 1971 - 1980, Stoecker and Pascarella tracked data on students who completed pre- and post-college surveys addressing student's pre-college experiences and aspirations, college experience, institutional characteristics, and post-college attainment. The researchers found that when controlling for pre-college experiences and aspirations, female students at women's colleges and those at coeducational colleges did not differ significantly in early career attainment, thus suggesting that the students differed in background experiences and aspirations prior to even attending college. However, Stoecker and Pascarella did acknowledge that their study only observed early career attainment. The researchers suggested that perhaps it is the long-term accomplishments of women's college graduates that caused Tidball's 1973 study, comparing the recipients of Who's Who among American Women, to be significant.

In 1985, Tidball compared the baccalaureate origins of medical school entrants and made observations on changes in entry rates over time. Subjects included both male and female entrants and spanned two periods of time, 1950 - 1959 and 1975 - 1978. The first group of subjects, those entering medical schools from 1950 - 1959, had been included in a previous study completed by the U. S. Department of Health, Education, and Welfare in 1961 (as cited by Tidball, 1985). At a time when the government was concerned with the possibility of a future shortage of physicians, the initial purpose of the

1961 study was to establish baseline data to determine the attributes of colleges that tended to produce more medical school entrants. The original study concentrated predominately on males because, as the authors of the original study suggested, at the time, it was primarily men who practiced medicine. However, when Tidball compared the number of female entrants from each time-period, female entry rates from women's colleges had increased threefold between 1950 - 1959 (2.1%) and 1975 - 1978 (6.8%).

Tidball's 1985 study compared the initial findings of the 1950 - 1959 baseline groups to students who had entered medical school between 1975 and 1978. Tidball's research also took into consideration the numerous single-sex colleges, both male and female, that had gone coeducational in the 1960s and early 1970s. For the 1975 - 1978 group, Tidball found that the schools entering the greatest percentage of male students into medical schools were private universities with medical schools (8.2%), followed by men's colleges that had become coeducational between the two time periods (6.0%), then coeducational colleges (5.1%), women's colleges that had become coeducational (4.4%), and men's colleges (4.1%). The combination of private universities (without medical schools) and public universities (with or with out medical schools) made up only 7.9% of male entrants. Interestingly, for female medical entrants, the entry rate of students who had attended a women's colleges was the highest (6.8%), followed by private universities with medical schools (3.2%), then women's colleges that had gone coeducational (2.8%), men's colleges that had gone coeducational (2.6%), coeducational colleges (2.1%), and private universities without medical schools (1.5%). Public universities (with or without medical schools) made up 1.7% of female medical school entrants from 1975 - 1978.

Tidball found that although female entrants were still less in number than their male peers, the percentage did increase substantially between the 1950s and 1970s (1985). In addition, the percentage of female entrants coming from women's colleges greatly outnumbered those attending other types of colleges and universities. Tidball further suggested that according to her findings, women had not benefited from either the entrance of males into women-only colleges or by the allowing of females into previously male-only colleges.

Crosby, Allen, Culbertson, Wally, Morith, Hall, and Nunes (1994) did a follow up study on Tidball's 1985 study of the baccalaureate origins of women entering medical schools in the United States. They attempted to clarify whether the significant factor in medical school matriculation was attending a women's college, or the selectivity of the compared schools. While controlling the selectivity of schools, Crosby et al. re-examined some data used in Tidball's original study. Crosby et al. used the 1976 edition of *Barron's Profiles of American Colleges* to categorize the schools by selectivity. Control variables used in this study included institution size, tuition rate, average SAT scores (verbal & math), and affiliation with a medical school. The first part of the study compared all of the women's colleges (n = 7) to all of the coeducational colleges (n = 249). The second part of the study compared only the selective women's colleges (n = 5) to the selective coeducational colleges (n = 42). Crosby et al.'s findings in the first t-test replicated the findings of Tidball's research. The women's colleges had a higher productivity rate of graduates entering medical school, thus higher achievement. However, when the researchers performed a second t-test on just the highly competitive schools, there was not a significant difference between the productivity of the two types of institutions. Step-wise multiple regression analysis further showed that the controlled variables of institution size, average verbal SAT scores, and affiliation with a medical school accounted for more variance in medical school matriculations than did gender, although gender was still significant.

Crosby et al. (1994) found that highly selective women's colleges were no better at producing a higher percentage of female students entering medical school. A limitation of this study was that it only applied to one year of data, 1976, because of the limited availability of back issues of *Barron's Profiles*. Another limitation of this study was that it only studied those students attending selective or highly selective schools. Crosby et al. suggested that advances made by women in higher education during the previous two decades, including the opening of historically all-male schools to women, led to both the reduction of attendance at women's colleges as well as the increase in productivity of women at coeducational schools.

Though some studies have investigated the effectiveness of women's colleges to some degree throughout the years, research was very limited throughout the late 1970s and 1980s. Much of the current research done on the effectiveness of the college experience has used national survey results provided by the Higher Education Research Institute at the University of California, Los Angeles. This institute sponsors the Cooperative Institution Research Program (CIRP) which keeps track of data received from national surveys of higher education (Smith, Wolf, Morrison, 1995). Many researchers have used the CIRP to measure the effects of the college experience. The survey annually polls first-years students at over 550 institutions and post tests them on a follow up survey given four years later. Professors and administrators also complete the survey. The results of CIRP surveys are referred to periodically throughout this review of literature, as is the Higher Education Graduate Information Survey (HEGIS). The Integrated Postsecondary Education Data System (IPEDS) database, sponsored by the U. S. Department of Education collects the survey results. The survey collects demographic data regarding the dissagration of graduation rates, as well as other institutional records.

In 1995, Smith, Wolf, and Morrison compared the perceptions of students who attended women's colleges to those attending comparable four-year private coeducational institutions using the CIRP survey. This study was based on the 1986 and 1990 CIRP results of all available data taken from females attending women's colleges (n = 160) and those at private four-year coeducational schools (n = 764). The women completed an initial survey upon college entrance in 1986, and then a follow-up survey in 1990. The initial survey included questions about the students' background, high school experiences, and their initial educational and career goals. The follow-up survey asked about the students' college experiences and future goals. Each institution provided information about the student's SAT scores, degree received, and characteristics of the institution in addition to the information obtained in the survey. The SAT scores that were available for the women in the survey (less than 60%) indicated a mean math score of 520 and a mean verbal score of 500. There was no significant difference in the selectivity of the colleges when comparing the students attending women's colleges to those at coeducational schools.

The variables compared in Smith, Wolf, and Morrison's 1995 study included: student demographic variables, pre-college aspirations, institutional gender make-up, institutional priority variables, academic and extra curricular involvement, and educational outcome variables. Smith et al. used stepwise multiple regression to control for the institutional gender in the measurements of variable impact. The study used regression analysis to control for backgrounds, and created a causal model to determine the impact (both direct and indirect) of attending a women's college on each of the variables. The causal model had five stages, each stage building on the factors introduced in the level prior to it.

The results of the Smith et al. study (1995) indicated that students attending women's colleges were more likely to perceive their institution as being student-centered, concerned about multiculturalism, and concerned with civic involvement. Smith et al.'s model also indicated that colleges, which held the beliefs of being student-centered, multicultural, and civic-minded, were also more likely to have students who were involved in academic and extra curricular activities, and who were successful in their goals of learning, leadership, and degree aspirations. These students also showed satisfaction with social life and the overall college experience, as well as having a sense of competence. Being dissatisfied with social life is a common finding in women's college research (Smith, 1990; Smith et al., 1994). However, this study suggested that students at women's colleges were less likely to be unhappy with their social life if they perceived that their institution cared about them and their development (Smith et al., 1995).

A prior study done by Smith in 1990 also used results of the CIRP. The sample included 175 women from women's colleges and 705 women from four-year coeducational colleges, all of whom who completed an initial survey in 1983 and a follow up survey in 1986. The study compared the responses of students attending women's colleges to their peers in coeducational schools. The first part of the study compared student satisfaction measures on the follow-up survey in four areas: satisfaction with the school, perception of personal change, educational aspiration, and perception of the goals and values of the instruction. The study used regression to test for significance when controlling for background and then institutional type. Of 23 variables that measured student satisfaction, 11 were significantly different between the two groups. Smith found:

> Students at women's colleges are more satisfied with the overall quality of instruction, courses in the major, courses in the social sciences, opportunity to talk to professors, campus regulations, career counseling and advising, housing, contact with the faculty and administration, relations with the faculty and administration, and opportunity to attend films and concerts. (1990, p.187)

The eleventh item of significance, social life, was once again higher for the coeducational group. Smith found that the women who had attended women's colleges were also more interested in attending graduate or professional school, were more culturally aware, and had greater tolerance towards different beliefs. Smith found no differences between the two groups on job-related skills, leadership ability, or career commitment.

The study then looked at each group independently, while controlling for background and academic involvement, to determine what factors made up overall satisfaction for each group. There was no significant difference in the overall satisfaction of attending each school. However, what contributed to institutional satisfaction was different for the two groups. The women's college group listed five factors that contributed significantly to their overall satisfaction:

> Campus social life, quality of instruction, getting a degree, satisfaction with academic advising, and campus health services. For the coed group, seven variables contributed to satisfaction: quality of instruction, social life, relationship with faculty and administration, career counseling, courses in the major field, opportunity to talk to professors, and computer facilities. (Smith, 1990, p.191)

Austin's classic input-environment-outcome (I-E-O) model of college impact used in this study is a widely used theoretical model for measuring the effectiveness of the college experience (Smith, 1990; Smith et al., 1995). The model suggests three components that affect the outcome of college. First, the model considers entering characteristics of the student. Secondly, the characteristics of the institutions are included in the model. The third component is the actual experience of students while they are in college, as this can be different even between individual students attending the same institution.

In 1995, Kim and Alvarex studied the academic achievement, social self-confidence, and career preparation of women as self-reported on CIRP pre- and post-college surveys. Kim and Alvarex used the 1987 Student Information Form to compare 387 women's college freshman and 3,249 coeducational college freshmen. These students completed a post test, the College Student Survey, in 1991. Kim and Alvarex (1995) did not exclude public universities from their study because their regression analyses were the same with or without the public school students. Austin's

I-E-O model evaluated the impact of the institution on the students' responses to the Likert survey. Kim and Alvarex (1995) found that the percentage of women who ranked themselves as being among the highest 10% in academic ability, fell 1.1% at the coeducational colleges, but rose 7.5% at the women's colleges when comparing pre- and post-test scores. The social self-confidence responses increased 7.5% for the women's college students and 5.3% by their peers at the coeducational institutions. The authors suggested that fewer opportunities for women to fill student government and campus organization offices could contribute to the lower self-confidence of females ranked in the top 10 percent of their class at coeducational institutions. Women's colleges tend to offer more opportunities for these types of leadership opportunities. The researchers found no significant difference in the groups' perception of being prepared for graduate or professional school. The women's colleges had a negative impact on acquiring job-skills. The study also showed no correlation between the number of female faculty at an institution and the students' preparation for graduate or professional school. However, the authors suggested further research should explore whether the number of female faculty indirectly affects the development of students.

One interesting finding of Kim and Alvarex (1995) was that being actively involved with campus organizations, sports, sororities, and other activities (all of which are common occurrences on women's college campuses) positively affected women's self-confidence. Other factors that positively influenced self-confidence included higher parental income and having a mother who was an artist. Factors that negatively influenced self-confidence included having a mother who was a skilled worker, or selecting to major in the physical sciences. Factors that positively predicted academic ability included background information that suggested that students were well prepared (which included high school GPA, SAT score, father's education, or father being a college teacher), or that they were in an academically oriented environment (peers having high intellectual self-esteem, or father being a college teacher).

Kim (2002) investigated the effect of women's colleges on women's intellectual development. In this study, CIRP data was used from 1,397 female students attending 86 different colleges from 1987 - 1991. Kim found no difference in the growth of critical thinking ability or analytical and problem solving skills of women at women-only and coeducational colleges. However, there was a positive significant effect from attending a women's college on the intellectual self-confidence of female students. Kim suggested that the women's college environment provided more intellectually stimulating experiences for students. Kim's study also revealed differences in the types of students coming to these two college environments. Women's college students, though having no more academic preparation, did have higher parental incomes and parental educational levels. There were also a higher number of non-white females attending the single-sex colleges. Contrary to previous studies, Kim's study did not find interaction with faculty to be significantly different between women's colleges and coeducational colleges.

Kim (2001) studied the effect women's colleges have on female students' desires to be political and social leaders. She explored whether or not these schools cultivate a desire to impact social condition more so than coeducational schools. Kim used national longitudinal data from the CIRP database. Though many researchers have used Austin's I-E-O model to explain the effect that the college experience has on student's perception outcomes, Kim also used Beryk and Raudenbush's (as cited in Kim, 2001) hierarchical linear model to compare the perceptions of women attending women's colleges to their peers at coeducational colleges. This study found that women's college students had a higher desire to influence societal conditions and these schools had a more altruistic and social activist climate. This could help to explain why there are a disproportional number of women's college graduates in leadership positions. Kim suggested that the students' development of values was more a result of the institutional climate than the ratio of students to female faculty, as suggested by Tidball (1973) in earlier research. Kim also suggested that many women's colleges are located on the eastern coast of the United States, where people are more politically active than in many other areas of the country. It may be that this proximity to Washington, D. C. causes these institutions' climates to be more socially active. Factors that Kim found to influence social activism included being around socially active peers, associating with peers from high socioeconomic status families, and participating in cultural diversity programs and demonstrations on campus. Kim suggested that it is this fostering of social activism by women's colleges that leads their graduates to pursue leadership and political roles. Kim also suggested that policy makers should reconsider the idea that coeducational schools are both natural and beneficial to both genders. This concept, initiated during the 1960s civil rights movement, argued that a single-sex college experience was unnatural. While political and social activism can affect a student's leadership ability while in college, it also seems to have positive long-term effects on occupational attainment.

Riordan (1994) examined the relationship between the number of years women spent in a single-sex college environment and its effect on educational achievement, occupational attainment, and annual income. The study used data from women attending women's colleges between the years of 1972 - 1979. The study included 125 women who attended women's colleges for 1 - 6 years and 1,832 women who attended coeducational colleges. Subjects had to have scored higher than a 700 on the combined verbal and math portions of the SAT and have completed at least one year of college to be included in this study. Using student questionnaires, school records, and test batteries, Riordan found that attending a women's college did not have a significant effect on educational attainment, but it did have a direct effect on occupational attainment. The women who attended women's colleges achieved higher occupational prestige and had higher salaries than their peers had from coeducational schools, even when controlling for years of education. There was a relationship between the number of years of education a female received at a women's college and these graduates' income and occupational prestige. The study found that women attending women's colleges achieved higher salaries, even though they tended to work fewer hours per week. They were also less likely to divorce and expected to have more children than their peers from coeducational colleges did. Women's college graduates were less likely to become employed full time immediately after college. Staying at home to start a family before entering the workforce attributed to this.

What is it about the women's college experience that makes it different from a coeducational college experience? This question can be evaluated on many different fronts: socialization, academics, educational environment, and differences among faculty and staff. Each of these components helps to build "the women's college experience" which seems to have an impact on the females who attend these schools.

College as a Gendered Experience

Some researchers have suggested that the college experience is different for males and females (Smith, Morrison, & Wolf, 1994; Jacobs, 1999). In 1999, Jacobs compared the graduation rates of women to that of men. He used data provided by CIRP, as well as the HEGIS to acquire information about the stratification of women graduates across colleges of different standings. Although the number of women graduating from college is topping that of men, Jacobs found that females were more likely to attend the lower ranking, less elite schools. Jacobs's study also showed that having part-time students and non-traditional students negatively correlated with the ranking of schools. He found that women, unlike their male peers, were more likely to be part-time students and graduate from schools with lower standings. Jacobs suggested that engineering programs were associated with more elite institutions and males were more likely to be in engineering programs. This could account for the stratification difference in men and women when addressing the selectivity of colleges. Likewise, education programs, which graduate more females, were more likely to be associated with the less elite, lower ranking schools.

Smith, Morrison, and Wolf (1994) investigated differences in the perceptions of college students when grouped by gender, as measured by the CIRP. A sample group of female students (n = 1,789) entering college in 1986 and graduating four years later were compared to a similar group of male students (n = 1,870). The study compared the two groups using a Likert scale in 12 self-rated areas. The study found that overall males ranked themselves higher at both entry and exit of college than females on nine of the self-rated areas. These areas were academic ability, physical health, drive to achieve, mathematical ability, intellectual self-confidence, emotional health, leadership ability, popularity, and social self-confidence. The women rated themselves higher at both entry and exit only on foreign language ability. The men saw themselves higher at artistic ability on the initial survey, but there was no difference between the groups' self-ratings at exit, and there was no significant difference between the groups' perceptions of writing ability on either survey. This study suggested that while women's perceptions of their abilities increased over the college experience, so did their male counterparts, thus the males' scores remain higher. The second part of the study compared the social and political views of each group. The women were more liberal and socially concerned, and remained that way over the four-year span. Men were more conservative than women were initially, and over time they became more liberal and socially concerned, but not reaching the level of the females.

Santiago and Einarson examined the background characteristics of science and engineering graduate students as predictors of academic self-confidence and self-efficacy (1998). The researchers compared a sampling of surveys completed by engineering, chemistry, physics, and applied physics graduate students ($n = 290$) entering graduate school from 1995 - 1996. For the purpose of this study, the researcher defined students' academic self-efficacy "in terms of student confidence in the ability to complete program requirements" (Santiago & Einarson, 1998, p. 169). Santiago and Einarson did not find significant differences between males and females in academic credentials, post-baccalaureate training and work experiences, or academic self-efficacy and career-related expectations upon graduating. However, they did find significant differences in the students Graduate Record Exam (GRE) scores and their perceptions of the role gender plays in graduate school admission. The female students' GRE quantitative scores were, on average, significantly lower than the men's scores (714 vs. 749). In addition, 41% of the women felt that their gender was an asset to admittance into graduate school as compared to 2% of males. Eight percent of males surveyed felt that their gender was a liability to admittance, while no females perceived this to be true. Logistic regression results suggested that indicators of positive academic self-efficacy were associated with positive ratings of undergraduate preparation and expectations about faculty/student expectations, minority status, already having a master's degree, and marital status. While the researcher did not find any significant differences between the genders in academic self-efficacy, it is important to note that less that 25% of the participants were females (n = 72). When considering that over 50% of all students graduating from college are women, it stands to reason that females with lowered perceptions of academic self-efficacy either did not major in these non-traditional fields to begin with, or, if so, did not chose to continue graduate school, perhaps because of initial feelings of inadequacy in academic self-efficacy.

Current research on gender and education has explored differences in the ways males and females learn. These differences are crucial to understanding why a gap still exists between males and females in the fields of math and science. Strand and Mayfield (2002) studied pedagogical reform in high school math classes and its effects on female students' interest in taking college level math. College students attending a moderately selective women's college (n = 355) completed a survey that asked about the students' experiences with, attitudes towards, and achievements in math as well as their completed courses, intended major, and plans to take math courses. The researchers found that unconventional teaching strategies in high school, such as problem solving, cooperation, and relevance to real-world experiences had a positive effect on the subjects' attitudes toward math in college. Students who received this type of instruction in high school were more likely to have a better attitude toward math and see themselves as better able to succeed in college math. Likewise, more conventional teaching methods such as using lecture and text to present the material, promoting competition, requiring abstract thinking, memorization, and individual assignments discouraged females' attitudes toward and self-confidence in math. These newer pedagogical approaches that Strand and Mayfield refer to as being female-friendly seem to make a difference in females' perceptions of ability and attitude towards math, but they did not find that these approaches impacted a student's interest in taking additional math courses or majoring in a math field.

Though the gender gap for female students interested in math and the sciences is slowly closing, there is still a dispute about the causes for this gap. Bandura (1997b) suggested that there are numerous factors that lead females away from traditionally all-male fields. Bandura cited differences in women's beliefs about their self-efficacy, and thus capabilities, as the primary cause that affected career aspirations. He suggested numerous external experiences with parents, teachers, school counselors, peers, and cultural role models can all instill sexual discrimination and biased messages that lead young girls away from math and science classes. Bandura also suggests that the masculinity of computers, through their association with mathematics and electronics, has affected females' exposure and efficacy towards technology ability. This is another barrier that could widen the gender gap in math, science, and technology it if is not addressed early in female students' educational experiences.

Females in Math and the Sciences

Schools are not the only places where males and females differ in their exposure to and opinions of science. Even the perceptions of males and females in society seem to differ over the importance of science. Fox and Firebaugh (1992) conducted a study examining the perceptions of Americans' confidence towards the science community. Data previously collected by the National Science Foundation (NSF) from 1973 - 1989 was used to research trends in confidence that the public has towards institutions such as banks, the military, Congress, and major companies. A question on the survey asked to what degree of confidence did the respondent have in the persons running selected institutions, which included the science community. Though there were no longitudinal trends found concerning changes in public confidence over time, the study did find that women tended to continually express less confidence in the science community than men did. The authors suggested a correlation between this phenomenon and three factors found in the study. First, women did not think science was as useful as men did, especially in the area of space exploration. Secondly, women were less likely to have as high a work status in the labor force as the men. The third factor that accounted for this gap in confidence was that women completing the survey identified themselves as being more religious than the men did. Fox and Firebaugh explained that the female respondents were more likely to attend church and claim religious affiliation than the males. These findings also raise questions of religion and science debates, such as creationism versus evolution. How do these issues affect female students' educational choices?

These societal differences can also make for continued gender discrimination within the science workforce. Though it is much more subtle than during the initial development of Title IX, sexist discrimination towards women still exists in non-traditional career fields as well as in upper levels of management. Sonnert and Holton (1996) surveyed 699 scientists and completed interviews with 200 of the participants. All subjects chosen for Sonnert and Holton's study were what the researchers described as especially promising scientists in a variety of fields, all having received prestigious post-doctoral fellowships. The study looked at two models of explanation for the continued subtle discrimination that exists for women in these careers. The first model, the deficit model, suggested that both formal and informal exclusion of women scientists occurs in the work force. It suggested that women as a whole receive fewer opportunities for career advancement. This results in less successful careers for these women than their male peers. In this model, the researchers suggested legal, political, and social obstacles as the cause for the continued gender gap in the sciences. The second model the study considered was the difference model. This model suggested the cause of the gender gap to be deeply rooted gender differences between men and women. This model takes into consideration the ingrained differences in gender-role socialization, as well as differences in behavior, outlook, and goal setting.

Sonnert and Holton explained three types of perceived gender differences that are important in examining career patterns of women in the sciences (1996). First, they suggested that society socializes females to be less competitive and as a result have less drive for professional success in any career. Second, societal attitudes about science, as discussed earlier, may define it as a male field and discourage female participation. The third contributing factor suggested was epistemological gender differences that exist, but are not compatible with what the authors' termed "women's ways of knowing." This refers to the way that gender affects how people approach and pursue their work. The researchers found differences in the scientific and professional styles of the men and women interviewed, specifically differences in their perceptions of professional conduct, peer interaction, choice of research, way of thinking, and methods of work selected.

Sonnert and Holton found that of the female respondents, those affiliated with institutions that are more prestigious were actually disadvantaged in that they lacked the rank achievement of other scientists (1996). The authors referred to the "glass ceiling" effect of real, yet invisible, barriers that inhibit women from reaching top professional and leadership positions within their profession. Within the younger group of scientists surveyed, the career status of women in physical science, mathematics, and engineering averaged almost one full academic rank below their male peers. The only group of women not affected by the "glass ceiling" seemed to be those in biology.

Almost 73% of the women surveyed felt subjection to some form of gender discrimination (Sonnert & Holton, 1996). Interestingly, close to 13% of the males surveyed felt that they experienced reverse discrimination. Women expressed concern over experiencing less collaboration as equal or senior partners. The women believed they were seen more often as junior partners. The scientists interviewed also expressed differences that seemed to result from socialization. Female scientists lacked confidence in their career and scientific ability and many tended to be perfectionists. Many of the female scientists interviewed expressed concern over the possibility of criticism and fear of failure. Both genders described male scientists as being more aggressive and self-promoting in their careers. They received higher visibility and were more willing to participate in what the authors referred to as "bonding rituals." These rituals included casual talk between professors that could serve as self-promotion and possibly result in improving a scientist's research opportunities or career advancement.

Many women scientists reported the positive influence of a same-gender role model within their post-doctoral education (Sonnert and Holton, 1996). They also reported being less competitive and less likely to be interested in working with competitors on the same topic. Rather, the female scientists preferred to find their own niche and complete more comprehensive and in-depth studies. Though the women were less likely to publish research than the males, of the articles they published, women received a significantly larger number of citations per article (24.4 versus 14.4). This suggests that the quality of published work is of greater importance to many women than the quantity of publications. The differences that exist between genders within the science workforce are very reflective of the same differences reported between male and female students in schools. The early socialization that these females received by their teachers, parents, counselors, and the mass media about the roles of women seems to have continued to affect their ability to compete confidently in the workforce. Findings such as these lead to concerns about the amount and type of action needed to ensure that tomorrow's female leaders avoid the same social barriers of earlier generations. This subtle discrimination has denied so many seemingly competent females opportunities for success, leadership, and advancement in some of society's most lucrative careers.

The career directions of women have changed dramatically over the past thirty years. The number of women receiving bachelor's degrees in non-traditional fields, like math and science, is rising. In 1994, women made up an average of 45.8% of all science and engineering graduates, and this number rose to 50.6% in 2001 (National Science Foundation, 2004b). However, there is still inequity for women within the sciences. For example, while females made up 77.5% of psychology graduates in 2001, they only represented 20.1% of those graduating with an engineering degree (National Science Foundation, 2004b). When comparing the salaries of these two science careers, one better understands the extent of this inequity. When comparing the median annual earnings for these careers, psychologists average $51,170 per year, while the median earnings for engineers include $64,410 for biomedical engineers; $72,750 for aerospace engineers; and $83,370 for petroleum engineers (U. S. Department of Labor, 2004). The true extent of the inequity between these career fields further increases when the level of degree needed to enter the fields are considered. According to the Occupational Outlook Handbook, psychologists have very limited opportunities with just a bachelor's degree, and really must have a doctoral degree or at least a master's level degree for entrance into the workforce. Yet most entry positions into engineering require only a bachelor's degree or, in some cases, a masters degree (U. S. Department of Labor, 2004).

Liberal feminist activists would argue that while the science community has made improvements, sexist segregation still exists within certain subcategories of the sciences. This discrimination within the sciences could result in the "feminization" of certain science careers. According to Davis (1975), as the number of female workers in a field increases, feminization occurs. As Davis explains, feminization of a career results in two labor-market effects: a drop in prestige and a drop in the overall wages within that career field. When society considers a career as "women's work," social esteem for the skills needed for the career, and the social status of the career field itself, drops. An example of this is the change that took place in the previously male-dominated field of elementary education in the late 1800s. As more females entered the field, males left them, and began to teach primarily in secondary education positions (Gordon, 1990). There is now a large salary gap and difference in the gender make-up of early childhood educators as compared to secondary educators.

Gender wage-gaps are apparent across many occupations suggests Jacobs (1995). In a study comparing the entry-level earnings of college graduates, Jacobs found that when compared to the field of engineering, a traditionally male-dominated field, the earnings of those entering female-dominated careers such as education, psychology, and the social sciences actually decreased during the 1970s and 1980s. The only female-dominated profession to have an increase in entry pay during this time was nursing. Jacobs further suggested that it is the crowding effect of having an excess supply of females trained in these fields that limits women's bargaining power within these professions.

A study conducted by the American Association for the Advancement of Science (AAAS) surveyed biological scientists on salary levels, job histories, and other factors that shaped their careers (Holden, 2001). Of the 8,692 respondents, 72% were male. Two-thirds of the men were between the ages of 40 and 59. Of the 27% of female respondents, the mean age was much lower. Thirty-eight percent of the women were under the age of 40. The researcher attributed these findings to the improved inclusion of women in the sciences over the past few decades. However, the study found that there is still a gender gap with regard to salary; men earned almost one-third more than women. The study cited an average mean salary of $94,000 for men compared to $72,000 for females. They found the greatest difference in salaries was among academic administrators where the gap was almost $50,000 ($120,000 for men versus $75,000 for women). Holden suggested that this difference could be a result of the fact that there is such a surge of younger females in the profession. There is a wide gap between starting salaries and the salaries of those in the peak of their career.

Sexist discrimination exists not only in non-traditional career fields and educational departments, but also in higher education institutions themselves (Parsons & Ward, 2001; Tidball, 1976). Parsons and Ward note that females are overrepresented in the less prestigious segments of higher education and underrepresented in the more prestigious leadership positions (2001). They found that from 1980 - 1996, feminist voices were all but excluded from higher education policy literature. They suggested that the absence of women in higher education leadership positions has resulted in a male-based normative leadership model for higher education. Parsons and Ward found that this model of leadership tends to exclude women's issues and interests within decision-making policy. The study suggested that this socialization pattern was caused by the underrepresentation of women faculty and researchers. This lack of representation led to limited studies on women and women's issues, and therefore lessened the voice of women and women's issues within the leadership of higher educational institutions.

The U.S. government has attempted to address these gender inequalities in math and the sciences for many years. For liberal feminists, the battle for legislative gender equality has been a long but productive process. Title IX of the 1972 Education Amendment (20 U. S. C. § 1681) began the process of equalizing public educational opportunities between the genders (National Coalition for Women and Girls in Education, 2002). In 1981, the Equal Opportunities for Women and Minorities in Science and Technology Act mandated annual statistical reports on underrepresented groups in the sciences (National Science Foundation, 2002). In response to the Act, in 1993 the National Science Foundations created the Program for Women and Girls. In May 1999, this program was renamed the Program for Gender Equity in Science, Mathematics, Engineering, and Technology. Most recently, the U. S. House of Representatives passed the Commission on the Advancement of Women in Science, Engineering, and Technology Development Act (H.R. 3007) in 1998 (National Science Foundation, 2002). With the support of these legislative actions, there has been an increase in the number of females receiving post-secondary degrees in math and science and therefore an increase in the number of females entering these career fields. However, there is still more work that needs to be done to address salary equity between the genders, as well as investigate the barriers that continue to keep women from entering the most lucrative science careers at the same rate in which they have begun to enter other areas of science.

Theoretical Perspective

In 1977, Albert Bandura originally introduced the concept of self-efficacy as part of his social cognitive theory. Researchers use this concept, which is a belief in one's personal capabilities, as a theoretical model in numerous types of studies, including some areas of academic research. Bandura characterizes self-efficacy as how successful one is at completing a task or reaching a goal. The choices made, the effort and persistence put into an activity, and how one feels about the activity influences self-efficacy. Although the root of self-efficacy has not been determined, three factors that help to predict it include aptitude, ability, and previous experiences.

Bandura's model of self-efficacy suggests four factors that affect one's self-efficacy: mastery experience, vicarious experience, verbal persuasion, and psychological state (Bandura, 1997b). By gauging the effects of their experiences, individuals raise or lower their self-efficacy. Mastery experience is the most effective form of improving self-efficacy. Peer modeling is an example of vicarious experience, and while less effective than mastery experience, it can still affect one's self-efficacy. Verbal persuasion, which is verbal judgment by others, has the least effect on self-efficacy. Negative judgment has a greater effect than positive persuasion. According to Bandura, self-efficacy affects the choices people make and the effort they put into accomplishing activities. Self-efficacy describes how resilient one is in overcoming obstacles and how long one may persevere in trying situations.

Self-efficacy is a judgment of confidence in one's abilities to complete a specific task (Bandura, 1977). It differs from self-concept in that self-concept is a judgment about self worth, and relates to self-esteem. Self-efficacy is context-specific and task-based. It causes one to ask, "Can I reach a goal based on my aptitude, ability, and previous achievement"? It is not a cogitative appraisal or a self-evaluation of one's worth.

In a Harvard Mental Health Letter, Bandura (1997a) explained that self-efficacy could affect a person's cognitive function, in that people with high self-efficacy more often have high aspirations, set difficult challenges, and commit to meeting those challenges. He also explained that perceived high self-efficacy also leads to greater motivation because these people are more likely to set goals, make action plans to meet their goals, anticipate possible outcomes, and believe strongly that they can attain their goals. Bandura suggested that self-efficacy leads to beliefs of one's ability to accomplish a task. This includes determination of how much effort to put into a project and resiliency in the face of failure.

One future area of research on self-efficacy includes investigating the gender “confidence gap” in math, science, and technology (Pajares, 2004). Differences between the academic experiences of females at women’s colleges as compared to those at coeducational colleges can be one factor that helps to explain the success of women’s college graduates. In 1994, Trice compared the syllabi of courses at women’s colleges and coed colleges for differences in the number and kinds of assignments given at these two types of institutions. Course assignments examined included the subject areas of psychology, art history, mathematics, and English at both introductory and advanced levels. Syllabi (n = 502) were submitted from 18 women’s colleges and 18 matched-pair coeducational colleges, spanning three geographical regions. Schools were matched for location, size, and selectivity.

Trice (1994) found that, overall, there were more assignments in introductory courses than advanced courses at all of the colleges surveyed. However, the women’s colleges had more short-term assignments and tests in every subject than the coeducational college. The women’s college syllabi also had significantly higher numbers of assignments for the quantitative and scientific disciplines of psychology and mathematical introductory courses. The women’s colleges also had significantly more assignments in the advanced psychology and English courses. Using Bandura’s theory of self-efficacy, Trice suggested that these additional opportunities for behavioral accomplishments helped to increase women's college students' self-efficacy. Trice suggested that women's colleges tended to break down the material into smaller chunks, thus allowing more feedback and better opportunities for females with otherwise weak scientific and mathematical backgrounds to be successful.

Trice (1994) found that only 4% of advanced courses at women's colleges had three-requirement syllabi, as opposed to 26% of advanced courses at coeducational colleges. The three-requirements included only major assignments, such as a midterm, final exam, and term paper. This tactic of having a small number of assignments count towards a large percentage of course fulfillment has traditionally been a tool for separating students and allowing the best students to rise above the rest. This style of syllabi allows little opportunity for student-professor interaction and is very demanding. Trice suggested that because women's colleges traditionally have smaller pools of potential students and a historical tendency of accepting students excluded from other institutions, women's colleges tend to be more inclusive and therefore less likely to try to separate the "cream of the crop." It is these additional opportunities for behavioral accomplishment, Trice suggests, that allow female college enrollees, who, similar to all females students typically, have lower self-concepts than males, to achieve at higher rates than their female peers at coeducational colleges.

If course assignments can affect the level of student-to-professor interactions, then what impact do these interactions have on a student's success? In a discussion of observational learning, Bandura explained the effect same gender role models could have on a person (1997b). "The greater the assumed similarity, the more persuasive are the models' successes and failures. If people see the models as very different from themselves, their beliefs of personal efficacy are not much influenced by the models' behavior and the results it produces" (Bandura, 1997b, p. 87). The question of the importance of same gender role modeling by professors has been inconclusive in prior research. While some researchers suggest it does influence female college students' performances (Tidball, 1973; Sonnert & Holton, 1996), others have not found significant findings to justify the need for same gender role modeling in academia (Kim & Alvarex, 1995; Kim, 2002).

In a 1994 study by Scheye and Gilroy, the researchers found that the gender composition of female college student's educational environments affected their perceived efficacy to pursue non-traditional career fields. Though the study found no direct effect, women who attended single-sex schools and cited a male professor as having the most impact on them had a stronger sense of efficacy towards pursuing a non-traditional field. The authors cited two possible reasons for this. First, the students in the single-sex environment experienced exposure to female role models in so many other aspects of their educational environment that this caused an increase in efficacy. This combined with the fact that the male professors choosing to teach at women's colleges tended to support the idea of females pursuing non-traditional careers was another part of the explanation. The second possible cause for this difference in sense of efficacy towards non-traditional fields may have been the fact that some women chose a single-sex environment because they were already interested in a non-traditional occupation and felt that this type of environment would be the most beneficial to their aspirations. They may have sought out male role models to better prepare themselves for the realities of the workforce.

Conclusion

With the recent debates over federal funding for colleges, combined with increased college tuition hikes nationwide, there have been concerns over the value of a single-sex education for women. “The idea of gender separation is viewed with great and justifiable skepticism in democratic societies” (Riordan, 1994, p. 505). Though justifiable in their productivity, the recent well-being of women’s colleges has suffered because of social, cultural, political, and economic changes in the United States. The number of women’s colleges in the United States has plummeted from 298 in the 1960s to 68 today (Women’s College Coalition, 2004). Many women’s colleges have closed, while others have gone coeducational in order to remain in operation. There is much talk in the media and on women’s college campuses about how, and if, these schools will be able to meet the changing needs of post-secondary education in the 21st century.

Women’s colleges have been trying to overcome the dilemmas of low enrollment and limited finances by making themselves more appealing to today’s college students. According to researchers, these schools offer a very unique experience that leads to success both while in school and afterwards. Yet in spite of this, the paradox remains that more and more women’s colleges are closing.

The initial purpose of women’s colleges was to offer women a post-secondary education that would better prepare them to be wives and mothers. The quality of education at these schools did eventually become equitable to the opportunities of males. During a time when the historically all-male colleges did not allow women, women’s colleges were the only option for women interested in pursuing a career in math or the sciences. This is no longer the case, and the need for and use of these institutions is being re-evaluated. In some cases it has even been argued that these institutions restrict equal opportunities to higher education because of gender separation and keep women from experiencing "real-life," male-dominated interactions that they may face after leaving college (Oates & Williamson, 1978). Regardless, research continues to show that women's colleges do provide opportunities and experiences for women that are different from those at coeducational schools. However, this research, combined with statistics on the successes of so many women's college graduates, does not overshadow the fact that the number of women's colleges is dwindling. More and more of these schools are closing or becoming coeducational.

According to Riordan (1994), a single-sex environment is more conducive to learning, especially for females. Research has shown that within an academic setting, teachers give males more attention and call on them more frequently than females (Smith, 1990). In addition, males tend to dominate classroom discussions and interactions (Canada & Pringle, 1995). The success rate of women's college alumni argues a strong need for the continuation of women's colleges. Women's colleges seem to provide the environment needed to foster positive outcomes from the women who attend them. Is this just a perceived difference, derived from their college experience, or is there a true difference in the type of educational environment and experiences at single sex and coeducational schools? Much of the recent research on women's colleges has focused on students' perceived differences in academic achievement without being able to explain the reason for these differences clearly.

This study investigated differences in the frequency of degrees awarded at women's colleges in the areas of science and math when measured against comparable coeducational schools. Can the academic programs offered at these institutions explain differences in the success and leadership of women's college graduates? Do women's college students have a tendency to major in the sciences more often than students at coeducational colleges do? This could help explain the disproportionable number of women's college graduates who go on to become leaders in politics, science, and other non-traditional career fields. Alternatively, as suggested by some researchers, is it some other undetermined aspect of the women's college experience, or a combination, that has contributed to the success of these graduates (Kim, 2001; Kim, 2002; Kim & Alvarex, 1995)?

The four science majors included in this study were life science, physical science, math and computer science, and social science. Though there is much interest in the continued gender inequity within the field of engineering, this study does not address this scientific area because so few women's colleges currently offer a degree in this area. Selectivity among single-sex and coeducational schools was examined in relation to the proportion of physical science, life science, math and computer science, and social science degrees awarded. A longitudinal comparison of schools examined if gender equality legislation has resulted in a changing trend for women to pursue degrees in non-traditional majors over a 16-year period.

Though not directly addressed in this study, there is still the question of whether the women who choose to attend women's colleges differ from those at coeducational colleges to begin with. Is it their college experiences or their background that cause these differences? Perhaps these women naturally bring with them the self-confidence, academic experiences, and leadership skills needed to become better leaders. Maybe it is something unique to the women's college experience that allows them to rise above their coeducational peers in the areas of leadership, professional and graduate school attainment, and future employment. What exactly is it about women's colleges that cause their students and graduates to achieve at such high rates? A specific factor has not been determined to cause this phenomenon. Can the stratification of degrees awarded to undergraduate female students help to better explain this phenomenon?

The challenge for women's colleges today can best be summed up by the thoughts of the most notable founder of women's college research, M. Elizabeth Tidball, who, in 1973, suggested that "unless their positive societal contribution is encouraged and aided, women's colleges with their concentrated source of talent are likewise in jeopardy" (p. 135). As the number of women's colleges continues to decline, it is important that researchers continue to study both the immediate and long-term effects that a single-sex college education has on the social, academic, and leadership skills of women.

CHAPTER 3

METHODOLOGY

Subjects

Subjects for this study included 42 liberal arts colleges in the United States. A near majority of colleges, 45%, were located in the Northeast (n = 19), followed by 36% in the Southeast (n = 15), 12% in the Mid-West (n = 5), and 7% in the West Coast region (n = 3). The 42 colleges included in the study were divided into two groups; one group contained women's colleges (n = 21), while the other was made up of coeducational colleges (n = 21). For the purpose of this analysis, each school in the women's college group was matched to a school in the coeducational college group based on similarities in ranking as published in *U. S. News and World Report America's Best Colleges 2002* listing of private liberal arts colleges (Appendix B). Data for this ranking system was generated in the 2000 - 2001 school year, which coincided with the last year of data collection for this study.

The two college groups were further divided by levels of selectivity. This study compared four levels of selectivity derived from *U. S. News and World Report America's Best Colleges 2002* annual ranking of liberal arts schools, in which tier assignment for schools was calculated using a variety of factors. *U. S. News and World Report's* (2001) liberal arts college rankings were based on the following factors: academic reputation scores, grade point average, graduation and retention rates, faculty resources, student selectivity, financial resources, alumni giving, freshman retention, 2001 graduation rate, 2001 predicted graduation rate, percentage of classes under 20 pupils, student to faculty ratio, SAT/ACT scores of incoming freshmen, freshmen in top 10% of school class, and acceptance rate.

When divided by selectivity level, 29% of the colleges included in this study were ranked as first-tier schools (n = 12), 33% were second-tier schools (n = 14), and 19% of the schools were each in the third- and fourth-tiers (n = 8 and n = 8 respectively). When divided equally into sample groups (coeducational colleges and women's college), the numbers of participating schools from each selectivity level were 6 first-tier schools, 7 second-tier schools, 4 third-tier schools, and 4 fourth-tier schools per group. Throughout analysis, this study refers to first-tier schools as being highly selective, second-tier schools as being selective, third-tier schools as being moderately selective, and fourth-tier schools as being less selective.

For the purpose of trend analysis, college matriculation periods were grouped into four 4-year periods: Time 1 (1985 - 1988), Time 2 (1989 - 1992), Time 3 (1993 - 1996), and Time 4 (1997 - 2001) -which excluded the 1998 - 1999 school year. Although the study compared graduation rates in groupings of 4-year increments, information was not available from the national database for the 1998 - 1999 school year. Therefore, the last measurement of time contained four years of data, yet it spanned a five-year period from 1997 - 2001. Because students typically go through college in increments of four years, these 4-year groupings represented the average rates during each period. This process allowed for consideration of occasional outlier scores which, when considered individually, may have otherwise skewed the statistical results.

Sampling

From 1985 - 2001, excluding 1999, 158,114 undergraduate female students received a baccalaureate degree from the group of colleges included in this study. Of this total, 47.6% received a degree in one of the four major areas investigated and therefore were included in this study (*n* = 75,228). The other 52.4 % of females that graduated from 1985 - 2001 received a degree from outside of the four major areas of study (*n* = 82,886) and were thus excluded from the statistical analysis because they did not meet the criteria for subject participation.

As shown in Figure 1, within the total population of female graduates from 1985 – 2001 (*N* = 158,114), 2.7% of females received a physical science degree (*n* = 4,235). Math and computer science majors comprised the next largest percentage, 3.2% (*n* =5,124), while life science graduates made up 9.2% of the total population of female graduates (*n* = 14,480). The largest group of graduates included in the study were social science majors who made up 32.5% of all graduates (*n* = 51,389). The other 52.4% of total graduates received a non-science degree and were therefore excluded from the study.

Within the sample of graduates included in this study (*n* = 75,228), 42% of the women attended women's colleges, and 58% attended coeducational colleges from 1985 – 2001. The subjects sampled were comparable to the total population of selected college graduates (*N* = 158,114) in which 44% attended women's colleges, and 56% of total graduates attended coeducational colleges.

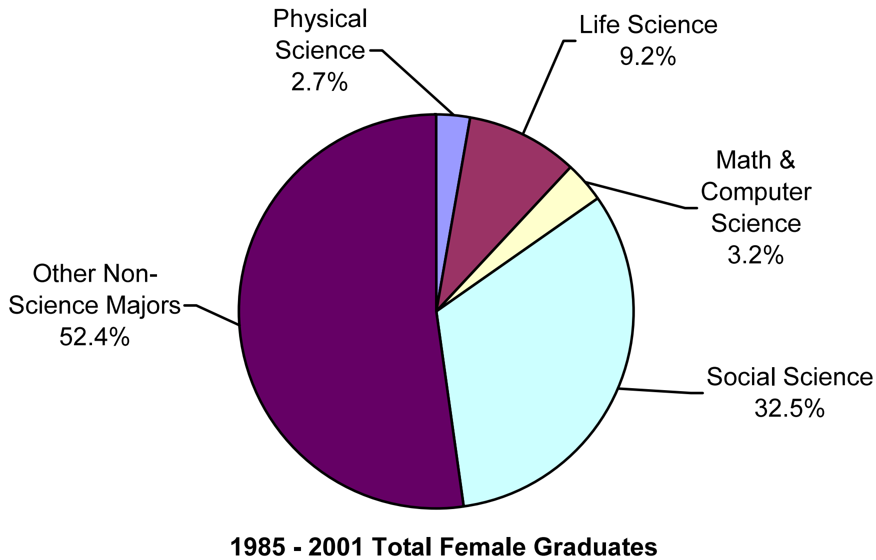

Figure 1: Percentage of Graduates by Major

When further divided by level of selectivity, 55% of the sample of females included in this study graduated from highly selective colleges, 28% graduated from selective colleges, 9% graduated from moderately selective colleges, and 8% graduated from less selective colleges. The representation of graduates by selectivity level was comparable to the college population that was sampled for this study, in which 56.2% of the total population attended highly selective schools, 26% attended selective schools, 9.3% attended moderately selective schools, and 8.5% attended less selective schools. Figure 2 shows the frequency of graduates from women's colleges and coeducational colleges within each level of selectivity.

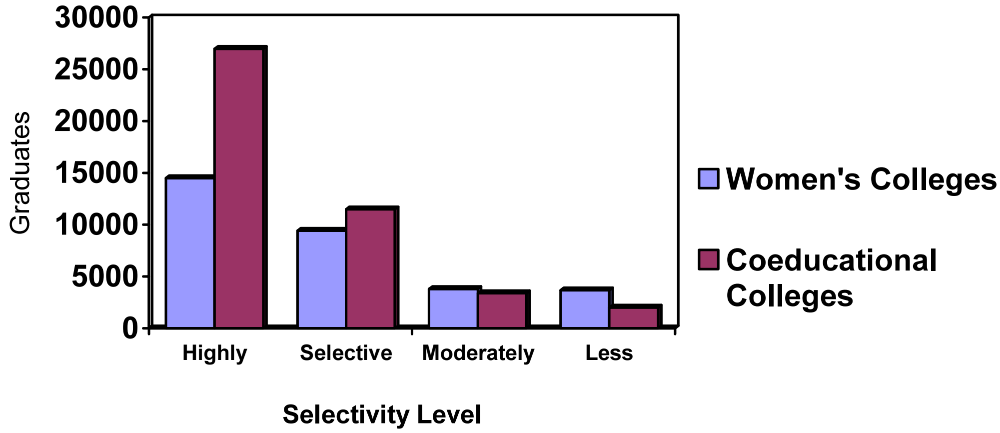

Figure 2: Frequency of Graduates Included in the Study

Instruments

The National Center for Educational Statistics (NCES), a division of the U. S. Department of Education, previously collected all data analyzed in this study. Using results from the national Higher Education General Information Survey (HEGIS), the NCES has gathered and reported data on colleges annually since 1985, excluding the 1998 – 1999 school year, during which time data was not properly collected. The NCES compiles the data resulting from the HEGIS into an Integrated Postsecondary Education Data System (IPEDS). The National Science Foundation (NSF) then archives this data in an on-line database. The database, WebCASPAR, is publicly available on the Internet at http://casper.nsf.gov. The college survey data collected from WebCASPAR used in this study included school affiliation, total number of graduates, and specific information on postsecondary majors (physical sciences, life sciences, math and computer sciences, and social sciences) from 1985 – 2001. This research excluded 1999 graduates, as the NCES was unable to provide any data on colleges for the 1998 - 1999 academic year.

Design

The subjects were assigned to two groups according to the type of collegiate institution from which they graduated (independent variable): single-sex or coeducational college. Each group was comprised of four levels, according to the selectivity of the schools (independent variable): highly selective, selective, moderately selective, and less selective. The repeated measures design allows for observation of changes in the percentage of degrees conferred over time (trend analysis): Time 1, Time 2, Time 3, and Time 4.

As Figure 3 illustrates, a between- and within-group analysis investigated the significant main effects or interactive effects produced by the independent variables when measuring the dependent variables (both collectively and independently). Dependent variables measured included the percentage of female graduates receiving degrees in the areas of physical science, life science, math and computer science, and social science.

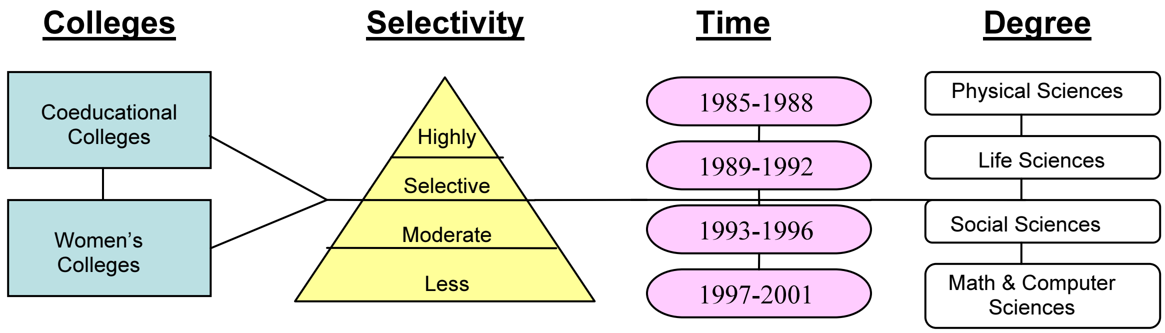

Figure 3: Graphical Representation of the Study

The model used for this study included seven sources of variability. Thus seven separate hypotheses were tested. These sources of variability included the effects of each of the following on the percentage of degrees conferred:

1. College
2. Selectivity
3. College x Selectivity
4. Time
5. College x Time
6. Selectivity x Time
7. College x Selectivity x Time

Procedures

Each single-sex college was matched with a coeducational college of similar selectivity based on 2001 rankings of liberal arts college found in *U. S. News and World Report America's Best Colleges 2002* (2001). Data was then collected on the selected schools using an on-line database containing survey information obtained by the U. S. Department of Education and archived by the NSF. Data collected for the study included annual information for each school based on the total number of degrees conferred as well as more specific information on individual postsecondary majors grouped under the headings of physical sciences, life sciences, math and computer sciences, and social sciences from 1985 – 2001, excluding the 1998 – 1999 school year.

The IPED database reports graduation rates individually for each area of study as well as compiles them into groups of similarity. This study examined four major areas of study: physical sciences, life sciences, math and computer sciences, and social sciences. Subgroups of the four major areas were previously determined by the IPED database. Physical science degrees included astronomy, chemistry, and physics. Life science degrees consisted of agricultural science, biological science, medical science, and other life sciences. Math and computer science degrees involved programs in mathematics and statistics, computer science, and other math sciences. The majors included in the grouping of social science degrees included economics, political science and public administration, sociology, anthropology, linguistics, history of science, area and ethnic studies, and other social sciences.

For the purpose of this research, raw score data was obtained on each of the dependent variables by calculating the sum of all degrees conferred within each subgroup. For the purpose of analysis, the raw scores were then converted into percentage scores to represent the comparative relationships between subgroups and total populations, as shown in Appendix C.

Data Analysis

To analyze the effect that time, type, and selectivity had on the percentage of degrees awarded to female physical science, life science, math and computer science, and social science graduates, the data was analyzed with the use of a doubly multivariate repeated measures analysis of variance test. This test allowed for the investigation of both main effects, as well as interaction between the independent variables on the dependent variables (physical sciences, life sciences, math and computer sciences, and social sciences). Statistical analysis was performed using Statistical Software for the Social

Sciences (SPSS), Version 12.0, computer software on the raw data shown in Appendix C. First, the college type and selectivity were independently analyzed for significant individual effects on the percentage of degrees conferred upon female graduates without the consideration of time as a variable. Next, the interactive effect of college type and selectivity (Type x Selectivity) on the dependent variables was measured, again without time as a variable. Then the effect time had on the percentage of degrees conferred upon female graduates was measured. Final trend analysis included measuring the interactive effect of college type and time (Type x Time), college selectivity and time (Selectivity x Time), and college type, selectivity and time (Type x Selectivity x Time). The statistical design of the study allowed for the measurement of main and interactive effects on the dependent variables both collectively and independently.

CHAPTER 4

RESULTS

Descriptive Statistics

Sampling for this study was comprised of 42 liberal arts colleges in the United States. Independent variables included the type of college, the selectivity level of the college, and the effect time had on the percentage of female graduates from 1985 - 2001. Dependent variables included four major areas of study: physical science, life science, math and computer science, and social science.

The effect that college type and selectivity had on the subjects in this study was measured repeatedly over four 4-year periods. Appendix D shows mean scores and standard deviations for the dependent variables when categorized by type, selectivity, and time as listed in its entirety. Table 1 shows the mean scores and standard deviations for each dependent variable when measured over time. The mean scores of life science graduates increased over time while the mean scores of math and computer science graduates decreased over time. Both social and physical science graduates' scores fluctuated between time periods, but overall showed very little change from the first measurement to the last.

The percentage of social science degrees conferred was much higher than that of any of the other groups. The rate of social science graduates was followed by life science graduates, then math and computer science graduates. The lowest rate of scores was made up of students receiving a degree in physical science. However, it is important to note that the social science category included twice as many individual degrees as each of the other categories. There were eight separate degrees under the heading of social science, four within life science, and three within both physical science and math and computer science. Even when considering this, the difference in mean scores between social science graduates and the other three dependent variables was substantial.

Table 1

Descriptive Statistics for Time

Time Period	Dependent Variables							
	Physical		Life		Math & Computer		Social	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1985 - 1988	.027	.022	.086	.065	.050	.036	.290	.114
1989 - 1992	.023	.017	.084	.070	.033	.024	.301	.106
1993 - 1996	.027	.019	.109	.072	.028	.018	.302	.102
1997 - 2001	.028	.019	.129	.091	.028	.018	.294	.108

Note. N = 42 colleges

Table 2 shows the means and standard deviations of the two types of colleges, women's colleges and coeducational, when broken down by time periods (Type x Time). The coeducational colleges had higher mean scores for physical science during each time period except the third one, during which the women's college mean scores were higher.

The mean scores for both groups fluctuated greatly between measurement times for physical science graduates. Likewise, the coeducational colleges had higher mean scores in life science for each time period examined. Over time, both the coeducational and women's college groups showed an overall increase in life science. The women's colleges had higher mean scores in math and computer science and social science for each time period examined. Math and computer science scores for both groups of colleges decreased over time. Within social science, the women's college scores decreased as the coeducational college scores increased, bringing the two groups' mean scores closer in the last time period than in any of the preceding years.

Table 2

Descriptive Statistics for Type x Time

Major	Time Period	Colleges			
		Coeducational		Women's	
		M	*SD*	*M*	*SD*
Physical Science					
	1985 - 1988	.027	.024	.027	.019
	1989 - 1992	.024	.019	.022	.016
	1993 - 1996	.025	.020	.028	.018
	1997 - 2001	.029	.021	.027	.017
Life Science					
	1985 - 1988	.099	.084	.072	.034
	1989 - 1992	.104	.090	.065	.033
	1993 - 1996	.125	.093	.094	.037
	1997 - 2001	.135	.089	.122	.094
Math & Computer Science					
	1985 - 1988	.036	.025	.050	.036
	1989 - 1992	.028	.015	.037	.030
	1993 - 1996	.024	.012	.033	.022
	1997 - 2001	.023	.012	.032	.021
Social Science					
	1985 - 1988	.257	.105	.323	.115
	1989 - 1992	.285	.096	.318	.116
	1993 - 1996	.292	.101	.311	.104
	1997 - 2001	.290	.111	.298	.107

Note. N = 42 colleges

Table 3 shows mean scores and standard deviations of the percentage of degrees conferred upon graduates in physical science, life science, math and computer science, and social science for each level of selectivity when measured over time (Time x Selectivity). For both physical science and social science graduates, the more selective colleges conferred a higher percentage of degrees than the less selective during each time measured. The rate of degrees conferred fluctuated greatly within both life science and math and computer science. These mean scores are further illustrated in Figures 4 – 8, which show trend analysis for each dependent variable when measuring the effect of selectivity.

Figure 4 shows the relationship of Selectivity x Time on physical science graduates. Although the scores fluctuated between the time periods, the highly selective schools did show a slight increase over time in the percentage of physical science graduates. Selective and moderately selective schools also showed fluctuation; however, these average scores, when measured over time, were the same for both the first and last time periods. The less selective colleges showed a slight decrease over time in physical science scores.

Table 3

Descriptive Statistics for Selectivity x Time

Major	Level of Selectivity	Time							
		1985 - 1988		1989 - 1992		1993 - 1996		1997 - 2001	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Physical Science									
	Highly	.033	.022	.029	.017	.036	.019	.035	.019
	Selective	.031	.027	.023	.016	.026	.017	.031	.020
	Moderately	.027	.011	.022	.022	.022	.016	.027	.015
	Less	.013	.015	.013	.015	.017	.023	.011	.010
Life Science									
	Highly	.080	.023	.069	.024	.099	.029	.114	.036
	Selective	.073	.029	.080	.032	.098	.033	.110	.037
	Moderately	.086	.114	.079	.066	.106	.072	.157	.162
	Less	.114	.132	.121	.139	.149	.139	.155	.120
Math & Computer Science									
	Highly	.032	.020	.022	.012	.024	.013	.027	.011
	Selective	.049	.039	.035	.032	.029	.020	.029	.021
	Moderately	.044	.024	.035	.019	.025	.013	.016	.006
	Less	.046	.037	.042	.025	.038	.024	.038	.022
Social Science									
	Highly	.372	.050	.380	.057	.370	.069	.371	.077
	Selective	.324	.096	.331	.093	.340	.077	.330	.077
	Moderately	.246	.096	.250	.081	.236	.099	.204	.087
	Less	.151	.087	.218	.098	.201	.070	.207	.097

Note. N = 42 colleges

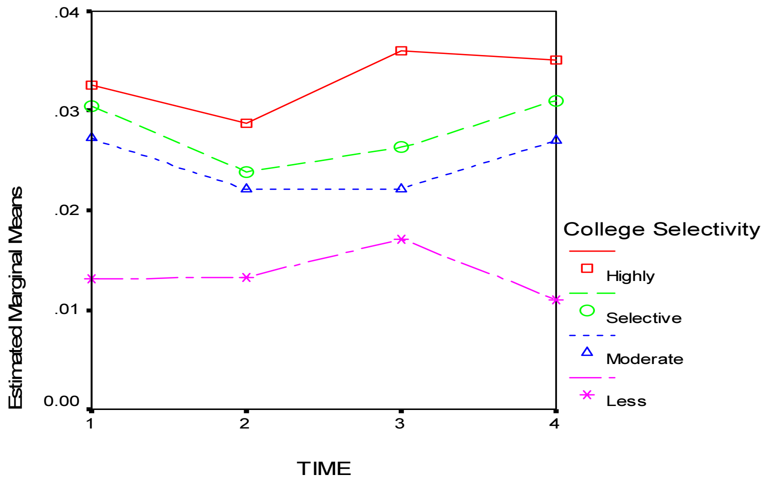

Figure 4. Descriptive Statistics for Selectivity x Time on Physical Science Graduates

Figure 5 shows the effect of Selectivity x Time on life science graduates. All life science graduates' levels showed an increase in scores over time in each selectivity level. The highly selective and moderately selective groups did show a slight decrease between the first two time periods, therefore causing more fluctuation between these groups over time.

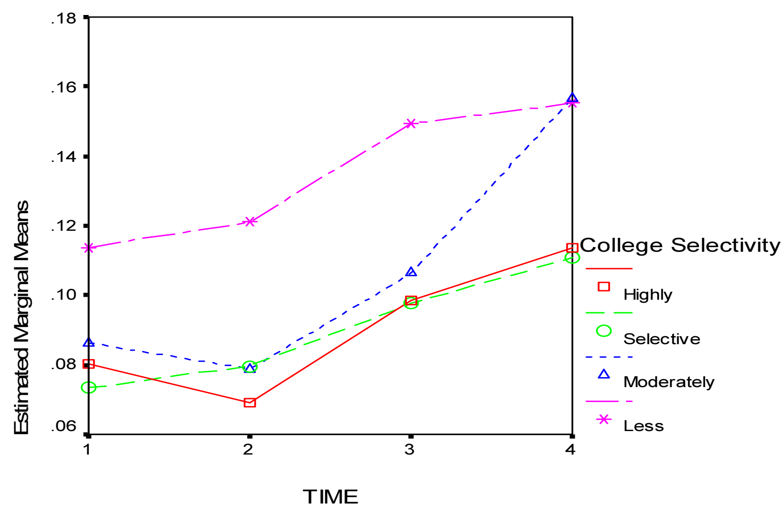

Figure 5. Descriptive Statistics for Selectivity x Time on Life Science Graduates

Figure 6 shows the effect of Selectivity x Time on math and computer science graduates. Mean scores decreased in every selectivity group. Moderately selective schools showed the largest drop in scores, whereas highly selective schools had the least substantial change over time.

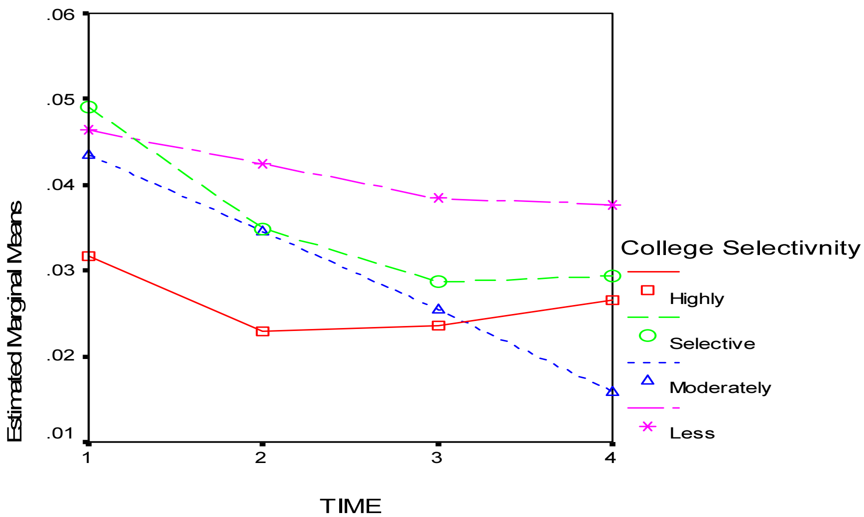

Figure 6. Descriptive Statistics for Selectivity x Time on Math and Computer Science Graduates

Figure 7 shows the effect of Selectivity x Time on social science graduates. Less selective colleges showed an increase over time. Highly selective and moderately selective colleges showed a slight decrease over time; selective colleges showed a slight increase over time in the percentage of female social science graduates.

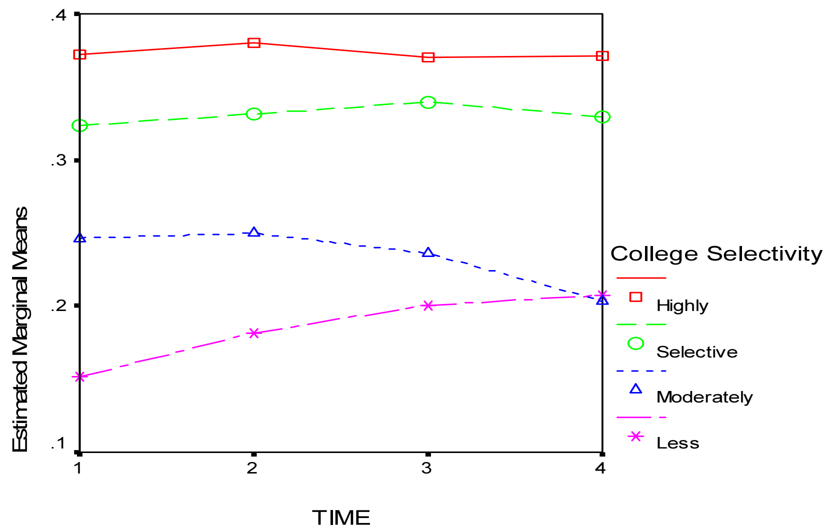

Figure 7. Descriptive Statistics for Selectivity x Time on Social Science Graduates

Inferential Statistics

A doubly multivariate repeated measures analysis of variance test was performed on the data to determine the effect of the independent variables on the dependent variables collectively and then independently. When appropriate, the researcher used pairwise comparisons to show significant mean differences. Trend analysis was shown using within-subjects contrasts. The chosen level of significance (alpha) for all hypotheses tested was .05. All multivariate analyses were interpreted using Hotelling's Trace scores, and all univariate analyses were interpreted using Greenhouse-Geisser scores, except where noted.

College Type. The effect that college type (coeducational or women's college) had on the percentage of female physical science, life science, math and computer science, or social science graduates was measured as both a main effect and with other independent variables. The first null hypothesis focused on the main effect of college type independently and did not consider interaction or trend analysis.

Null Hypothesis 1: College type does not affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

This hypothesis stated that the effect of college type (coeducational or women's colleges) on the percentage of degrees awarded to females in physical science, life science, math and computer science, or social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a multivariate analysis of variance (MANOVA) with college type as the independent variable. As shown in Table 4, multivariate analysis revealed that the effect of college type on the four dependent variables did not significantly differ, $F(4, 31) = 1.162$, $p = .347$. These results suggest that the type of college, whether coeducational or women's, did not affect the percentage of degrees conferred upon females graduates collectively in physical science, life science, math and computer science, and social science.

Table 4

MANOVA Table for College Type

Effect	T^2	*F*	Hypothesis *df*	Error *df*	*p*	η^2	Δ	$1 - \beta$
Type	.150	1.162	4	31	.347	.130	4.646	.320

Note. $p < .05$

When the effect of college type on the percentage of degrees conferred was analyzed independently for each dependent variable, there was also no significant difference at the .05 level. As shown in Table 5, all F scores produced in analysis of variance testing (ANOVA) were non-significant. Appendix E further confirms through pairwise comparison testing that the mean difference scores on the percentage of degrees conferred at women's colleges and coeducational colleges was not significant for any of the dependent variables measured. Therefore, there was insufficient evidence to reject the null hypothesis. The effect of college type on the percentage of degrees conferred upon female graduates in physical science, life science, math and computer science, or social science did not differ significantly overall.

Table 5

ANOVA Table for College Type

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Type									
	Physical	.00002	1	.00002	.019	.891	.001	.019	.052
	Life	.04460	1	.04460	2.476	.125	.068	2.476	.334
	Math	.00326	1	.00326	2.035	.163	.056	2.035	.284
	Social	.02809	1	.02809	1.430	.240	.040	1.430	.213
Error									
	Physical	.04237	34	.00125					
	Life	.61200	34	.01801					
	Math	.05453	34	.00160					
	Social	.66800	34	.01965					

Note. $p < .05$

Selectivity of Colleges. The effect that selectivity level had on female graduates in physical science, life science, math and computer science, and social science was analyzed as both a main effect and as part of an interactive effect with other independent variables. The second null hypothesis examined the main effect of selectivity and did not consider interactive relationships or trend analysis.

Null Hypothesis 2: The selectivity of an institution does not affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

This null hypothesis stated that the effect of college selectivity (highly selective, selective, moderately selective, or less selective) on the percentage of degrees awarded to females in physical science, life science, math and computer science, or social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a MANOVA with selectivity as the independent variable. Table 6 indicates that when multivariate analysis was conducted, the effect of selectivity on the dependent variables differed significantly, $F(12, 89) = 6.066$, $p = .000$. These results suggest that the effect of college selectivity level (highly selective, selective, moderately selective, or less selective) did affect the percentage of degrees conferred collectively upon female graduates in physical science, life science, math and computer science, and social science.

Table 6

MANOVA Table for Selectivity

Effect	T^2	F	Hypothesis *df*	Error *df*	p	η^2	Δ	$1 - \beta$
Selectivity	2.454	6.066*	12	89	.000	.450	72.788	1.000

Note. *$p < .05$

Univariate testing was conducted in an attempt to determine the underlying cause of the multivariate significance. Table 7 shows that the effect of selectivity (highly selective, selective, moderately selective, or less selective) on the percentage of social science degrees conferred differed significantly, F(3, 34) = 14.777, p = .000. However, there was not a difference in the effect of selectivity on the percentage of female graduates in physical science, life science, or math and computer science. Thus, the null hypothesis was rejected. The effect of selectivity on the percentage of degrees conferred upon female graduates, specifically those within the social sciences, differed significantly overall.

Table 7

ANOVA Table for Selectivity

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Selectivity									
	Physical	.00761	3	.00254	2.037	.127	.152	6.110	.476
	Life	.04943	3	.00446	.915	.444	.075	2.744	.229
	Math	.00509	3	.00326	1.057	.380	.085	3.171	.261
	Social	.87100	3	.29000	14.777*	.000	.566	44.332	1.000
Error									
	Physical	.04237	34	.00125					
	Life	.61200	34	.01801					
	Math	.05453	34	.00160					
	Social	.66800	34	.01965					

Note. $^*p < .05$

Appendix F shows that the effect of selectivity on mean scores of social science graduates differed significantly between every comparison except the two highest levels, and likewise, the two lowest levels of selectivity. Pairwise comparisons testing revealed significant mean differences between highly selective colleges and moderately selective colleges (p = .000), highly selective colleges and less selective colleges (p = .000), selective colleges and moderately selective colleges (p = .004), and selective colleges and less selective colleges (p = .000).

Pairwise comparisons testing of physical science graduates also showed a significant difference in mean scores between highly selective colleges and less selective colleges (p = .021). However, this difference was not substantial enough to have a univariate effect. Neither life science nor math and computer science graduates were significantly affected by differences in selectivity, as further confirmed in pairwise comparisons testing.

Interaction of Variables. The interactive effect that college type, selectivity, and time had on female graduates in physical science, life science, math and computer science, or social science was analyzed as both a main effect and as part of an interactive effect with the independent variables. The third null hypothesis looked only at the interactive effect of the college types, coeducational or women's, within the four levels of selectivity (Type x Selectivity), and did not consider main effects or trend analysis.

Null Hypothesis 3: College type and level of selectivity do not interactively affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

This hypothesis stated that the interaction of college type (coeducational or women's) and selectivity (highly selective, selective, moderately selective, or less selective) on the percentage of degrees conferred upon females in physical science, life science, math and computer science, and social science would have no effect at the .05 level of significance (when time was not a factor). Percentage rates of graduates were analyzed by a MANOVA with Type x Selectivity as the independent variable. As shown in Table 8, the interaction of Type x Selectivity on the four dependent variables did not significantly differ, $F(12, 89) = .938$, $p = .514$. These results suggest that the interaction of Type x Selectivity did not have a significant effect on percentage of degrees conferred collectively upon female graduates in physical science, life science, math and computer science, and social science.

Table 8

MANOVA Table for Type x Selectivity

Effect	T^2	*F*	Hypothesis *df*	Error *df*	*p*	η^2	Δ	1 - β
				Between Subjects				
Type x Selectivity	.379	.938	12	89	.514	.112	11.253	.508

Note. $p < .05$

When the interaction of Type x Selectivity on the percentage of degrees conferred was analyzed independently for each dependent variable, there was also no significant difference at the .05 level. The results shown in Table 9 indicate that all F scores produced in ANOVA testing were non-significant. Therefore, there was insufficient evidence to reject the null hypothesis. The interaction of college type and selectivity on the percentage of physical science, life science, math and computer science, or social science degrees conferred upon females did not differ significantly.

Table 9

ANOVA Table for Type x Selectivity

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Type x Selectivity									
	Physical	.00187	3	.00063	.502	.683	.042	1.507	.141
	Life	.00602	3	.02006	1.114	.357	.089	3.342	.273
	Math	.00358	3	.00119	.744	.533	.062	2.232	.192
	Social	.04995	3	.01665	.847	.478	.070	2.542	.214
Error									
	Physical	.04237	34	.00125					
	Life	.61200	34	.01801					
	Math	.05453	34	.00160					
	Social	.66800	34	.01965					

Note. $p < .05$

Trend Analysis. The effect that time had on the percentage of female graduates in physical science, life science, math and computer science, and social science was measured as both a main effect and as part of an interactive effect with the other independent variables. The fourth null hypothesis was a trend analysis used to examine the differences in the percentage of degrees conferred over time and did not consider the interactive effects of college type or selectivity.

Null Hypothesis 4: The time period of graduation does not affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

Hypothesis 4 stated that the effect of time (Time 1, Time 2, Time 3, or Time 4) on the percentage of degrees conferred upon female graduates in physical science, life science, math and computer science, or social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a MANOVA with time as the independent variable. Table 10 indicates that the effect of time on the four dependent variables differed significantly, $F(12, 23) = 5.196$, $p = .000$. These results suggest that the percentage of degrees conferred collectively upon female graduates in physical science, life science, math and computer science, and social science was significantly affected by time.

Table 10

MANOVA Table for Time

Effect	T^2	*F*	Hypothesis *df*	Error *df*	*p*	η^2	Δ	1 - β
				Within Subjects				
Time	2.711	5.196*	12	23	.000	.731	62.349	.998

Note. * $p < .05$

When the effect of time on the percentage of degrees conferred was analyzed independently for each dependent variable, there was also a significant difference at the .05 level. Univariate trend analysis (shown in Table 11) indicated that the effect of time on the percentage of female life science graduates significantly differed, $F(3, 102) = 14.353$, $p = .000$. The effect of time on math and computer science graduates also significantly differed, $F(3,102) = 11.575$, $p = .000$. However, the effect of time on the percentage of graduates in physical science or social science did not differ significantly. Therefore, the null hypothesis was rejected. The percentage of degrees conferred upon female graduates, specifically in life science and math and computer science, differed significantly over time.

Table 11

ANOVA Table for Time

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Time									
	Physical	.00004	3	.00018	1.831	.162	.051	4.185	.398
	Life	.00594	3	.00041	14.353*	.000	.297	21.016	.990
	Math	.00559	3	.00261	11.575*	.000	.254	24.763	.994
	Social	.00484	3	.00290	.793	.436	.023	1.319	.167
Error									
	Physical	.00799	102	.00102					
	Life	.14100	102	.00288					
	Math	.01641	102	.00023					
	Social	.20700	102	.00367					

Note. $*p < .05$

Pairwise comparisons testing of the effect of time on life science graduates suggests that there were significant mean differences between Time 1 and Time 3 (p = .005), Time 1 and Time 4 (p = .011), Time 2 and Time 3 (p = .005), Time 2 and Time 4 (p = .011), and Time 3 and Time 4 (p = .040) (see Appendix G). The only period in which data on life science graduates did not show significant mean differences was between Time 1 and Time 2. A test of within-subjects contrasts showed a relationship with significant linear and quadratic components between time and the percentage of life science degrees conferred (Appendix H). Figure 8 shows a significant positive trend in the percentage of life science graduates over time.

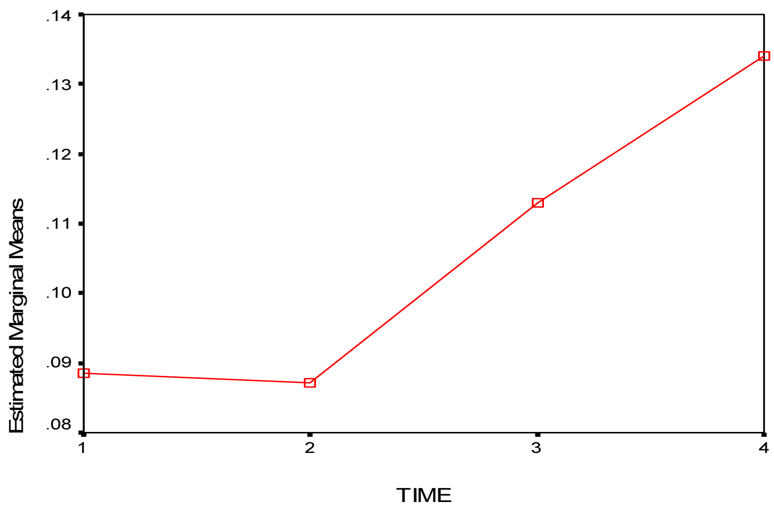

Figure 8. Estimated Marginal Means of Life Science Graduates Over Time

Pairwise comparison testing of the effect of time on math and computer science graduates suggested that there were significant mean differences between every combination of time except Time 3 and Time 4 (Appendix G). Time produced a significant mean difference for math and computer science graduates between Time 1 and Time 2 (p = .003), Time 1 and Time 3 (p = .003), Time 1 and Time 4 (p = .010), Time 2 and Time 3 (p = .002), and Time 2 and Time 4 (p = .003). A test of within-subjects contrasts showed a relationship with significant linear components between time and the percentage of math and computer science degrees conferred (Appendix H). Figure 9 shows a significant negative trend in the percentage of math and computer science graduates when measured over time.

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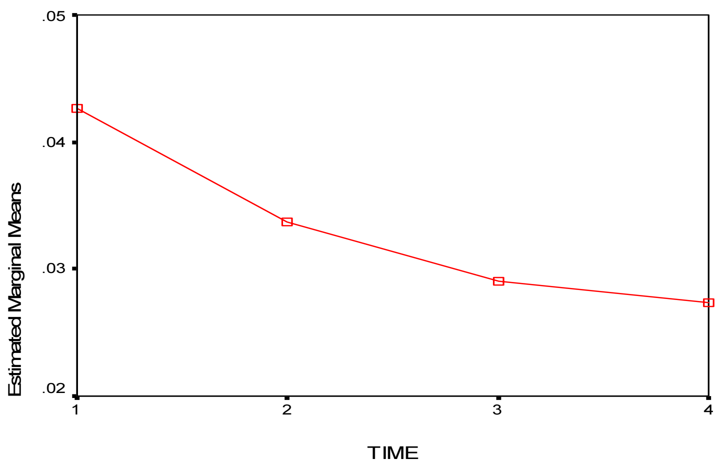

Figure 9. Estimated Marginal Means of Math and Computer Science Graduates Over Time

Pairwise comparisons testing of the effect of time on physical science majors revealed significant differences in mean scores; however, these differences did not impact overall univariate or multivariate analyses of variance. Appendix G suggests that time significantly affected the percentage of female physical science majors graduating between Time 1 and Time 2 (p = .040) and between Time 2 and Time 3 (p = .001). As shown in Figure 10, a test of within-subjects contrasts indicated a relationship with significant cubic components between time and the percentage of physical science degrees conferred over time (Appendix H).

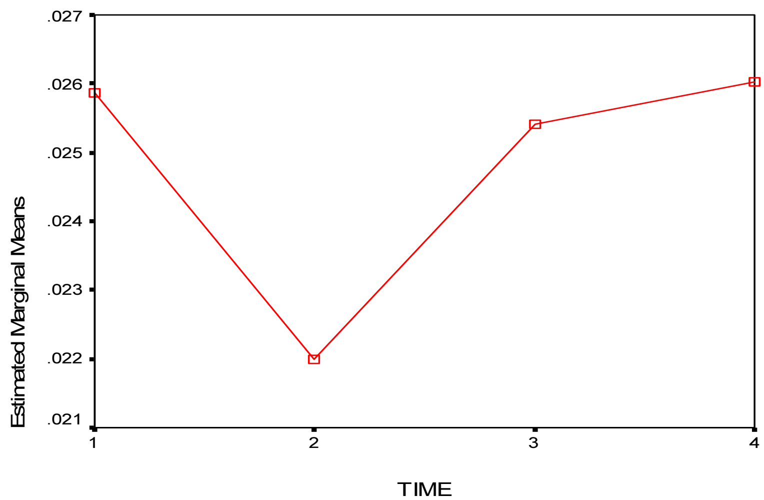

Figure 10. Estimated Marginal Means of Physical Science Graduates Over Time

Pairwise comparisons testing of the effect of time on social science graduates showed a significant difference between Time 1 and Time 2 (p = .006); however, this difference did not impact overall MANOVA or ANOVA testing. A test of within-subjects contrasts suggested a relationship with significant quadratic components between time and percentage of social science graduates (Appendix H). Figure 11 shows trends in the percentages of social science graduates when measured over time.

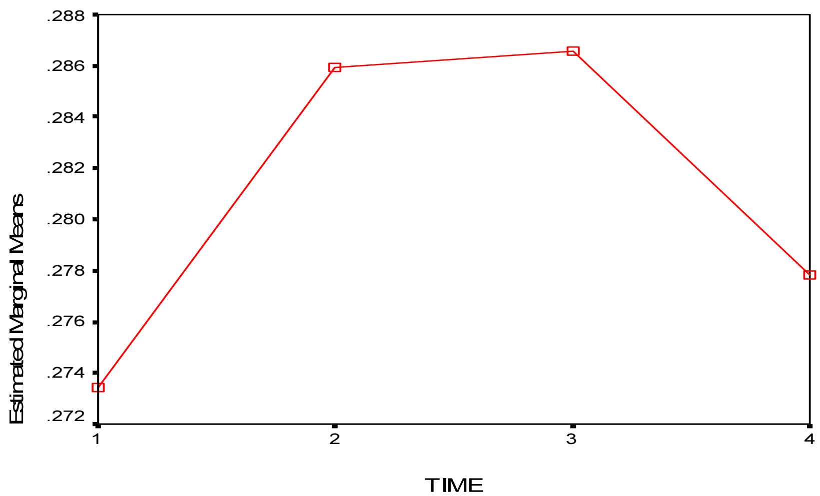

Figure 11. Estimated Marginal Means of Social Science Graduates Over Time

Null Hypothesis 5: College type and time do not interactively affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

Hypothesis 5 stated that the interaction of college type (women's or coeducational) and time (Time 1, Time 2, Time 3, or Time 4) on the percentage of degrees awarded to females in physical science, life science, math and computer science, and social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a MANOVA with Type x Time as the independent variable. As shown in Table 12, multivariate analysis revealed that the interaction of Type x Time on the four dependent variables did not differ significantly, $F(12, 23) = 1.556$, $p = .175$. These results suggest that Type x Time did not significantly affect the percentage of degrees conferred collectively upon female graduates in physical science, life science, math and computer science, and social science.

Table 12

MANOVA Table for Type x Time

Effect	T^2	F	Hypothesis *df*	Error *df*	p	η^2	Δ	$1 - \beta$
Within Subjects								
Time x Type	.812	1.556	12	23	.175	.448	18.675	.627

Note. $p < .05$

The effect of Type x Time on the percentage of degrees conferred was then analyzed independently for each dependent variable. The results shown in Table 13 indicate that for physical science, life science, and math and computer science, the interaction of Type x Time was not significant at the .05 level. When using Greenhouse-Geisser testing, the F score for Type x Time interaction on the percentage of social science graduates was .001 above the level of significance, $F(3, 9) = 3.332$, $p = .051$ (see Table 13). In contrast, when the same data was analyzed using Huynh-Feldt testing, the effect of Type x Time on the percentage of social science graduates was significant, $F(3, 9) = 3.332$, $p = .032$ (see Table 14).

In his book, *Advanced Multivariate Statistics for the Social Sciences, 4th ed.*, Stevens (2002, p. 502) explains that Greenhouse-Geisser tests tend to give more conservative estimates by underestimating epsilon, whereas the Huynh-Feldt estimator tends to overestimate significance. Therefore, Stevens suggests using the average of the two tests when determining significance. In this case the average significance of the two tests, F(3, 9) = 3.332, p = .042, would fall below the .05 level of significance. For this reason, the null hypothesis was rejected. The interaction of Type X Time on the percentage of female graduates, specifically those in the social sciences, differed significantly.

Table 13

ANOVA Table for Type x Time

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Time x Type									
	Physical	.00182	3	.00008	.773	.481	.022	1.768	.187
	Life	.00614	3	.00438	1.548	.224	.044	2.267	.271
	Math	.00372	3	.00001	.077	.936	.002	.165	.062
	Social	.02032	3	.01222	3.332	.051	.089	5.542	.556
Error									
	Physical	.00799	102	.00102					
	Life	.14100	102	.00283					
	Math	.01641	102	.00023					
	Social	.20700	102	.00037					

Note. $p < .05$

Table 14

ANOVA Table for Type x Time on Social Science Graduates

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	$1 - \beta$
Time x Type									
	Social	.02032	3	.00969	3.332*	.039	.089	6.992	.627
Error									
	Social	.20700	102	.00037					

Note. *$p < .05$

The mean scores of social science graduates were higher for the women's colleges than the coeducational colleges in every time period measured. However, the mean scores of social science graduates at women's colleges steadily decreased over time, whereas the scores of those at coeducational colleges increased over time (see Table 2). Within-subjects contrasts testing indicated that the interaction of Type x Time on social science majors differed significantly (see Appendix H). As Figure 12 shows, a relationship with significant negative linear components existed for Type x Time on women's colleges social science graduates. The interaction of Type x Time on coeducational college social science graduates had significant positive linear components. These results suggest that time positively affected the rate of female social science graduates coming from coeducational colleges, but simultaneously had negative affects on the rates of those coming from women's colleges.

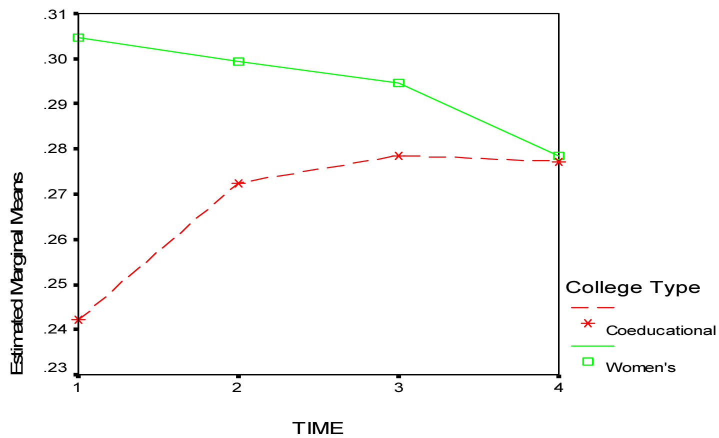

Figure 12. Estimated Marginal Means of Type x Time on Female Social Science Graduates

Tests of within-subjects contrasts in Appendix H also reveal a significant cubic relationship between time, type, and physical science majors (see Figure 13). However, this contrast was not large enough to affect overall ANOVA testing.

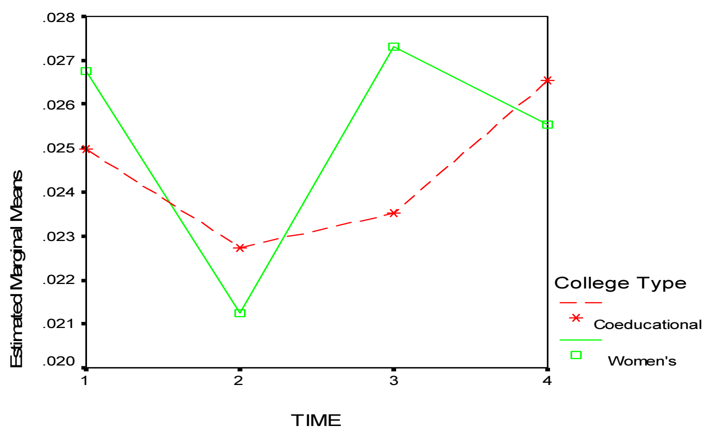

Figure 13. Estimated Marginal Means of Type x Time of Female Physical Science Graduates

Null Hypothesis 6: School selectivity and time do not interactively affect the percentage of female graduates in physical science, life science, math and computer science, or social science.

This hypothesis stated that the interaction of selectivity (highly selective, selective, moderately selective, or less selective) and time (Time 1, Time 2, Time 3, or Time 4) on the percentage of female graduates in physical science, life science, math and computer science, and social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a MANOVA with Selectivity x Time as the independent variable. As shown in Table 15, the interaction of Selectivity x Time on the dependent variables did not differ significantly, $F(36, 65) = .985$, $p = .509$. These results suggest that Selectivity x Type did not significantly affect the percentage of degrees conferred collectively upon female graduates in physical science, life science, math and computer science, or social science.

Table 15

MANOVA Table for Selectivity x Time

Effect	T^2	*F*	Hypothesis *df*	Error *df*	p	η^2	Δ	1 - β
Time x Selectivity	1.637	.985	36	65	.509	.353	35.473	.783

Note. $p < .05$

When the interaction of Selectivity x Time was analyzed independently for each dependent variable, there was also no significant difference at the .05 level. The results shown in Table 16 indicate that all F scores produced in ANOVA testing were non-significant. Testing of within-subjects contrasts also showed no significant difference in the interaction of Selectivity x Time on the dependent variables (Appendix H). Therefore, there was insufficient evidence to reject the null hypothesis. The interaction of Selectivity x Time on the percentage of degrees conferred upon female graduates in physical science, life science, math and computer science, or social science did not differ significantly.

Table 16

ANOVA Table for Selectivity x Time

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η^2	Δ	1 - β
Time x Selectivity									
	Physical	.000651	9	.00009	.924	.492	.075	6.335	.369
	Life	.008844	9	.00201	.712	.600	.059	3.128	.223
	Math	.002190	9	.00003	1.512	.182	.118	9.707	.570
	Social	.024130	9	.00048	1.319	.269	.104	6.579	.432
Error									
	Physical	.00798	102	.00103					
	Life	.14100	102	.00283					
	Math	.01641	102	.00023					
	Social	.20700	102	.00367					

Note. $p < .05$

Null Hypothesis 7: College type, selectivity, and time do not interactively affect the percentage of female physical science, life science, social science, or math and computer, or social science graduates.

This hypothesis stated that the interaction of college type (coeducational of women's) and selectivity (highly selective, selective, moderately selective, or less selective) over time (Time 1, Time 2, Time 3, or Time 4) (Type x Selectivity x Time) on the percentage of degrees awarded to females in physical science, life science, math and computer science, and social science would not differ at the .05 level of significance. Percentage rates of graduates were analyzed by a MANOVA with Type x Selectivity x Time as the independent variable. As shown in Table 17, multivariate analysis revealed the interaction of Type x Selectivity x Time on the dependent variables did not differ significantly, $F(36, 65) = .966$, $p = .536$. These results suggest that the interaction of Type x Selectivity x Time did not significantly affect the percentage of degrees conferred collectively to female graduates in physical science, life science, math and computer science, and social science.

Table 17

MANOVA Table for Type x Selectivity x Time

Effect	T^2	F	Hypothesis *df*	Error *df*	p	η^2	Δ	$1 - \beta$
Within Subjects								
Type x Selectivity x Time	1.605	.966	36	65	.536	.348	34.764	.772

Note. $p < .05$

When the effect of Type x Selectivity x Time on the percentage of degrees conferred was analyzed independently for each dependent variable, there was significance at the .05 level. The results shown in Table 18 indicate that the interaction of Type x Selectivity x Time on the percentage of degrees conferred upon female math and computer science graduates differed significantly, $F(9,102) = 2.405$, $p = .032$. All other F scores produced in ANOVA testing were non-significant. Therefore, the null hypothesis was rejected. The interaction of Type x Selectivity x Time on the percentage of degrees conferred upon female graduates, specifically math and computer science graduates, differed significantly.

Although no significant within-subjects contrasts existed for Type x Selectivity x Time on any of the dependent variables (see appendix H), the relationship between Type x Selectivity x Time and math and computer science graduates did have a non-significant negative liner component ($p = .053$). As the mean scores in Appendix D indicate, all colleges, no matter type or selectivity, produced less math and computer science graduates overall from Time 1 to Time 4.

Table 18

ANOVA Table for Type x Selectivity x Time

Source	Dependent Variable	*SS*	*df*	*MS*	*F*	*p*	η²	Δ	1 - β
Type x Selectivity x Time									
	Physical	.00062	9	.00009	.883	.522	.072	6.055	.353
	Life	.01183	9	.00269	.952	.448	.078	4.184	.292
	Math	.00348	9	.00052	2.405*	.032	.175	15.433	.806
	Social	.01322	9	.00265	.723	.609	.060	3.606	.242
Error									
	Physical	.00799	102	.00102					
	Life	.14100	102	.00282					
	Math	.01641	102	.00023					
	Social	.20700	102	.00367					

Note. *$p < .05$

Figures 14 and 15 illustrate the interaction of Type x Selectivity x Time on math and computer science graduates. Both college types, coeducational and women's, had a decrease in mean scores of graduates over time. However, the women's college means were higher than the coeducational college's scores within each level of selectivity during every time period, with the exception of less selective schools during Time 1 and Time 2.

Figure 14 shows negative longitudinal trends in the math and computer science mean scores of highly selective coeducational colleges with the lowest score occurring during Time 3 ($M = .020$), followed by a slight increase in Time 4 ($M = .021$) (see Appendix D). Mean scores for both selective and moderately selective coeducational colleges decreased during every time period. However, this decrease was more extreme for the moderately selective colleges ($MD = .027$) than the selective colleges ($MD = .005$) when comparing Time 1 to Time 4. Less selective coeducational colleges showed a slight increase from Time 1 ($M = .047$) to Time 2 ($M = .049$) followed by consecutive decreases during Time 3 ($M = .036$) and Time 4 ($M = .034$).

For women's colleges, the highly selective and less selective colleges both showed a decrease in math and computer mean scores from Time 1 to Time 2 (see Figure 15). For these schools, Appendix D shows that the lowest mean score measurements occurred at Time 2 ($M = .024$ for highly selective and $M = .036$ for less selective colleges). A positive trend emerged for both highly selective and selective women's colleges, with both showing slight gains during Time 3 and Time 4. A continual decrease occurred for the selective women's colleges until Time 3 ($M = .035$) and then slight gains were made during Time 4 (.036). The moderately selective women's colleges showed a continual decrease from Time 1 to Time 4 (*MD* = .027).

These results suggest that within both college types, moderately selective colleges showed greater longitudinal decreases over time than the other selectivity levels measured. Both coeducational and women's colleges showed an overall decrease in the percentage of math and computer science degrees conferred to females from Time 1 to Time 4. The women's colleges had a higher overall percentage of graduates than the coeducational colleges. The results also suggest that the women's colleges were beginning to show slight positive trends in the percentage of degrees conferred to female math and science graduates over time, whereas the coeducational colleges did not.

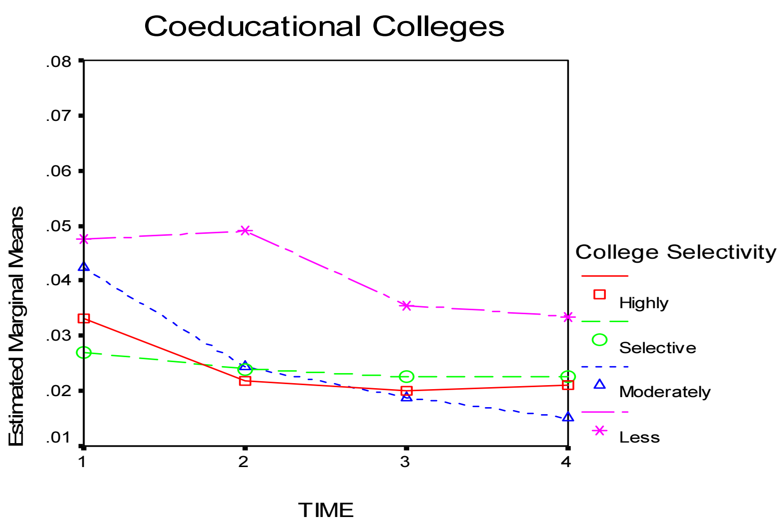

Figure 14. Estimated Marginal Means of Type x Selectivity x Time on Coeducational College Female Math and Computer Science Graduates.

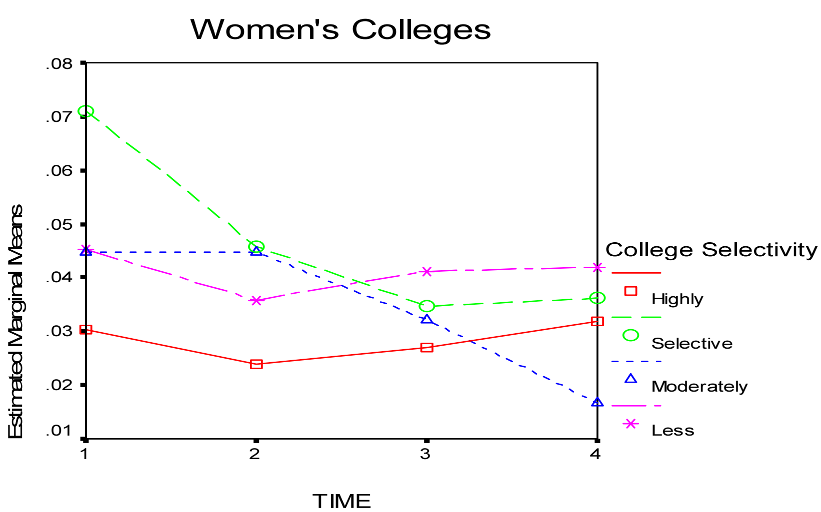

Figure 15. Estimated Marginal Means of Type x Selectivity x Time on Women's College Female Math and Computer Science Graduates.

CHAPTER 5

CONCLUSION AND DISCUSSION

Introduction

Previous research on single-sex education has suggested that a women's college environment beneficially affects the academic achievement of female students (Canada & Pringle, 1995; Kim, 1996, 2002; Kim & Alvarez, 1995; Smith, 1990). This research has also shown that a single-sex academic environment advantageously influences the career and post-secondary attainment of female graduates (Tidball, 1976, 1980b, 1985; Tidball & Kistiakowsky, 1976; Riordan, 1994). However, other studies suggest that when controls for college selectivity level are taken into consideration, the selectivity level of the college becomes the main factor in causing differences in achievement between females at women's colleges and those at coeducational colleges (Oats & Williamson, 1978; Smith, 1990; Crosby et al., 1994).

This study fills a gap in the previous literature on women's colleges by examining the more recent relationship between college type and selectivity. Previous research of this nature occurred during the 1970s and early 1980s as women's colleges were recovering from major changes brought about by the civil rights movement and the women's liberation movement. These major social events of the 1960s and early 1970s had an effect on both the focus and rate of females applying to women's colleges over the next two decades. Though many small, private colleges closed during this time, the affect on women's colleges was more noticeable because there were so few of these schools when compared to the number of coeducational colleges. During this time, the reputation and direction of some women's colleges changed, while many others were forced to close or become coeducational. At the same time, these events also allowed many women to gain equity in the classroom and the workplace, especially in non-traditional fields such as math and science. Though not all gender-based biases have been overcome within these fields, great strides have been made to attract more women to these types of careers. For this reason, this study also examined changes in the rates of females obtaining non-traditional degrees from liberal arts colleges after this transition occurred.

Summary of Findings

This study sought to determine whether there are differences between women's colleges and coeducational colleges in regard to the percentage of baccalaureate degrees conferred upon females in physical science, life science, math and computer science, and social science. In examining this topic, the study also took into account school selectivity level and year of graduation. Furthermore, it explored how both main effects and interactions affected the percentage of degrees conferred. The seven research questions the study addressed and its relevant findings are as follows:

1. Does the type of college (coeducational or single-sex) have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 1. The type of college, coeducational or women's, did not significantly differ in its effect on the dependent variables, either collectively or individually.

2. Does the selectivity of the institution (highly selective, selective, moderately selective, or less selective) have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 2. The selectivity level of the colleges did significantly differ in its effect on the dependent variables. Significant between-group differences were found for social science graduates. Pairwise comparisons suggest that the differences for these graduates existed between each selectivity level except the two highest, highly selective and selective. A significantly higher percentage of graduates obtained social science degrees over other science degrees, and within this group of graduates, there were significantly more students graduating from the more selective colleges than the less selective ones.

3. Does the interaction between the type of college and level of selectivity have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 3. The interaction of Type x Selectivity did not differ significantly in its effect on the percentage of degrees conferred when time was excluded from the statistical design.

4. Does time (Time 1, Time 2, Time 3, or Time 4) have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 4. Time did have a significant main effect on the percentage of degrees conferred. Univariate testing revealed that the effect of time differed significantly for both life science and math and computer science graduates. Further pairwise comparison testing indicated that for life science graduates the difference was significant between every time period, except between the first two. The effect was a significant increase in the rate of graduates over time. For math and computer science graduates, pairwise comparisons indicated a significant difference between every time period except the last two, and the effect was a decrease in the percentage of graduates over time.

5. Does the interaction between the type of college and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 5. The interaction of Type x Time had neither a significant multivariate effect nor a significant univariate effect on graduates in physical science, life science, or math and computer science. However, the interaction of Type x Time differed significantly when measuring the percentage of social science degrees conferred upon females. Although the percentage of female social science graduates was consistently larger for women's colleges than coeducational colleges during each time period measured, the two groups showed opposite trends over time. Within-subjects contrasts testing indicated that the women's college scores had a significant linear decrease over time, whereas the coeducational college scores had a significant cubic increase over time.

6. Does the interaction between school selectivity and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, or math and computer science?

Finding 6. The interaction of Selectivity x Time did not differ significantly in its effect on the dependent variables either collectively or individually.

7. Does the interaction between the type of college, selectivity, and time have a significant effect on the percentage of degrees conferred upon females in the areas of physical science, life science, social science, and math and computer science?

Finding 7. The interaction of Type x Selectivity x Time did not differ significantly in its effect on the dependent variables collectively. However, it did have a significant univariate effect on the percentage of math and computer science degrees conferred. Within-subjects contrasts were not significant, but both women's colleges and coeducational colleges showed a significant decrease in the rate of female graduates in math and computer science over time. The women's colleges had higher overall mean scores in math and computer science than the coeducational schools. The women's colleges also showed a slight increase in the percentage of math and computer science graduates over time; however, the coeducational colleges did not. This trend, while slightly positive, was not large enough to overcome the decrease in percentage rates made during the prior time periods measured. In addition, this interaction had an especially negative effect on moderately selective colleges, no matter the type of college. Overall, the less selective and selective colleges had a higher percentage of math and computer science graduates than the moderately selective and highly selective colleges.

Conclusions and Discussion

When exploring the impact that pursuing a math or science career can have, it is important to recognize how the future earning potential of these careers differs from traditionally female-dominated careers. When Jacobs (1995) compared the first year earnings of college graduates entering various careers during the 1980s, he found that those entering female-dominated careers were paid less than those entering male-dominated careers. When compared to engineers, the earnings of those in female-dominated fields, such as psychology and the social sciences, declined in the early 1980s. Comparatively, the earning of those in math and physical science increased. The only female-dominated fields to have an increase in entry pay during the late 1980s were nursing and other health professions. These findings, like the U.S. Department of Labor's current listings of average annual wages, are discouraging for those entering the work force in a female-dominated career (2004). As women continue in their careers, the long-term effects of the wage gap are just as disappointing. The Business and Professional Women Foundation (BPW) reported a 27% wage gap between men and women in 2001 (2003). Although this number has decreased over time, the issue of pay inequity between genders remains.

The gender wage gap can be attributed, in part, to the differing occupational choices of males and females. In 2003, the BPW cited that, of the top 20 occupational choices for women, 17 were female-dominated. In addition, women still made up the majority of workers in traditionally female careers such as nursing (93%) and elementary school teaching (82.5%). These female-dominated professions do not have the financial earning power that a career in math or science does. As discussed in Davis (1975), the "feminization" of these careers in previous years has resulted in drops in overall wages and prestige for these careers. These drops have made it difficult to attract more males into these fields. As Jacobs explains, "[r]estricting women to a narrow set of jobs approved of as 'women's work' can produce an excess supply of women for these occupations thus limiting women's bargaining power and lowering their wages. The extent to which women are crowded into a few fields of study is one indication of the potential economic returns to their degrees" (1995, p. 84). The attainment of gender equity within non-traditional fields of study at the college level, and in earlier years, is vital to reducing gender biases discrimination in the workplace.

In this study, the rate of graduates coming from what researchers refer to as the hard sciences, the areas of physical science, life science, and math and computer science, was small when compared to the total population of graduates. When measured collectively, the graduates included in this study made up only 47.6% of the total population of female graduates attending these schools from 1985 - 2001, of which the majority held a social science degree. Female physical science graduates made up the smallest proportion of those studied and constituted only 2.7% of the total population of graduates from the colleges included in this study. Though both the more selective institutions and coeducational schools produced a larger percentage of these graduates, these differences were not significant. The effect of college type, selectivity, or time did not differ significantly in its affect on the rate of physical science graduates.

Female math and computer science graduates, which constituted only 3.2% of females graduating from colleges included in the study, showed negative results over time. The findings of this study suggest that the rate of these graduates actually decreased significantly over time. Factors that significantly contributed to higher rates of math and science gradates included attending a women's college and attending a less selective or selective college as opposed to a highly selective or moderately selective college. These findings are disconcerting, especially when considering the findings of Jacobs (1999), who suggested that it was the more selective colleges, specifically those with engineering programs, which produce more math and science graduates.

Life science graduates made up 9.2% of the overall population of female graduates from the colleges studied. The effects of college type and selectivity did not differ significantly when measuring the percentage of these graduates. This study did find that the rate of life science gradates increased significantly over time. One explanation for this increase may be the additional recruiting efforts made by the medical community during the time periods included in this study. Because of concerns over future shortages in nursing and other medical fields, major recruiting efforts were made to attract more entrants into health science fields in the late 1980s (Freles, Straub, & Goldsteen, 1989).

Social science graduates made up 32.5% of the total population of female graduates from the colleges included in this study, the largest group represented. The effect of selectivity significantly differed among social science graduates, with more of these graduates coming from the more selective colleges. When compared over time, the effect of college type also significantly impacted the rates of these female graduates. Though women's colleges produced more of these graduates overall, time negatively affected women's college graduates and positively affected coeducational college graduates. The fact that many fields within social science are considered traditionally female-dominated in the workforce is not promising for closing the wage gap between genders; however, it is interesting to note that the gap in the rates of degrees conferred between coeducational and women's colleges is closing in regards to social science graduates.

Effect of College Type. Bandura's 1977 theory of self-efficacy suggests that the three factors that influence self-efficacy are aptitude, ability, and previous experiences. Trice (1994) suggested that the women's college experience improves a female student's self-efficacy because this type of college environment is more likely to have more short-term assignments than coeducational colleges; therefore, Trice theorized that it is these opportunities to interact and receive more feedback from a professor, especially in non-traditional courses, that increased a female's self-efficacy. Likewise, radical feminists have promoted education that excludes males by suggesting that a single-sex environment is more beneficial to females than a coeducational one (Hoffman, 2001).

The results of this study suggest that attendance at a women's college did not have a significant main effect on the percentage of degrees conferred in any science or math field studied. If anything, the opposite was true. In the social sciences, the interaction of college type and time negatively affected the percentage of degrees conferred upon women attending women's colleges, while positively affecting the rate of those attending coeducational colleges. If the reduction in the percentage of women's college graduates in the social sciences was accompanied by an increase in the hard sciences, even if it was spread across the three other majors studied, then progress is still being made by women breaking gender barriers within non-traditional fields.

The only interaction to show some positive findings for women's colleges was in measuring the effect of Type x Selectivity x Time on math and computer science graduates. In this measurement, females showed slight benefits from the women's college experience. Although there was a significant decline by both types of schools between Time 1, Time 2, and Time 3, the decline was not as apparent (nor significant) between Time 3 and Time 4. Further investigation showed that during this last comparison period, most of the women's colleges actually began to show increases while the coeducational colleges continued to decline. The only exception to this pattern was found in the data involving moderately selective women's colleges; however, both types of moderately selective colleges had more precipitous drops between every time period when compared to the other levels of selectivity.

Advocates of Bandura's theories suggest that investigating the gender "confidence gap" in math, science, and technology is important for future research (Pajares, 2004). Because of the results of previous research on the effect of a single-sex educational environment on female student's self-efficacy (Trice, 1994; Scheye & Gilroy, 1994), it was expected that the women's colleges would confer a significantly higher rate of non-traditional degrees. However, this study did not find a difference between the graduation rates of females in non-traditional fields at coeducational colleges and women's colleges.

The results of the present study are surprising when considering the numerous studies that have suggested that women's colleges produce a disproportional rate of females entering graduate school and non-traditional careers (Tidball, 1976, 1980b, 1985;

Tidball & Kistiakowsky, 1976; Riordan, 1994). It was anticipated that the reason for these disproportional rates of graduate school and non-traditional work force entrants was due, in part, to a disproportional rate of females graduating from women's colleges in non-traditional fields of study. However, there was no difference between the rates of these graduates at women's colleges and coeducational colleges. Future research should examine whether these disproportional trends of women's college graduates pursuing advanced degrees in the 1970s and 1980s continued into the 1990s, as this study did not include follow-up information in regards to what these female graduates chose to do with their degrees. If women graduates' future career and academic attainment decisions, like the decision to attend graduate school or pursue a full-time non-traditional career, differed between the two groups, then it would be possible to hypothesize that these differences were a result of the college experience.

Effect of Selectivity. In this study, the majority of female liberal arts graduates attended highly selective colleges (49.3%), followed by 28.2% at selective colleges, 12.3% at moderately selective colleges, and 10.1% at less selective colleges. The effects of selectivity were not as apparent or significant in this study as expected based on the findings of previous studies (Crosby et. al, 1994; Oats & Willamson, 1998). The only rate that differed significantly between selectivity levels was that of social science graduates. The highly selective colleges had significantly higher rates of social science graduates than the less selective colleges. The only comparison that did not differ significantly was between the two most selective levels, and likewise, between the two least selective levels. The effect of selectivity on physical science graduates also differed significantly between highly selective colleges and less selective colleges; however, these differences were not large enough to account for overall differences in variances.

The fact that more social science graduates attended the selective colleges may be attributed to the fact that 10 out of the 12 selective colleges examined in this study are located on the East coast. Kim (2001) suggests that on eastern campuses, political and social activism is more apparent than in other parts of the nation because of the close proximity to the nation's capital. When examining the other selectivity levels, only 5 out of the 14 selective colleges were in this geographical region, yet 5 out of the 8 moderately selective and less selective colleges studied were located on the east coast, a region in close proximity to Washington, D. C. Although less of the selective colleges were located on the east coast when compared to those in the less selective and moderately selective categories, this group still produced a significantly higher rate of social science graduates.

One important aspect of the effect of selectivity on non-traditional majors that was not controlled for in this study was the number of colleges featuring engineering programs. Analysis of these graduates was purposely excluded because there are currently so few women's colleges with engineering programs. Jacobs (1999) suggested that while women are now better represented within the populations of more selective colleges, an exception is within schools with engineering programs. The researcher found that females were less likely to attend elite schools that had engineering programs and more likely to attend less selective schools, especially those that offered pre-service education programs. Jacobs also explained that engineering programs were historically derived from physical science programs. The results of this study indicated that significantly more physical science and social science graduates came from the more selective schools. This was not the case for math and computer science graduates, in which a higher percentage appeared to come from the less selective colleges (though not a significant amount). For life science, the women's colleges had more graduates from the selective colleges, but ironically, within the coeducational colleges, it was the less selective colleges that had the higher rate of graduates. Again, these findings, though of interest, were not large enough to cause a significant impact.

Effect of Time. In this study, time had the most significant effect on every degree type studied. This comes as no surprise considering how dramatically the educational and occupational opportunities for women have changed over the last 30 years. Jacobs (1995) conducted research investigating the segregation of females in traditionally all-male fields of study from 1980 - 1990. He found that the rate of women entering non-traditional fields, which had steadily increased during the 1960s and 1970s, came to a halt by the mid 1980s. During the times that women were steadily entering traditionally all-male fields of study, gender segregation was decreasing and the ratio of males to females entering these career fields was beginning to narrow. According to Jacobs, this phenomenon, which resulted from the effects of Title IX and social movements of the 1970s, leveled off around 1985, when females were no longer entering non-traditional fields at such a significant rate.

The period examined in the present study began in 1985, around the time this leveling off, as Jacobs (1995) describes it, occurred and gender desegregation within career fields became stagnant. Jacobs' findings suggest that the total rate of graduates entering non-traditional careers did not increase as rapidly in the late 1980s as it had in previous times. The results of the present study were similar to Jacobs', in that the rates of females graduates from liberal arts colleges entering non-traditional fields did not increase over time (with the exception of life science), and in some cases the rates actually decreased (as was the case for math and computer science).

There is an overlap in the time periods examined in Jacobs' (1995) research and those included in the present study. The periods included in both studies coincided with times in which congressional mandates would have affected the recruitment and subsequent representation of women in the degree areas of science, math, technology, and engineering. The United States Congress adopted The Equal Opportunities for Women and Minorities in Science and Technology Act of 1981, four years before the first class of graduates included in this study would have matriculated. Most of the students included in Time 1 of the present study would have been either in secondary school or entering their first year of college the year this act was initiated. Therefore, the effects of the mandate may not have resulted in changes in degree preference by this initial group as opposed to latter groups. However, this did not seem to be the case, as there was a significant decrease in the percentage of physical science and math and computer science degrees conferred from Time 1 (1985 - 1988) to Time 2 (1989 - 1992). Likewise, the only time the rate of life science graduates did not show significant increases was between these same times, at which time the rate showed a non-significant decrease. Social science graduates were the only group to have a significant increase between Time 1 and Time 2; however, few career fields within this heading remain non-traditional for females.

It would be another 12 years before the findings of the 1981 Congressional act would warrant action by the science community at a systemic level. In 1993, the National Science Foundation developed the Program for Women and Girls to address the need for more exposure to math, science, and technology by female students in elementary, secondary, and post-secondary schools. Female graduates attending college during the later periods included in this study seem to have benefited from the programs that resulted from this initiative, whereas the first groups of graduates did not have the same opportunity. This could explain the significant increase in the rates of female graduates of physical science and life science, and the non-significant, yet increasing rate of social science graduates found between Time 2 (1989 - 1993) and Time 3 (1993 - 1996) (see Figures 8, 10, & 11); however, it does not explain the continued significant negative trend for math and computer science majors (see Figure 9).

Females continued to be proportionally represented, if not overrepresented, in certain majors within the social sciences in the early 1990s; therefore, federal initiatives would not have been expected to focus on monitoring the rates of females entering this field as much as they would on increasing the rates of those entering the hard sciences. This resulted in the leveling off of the percentage of female liberal arts college graduates in the social sciences and the decrease (though not significantly) during the last time comparison studied in this research. This combination of events could also explain an increase in the percentage of graduates, which was significant for life science graduates but not for physical science majors, between Time 3 (1993 - 1996) and Time 4 (1997 - 2001). Even the rates of graduates in math and computer science increased between the last two measurement periods. While there was still a negative trend in the rate of female math and computer science graduates, this was the only time that the comparison was not significant. This suggested that the percentage of math and science graduates was not decreasing at the same rapid rate at which it previously had. Further research on math and science graduates indicated that the factors that positively influenced the rate of these graduates between the last two time periods were attending a women's college and attending a less selective or selective college instead of a highly selective or moderately selective one. The rate of social science graduates actually dropped during this time, though not significantly, possibly suggesting that there was a shift from those majors to more of the hard sciences between the last two time periods measured.

This study also found that the percentage of social science graduates at women's colleges decreased as the percentage of math and science graduates began to increase. Is this a sign that women's colleges are once again on the forefront of breaking gender discrimination barriers by continuing to more rapidly promote entrance into non-traditional fields? During the times included in this study, Congress adopted legislation that focused specifically on promoting equal opportunities in the non-traditional workplace and major fields of study, not just in the overall educational environment as had Title IX. The fact that the coeducational liberal arts colleges showed increases in the percentage of social science graduates, an area already equitable for females, but had a continual decrease in the rate of math and science graduates during the same time period is disconcerting.

During the 1970s and 1980s, leadership by women in the social sciences was better accepted than in previous decades, as exemplified by the increased number of females spotlighted in politics and social activism during that time. The effects of Title IX were evidently making a difference in the educational opportunities of women receiving a college degree in traditionally female-dominated fields. However, few women had ventured to break down the invisible barriers known as "glass walls" within career fields that were not traditionally female-dominated. As Miller, Kerr, and Reid (1999) explain, the "glass wall metaphor describes occupational segregation attributed to employment barriers that restrict the access of women to certain types of jobs … or that trap them within certain types of jobs..." Though progress in occupational gender equality was made in the 1970s, these "glass walls" that blocked the entrance of females into non-traditional career fields continued to cause an inequity in wages that could only be resolved through entrance into academia's predominately male-dominated fields of study. The only females excluded from the effects of this inequity in the 1970s were women coming from women's colleges and those who had attended highly selective schools (Tidball & Kistiakowsky, 1976; Tidball, 1985; Crosby, et. al, 1994). Legislation passed in the 1980s allowed yet another opportunity to narrow the gender gap in earning power through the representation of women in non-traditional career fields.

Liberal feminists argue that legislative mandates are essential to successfully eliminating inequality and improving the opportunity for advancement by females. The

National Organization of Women (NOW) is in favor of the continuation of legislation such as Title IX and The Equal Opportunities for Women and Minorities in Science and Technology Act because these mandates ensure federal accountability of higher education institutions. Measuring and reporting annual rates and trends over time is a good first step in the monitoring process, but actually implementing programs that change gender stereotyping and social norms for females must be accomplished to ensure that true progress is made. The results of this study indicate that relatively few changes took place over time that benefited female graduates in physical science or social science. On the contrary, negative changes over time were shown for math and computer science majors. The only exception to this trend was an increase in female graduates in life science. Closer investigation is needed to determine whether this was the result of women entering more diversified careers within the life sciences, or if it is simply the longitudinal effect of successful recruiting by the medical community to attract more students into the fields of nursing and related health service careers, which continue to be traditionally female-dominated careers.

The findings of this study are somewhat discouraging in regards to the attainment of educational equality over time for females, especially within the areas of math and computer science. One limitation of this study is that it only studied the rates of female students attending liberal arts colleges and did not analyze trends in the rates of female graduates attending more technically orientated universities, which would have also been available to female students during this time. Perhaps females who were interested in pursuing these non-traditional majors, especially in physical science or math and computer science choose to attend colleges that had more prestigious programs in these non-traditional fields than do most liberal arts colleges. Since this group of females would have been the second generation of females allowed entrance into the more prestigious and previously all-male colleges and programs, it would be noteworthy to determine whether or not these ratios changed over time. Changes brought about in the late 1960s and early 1970s would have given the previous generation of female college applicants the legal right to obtain entrance into these types of institutions. However, the social stigma associated with breaking through the "glass walls" that divided man's work from woman's work would have still been apparent in the rate of females graduating from institutions that specialized in these traditionally male-dominated fields. After two decades, the alienation brought about by entering this previously unattainable territory would have not been so apparent in these male-dominated environments. Perhaps the decrease in math and computer science majors at liberal arts colleges in the times included within this study also coincided with an increase in the rates of females graduating from those colleges with greater prestige and influence within the mathematical, scientific, and technological communities.

Implications, Applications, and Recommendations

In this study, the rate of physical science graduates did not change significantly over time and the rate of math and computer science graduates decreased at the liberal arts colleges measured. This raises concerns because these two fields include a higher rate of non-traditional majors when compared to life sciences, the only field showing positive growth over time. Perhaps the decline can be explained by the fact that more females with intentions of majoring in math or computer sciences are attending technical colleges and universities which they would have been barred from attending prior to the 1970s. Future research should examine the trends of graduates at both liberal arts colleges as well as technological universities. Perhaps this lack of change and decrease in rates of female graduates in these majors at the private liberal arts colleges studied can be explained by the fact that women who are interested in these nontraditional fields have more post-secondary options now than they did previously. Future research should also investigate whether these women are beginning to attend previously all-male colleges and technical colleges at a higher rate than in the past. Attending a school specializing in these non-traditional areas would be more prestigious than attending a liberal arts college with less of a reputation in the field.

Measuring the post-secondary attainment of females in non-traditional fields is necessary to monitor progress; however, it does not directly address the underlying issue of gender inequity in these academic areas. Bandura (1997b) suggested that it was exposure to sexually discriminating and gender biased messages from academic role models and parents that inhibit females' interest in math and science. To insure continual progress in the rate of females entering non-traditional fields, an interest in math and science must be instilled in future generations of females early within their educational careers. The graduation rates of female students pursuing non-traditional majors at the post-secondary level are dependent to extent to that they are exposed to these non-traditional fields of study, not only while in college, but also during their formative years. It is important that future generations of females are not only exposed to math and science in elementary and secondary school, but are also surrounded by parents, teachers, school counselors, peers, and cultural role models that facilitate opportunities for them to have successful math and science experiences. These opportunities will not only promote positive academic self-efficacy by improving female students' perceptions of math and science, but will in turn further develop these students' interests in pursuing non-traditional careers as they continue into post-secondary school and then the workforce.

Opportunities for leadership by female students in the classroom and in extracurricular activities increase in the absence of male students on campus. It is the conjecture of this researcher that these additional opportunities to discover leadership ability and skills contribute to the success of those female students. Perhaps seeing other females serve as social advocates and leaders in non-traditional roles on campus shapes young women's perceptions of the role of females in academia. This would, in turn, change their understanding of exactly what, and more specifically where, a "women's place" is in society. Though only slightly significant, there was a difference between the college types in the rate of social science degrees conferred over time. The women's colleges saw a decrease while the coeducational colleges saw an increase. Though women's colleges continued to produce more social science graduates overall, these changes lessened the gap between the two types of school. Future research should examine the reasons for these changes and continue to study the longitudinal effects of college type to see if these changes continue over time.

Finally, much of the previous research on women's college graduates, from the 1960s and 1970s, studied females who attended college and entered the workforce when it was less common for females to be employed full time, much less within a non-traditional career field. The women who attended women's colleges during this time were already leaders by simply making the uncommon choice at the time to pursue an education and career instead of choosing to work within the home. It is logical to assume that these women brought with them some characteristics of leadership to the college experience, and that they may have initially differed from their female peers. Unfortunately, advanced statistical analysis and national surveying were not available at the time to accurately determine the development of these attributes resulting from background experiences. Future research should examine if both the current and future generations of women's college graduates are obtaining the same success as leaders, especially within non-traditional fields. Perhaps the success of these schools involved a sociological factor associated with societal norms of the time which has also leveled off within the past decade. Another possibility is that it is not the rate of degrees conferred in these non-traditional areas that is of significance, so much as the rate of achievement by these non-traditional graduates while in graduate school or furthering career opportunities, that is a better indicator of the impact of the women's college experience.

Unlike those females who never experienced the opportunity to engage academically outside of the constraints of male-dominated thinking and social mores, previous research (Tidball, 1976, 1980b, 1985; Tidball & Kistiakowsky, 1976; Riordian, 1994) suggested that women's college graduates are less apt to question their ability to succeed in roles traditionally considered as "man's work." However, based on the more recent findings of Kim and Alvarex (1995) and Smith (1990), the question arises as to whether it is the women's college experience, in and of itself, that allows these females the opportunity to grow as leaders, or if there are other covariate factors involved. This leads to the following queries: Would America's prior generations of women's college graduates have been just as successful having attended college in a coeducational environment? More importantly, if it were the women's college experience that positively affected so many generations of females, will this trend continue for future generations? Is the women's college experience a fad which has passed, one that is no longer a necessity as the result of federally mandated gender equality? Society's perceptions of the typical women's college, as well as the characteristics that attract female students to this environment, have dramatically changed throughout the last century.

Having attended a women's college, it is the belief of this author that there is something unique about the women's college experience that cannot necessarily be replicated in the coeducational college environment. Women's colleges have come full circle - from being considered finishing schools that prepared women to be better homemakers, to becoming academically challenging environments that promoted intellectual stimulation and career attainment - and back again. Today's women's colleges are using the noted success and leadership of previous generations of graduates, as spotlighted in the media, to attract young women whose interests lie in career achievement, more so than domestic training.

Women's colleges boast of their graduates' career success and leadership ability by citing the rates of these non-traditional leaders in the American workforce that are disproportional to the mere 2 - 4% of female college students that actually attend these schools. While this reputation may keep women's colleges competitive within the job market, it is the additional opportunities both in and out of the classroom that must be better marketed to continue to attract perspective enrollees and their parents. For female students to have the opportunity to receive academic instruction and leadership experiences which are gender-specific is, in the opinion of this author, a concept ahead of it's time. While most every other aspect of American society bases traits of leadership and success on male-based cultural-norms, women's colleges have managed to not only produce a disproportional rate of female leaders, but also do it in a way that embraces these student's feminine traits rather than rejecting them. Over time, women's colleges have developed strategies to integrate "women's ways of knowing," a concept explained by Sonnert and Holton (1996), to be a benefit to their graduates rather than a detriment, as it was historically viewed in the traditionally male-dominated career fields of math and science.

As women's colleges look to recruiting a new generation of students, they must determine how to focus recruitment and on which programs they plan to invest time, money, and resources. One direction in which some women's colleges have gone, and perhaps other should consider following, is the addition of more technical programs, especially engineering departments. Engineering seems to be the last career to have an unchanged gender divide within the workforce that also substantially continues to affect the gap in gender-wage equality. Engineering is ultimately the profession that women will need to enter in order to truly obtain gender equality in the workforce; however, as previous generations of female leaders can attest, breaking through the “glass walls” of gender discrimination within this field will no doubt be a daunting task.

The rate of females entering post-secondary schools and then continuing into the workforce has increased dramatically over the past century. For females, working outside of the home has become more accepted by society since the in mid-1900s; however, career options for these females have been primarily limited to lesser paying, female-dominated fields, like nursing and teaching. Females continue to strive to overcome tremendous barriers within society to achieve equality. Legislative mandates insuring equitable opportunities for women, such as the right to vote and the right to have equal opportunities in education and the workplace, have resulted from continual efforts made by female rights advocates. Title IX of the Education Amendment Act of 1972 opened the doors of previously all-male campuses and educational programs to women, but it did not erase the invisible barriers keeping these women out of the more prestigious and lucrative male-dominated fields such as math and the hard sciences. Further mandates were needed to ensure that gender stereotyping was reduced and females were given the opportunities needed to succeed in non-traditional career fields. Overcoming these barriers that keep women from entering non-traditional fields is important because it will also help to reduce the gender wage gap for women, thus ensuring women more economic mobility and ultimately more authentic equality within society. It is vital that future research continue to monitor the progress made by females in these higher paying career fields and derive suggestions for best practices to increase the number of women entering non-traditional fields.

Researchers should also explore changing societal norms so that the skills needed to perform women's work, in traditionally female-dominated fields, become better respected and valued by society. Cultural feminists suggest that the key to overcoming sexism is to respect women's special qualities and talents (Liss, Hoffner, & Crawford, 2000). Opening the doors of male-dominated career fields to females is important. However, it is just as important to change the societal norms and stereotypes that devalue the importance of the skills needed in traditionally female-dominated career fields. Legislative initiatives should strive for equality in the workforce by not only allowing expanded opportunities for females in non-traditional career fields, but also simultaneously valuing the importance of traditional occupational choices for women by improving wages and benefits within female-dominated career fields.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

Union University
Institutional Review Board

To: Stacy Stevens

From: Dr. James Huggins, Chair, Institutional Review Board

Re: #0804-0104 "Science and Math Degrees Conferred to Undergraduate Women: A Comparison of Women's Colleges and Coeducational Colleges"

This is to notify you that the Institutional Review Board has designated the above referenced protocol as exempt from the full federal regulations. This project was reviewed in accordance with all applicable statutes and regulations as well as ethical principles.

When the project is finished or terminated, please complete the attached Notice of Completion and send to Dr. James Huggins, IRB Chair, Union University, Box 3145, Jackson, TN 38305.

Approval for this protocol does not expire. However, any change to the protocol must be reviewed and approved by the board prior to implementing the change. If you have any questions, please call the Institutional Review Board office at 731.661.5580.

James A. Huggins

James Huggins, Chair, Institutional Review Board
Union University

09/02/04
Date Approved

APPENDIX B

LIST OF COLLEGES GROUPED BY SELECTIVITY LEVEL

List of Colleges Grouped by Selectivity Level

Tier	Women's College	State	Coeducational Colleges	State
First Tier				
	1. Wellesley College	(MA)	1. Williams Colleges	(MA)
	2. Smith College	(MA)	2. Vassar College	(NY)
	3. Bryn Mawr College	(PA)	3. Colgate University	(NY)
	4. Mount Holyoke College	(MA)	4. Trinity College	(CT)
	5. Barnard College	(NY)	5. Bucknell University	(PA)
	6. Scripps College	(CA)	6. Kenyon College	(OH)
Second Tier				
	7. Spelman College	(GA)	7. University	(OH)
	8. Agnes Scott College	(GA)	8. Lewis & Clark College	(OR)
	9. Mills College	(CA)	9. Hendrix Colleges	(AR)
	10. Randolph-Macon WC	(VA)	10. Washington & Jefferson Col.	(PA)
	11. Sweet Briar College	(VA)	11. St. Mary's College of MD	(MD)
	12. Hollins University	(VA)	12. Hanover College	(IN)
	13. Wells College	(NY)	13. Presbyterian College	(IL)
Third Tier				
	14. Wesleyan College	(GA)	14. Western Maryland College	(MD)
	15. Salem College	(NY)	15. Moravian College	(PA)
	16. Chatham College	(PA)	16. Erskine College	(SC)
	17. Rosemont College	(PA)	17. Schreiner College	(TX)
Fourth Tier				
	18. Marymount Manhattan Coll.	(NY)	18. Christopher Newport Univ.	(VA)
	19. Bennett College	(NC)	19. Paine College	(GA)
	20. Judson College	(AL)	20. Blackburn College	(NC)
	21. Pine Manor College	(MA)	21. Lycoming College	(PA)

Note. colleges are listed by ranking of selectivity as based on *U. S. News & World Report America's Best Colleges 2002* report of liberal arts colleges (2001).

APPENDIX C

RAW DATA

Raw Data

Colleges	College Gender 1=Single Sex 0=Coeducational	College Selectivity 1=1st Tier 2=2nd Tier 3=3rd Tier 4=4th Tier	85-88 % Physical Science Majors	89-92 % Physical Science Majors	93-96 % Physical Science Majors	97-01% Physical Science Majors
1	1	2	0.047	0.040	0.031	0.039
2	1	1	0.013	0.013	0.016	0.013
3	1	4	0.024	0.014	0.028	0.034
4	0	4	0.005	0.019	0.024	0.014
5	1	1	0.083	0.060	0.065	0.077
6	0	1	0.027	0.028	0.029	0.030
7	1	3	0.038	0.023	0.032	0.018
8	0	4	0.004	0.001	0.003	0.001
9	0	1	0.046	0.037	0.053	0.046
10	0	2	0.020	0.015	0.016	0.025
11	0	3	0.041	0.073	0.056	0.045
12	0	2	0.052	0.032	0.040	0.081
13	0	2	0.076	0.044	0.048	0.057
14	1	2	0.005	0.009	0.012	0.013
15	1	4	0.044	0.045	0.067	0.011
16	0	1	0.029	0.034	0.024	0.030
17	0	2	0.015	0.012	0.011	0.015
18	0	3	0.034	0.011	0.013	0.038
19	1	4	0.014	0.008	0.007	0.011
20	1	2	0.013	0.004	0.004	0.004
21	0	3	0.018	0.015	0.012	0.025
22	1	1	0.038	0.031	0.049	0.041
23	0	4	0.013	0.019	0.006	0.008
24	1	4	0.000	0.000	0.002	0.000
25	0	2	0.012	0.013	0.019	0.012
26	1	2	0.026	0.026	0.029	0.028
27	1	3	0.018	0.006	0.014	0.027
28	1	3	0.033	0.015	0.023	0.014
29	0	4	0.000	0.000	0.000	0.010
30	1	1	0.004	0.000	0.018	0.021
31	1	1	0.024	0.022	0.032	0.033
32	1	2	0.050	0.044	0.050	0.041
33	0	2	0.000	0.006	0.011	0.022
34	1	2	0.011	0.015	0.012	0.030
35	0	1	0.006	0.012	0.018	0.013
36	0	1	0.025	0.022	0.023	0.026
37	0	2	0.085	0.051	0.059	0.042
38	1	1	0.038	0.037	0.041	0.032
39	1	2	0.015	0.024	0.027	0.026
40	1	3	0.029	0.028	0.022	0.046
41	0	3	0.008	0.005	0.005	0.004
42	0	1	0.058	0.051	0.066	0.059

85-88 % Life Science Majors	89-92 % Life Science Majors	93-96 % Life Science Majors	97-01 % Life Science Majors	85-88 % Math & Computer Science Majors	89-92 % Math & Computer Science Majors	93-96 % Math & Computer Science Majors	97-01 % Math & Computer Science Majors
0.091	0.065	0.106	0.107	0.049	0.030	0.024	0.019
0.107	0.066	0.095	0.105	0.034	0.011	0.011	0.027
0.150	0.149	0.106	0.184	0.066	0.071	0.050	0.045
0.096	0.047	0.189	0.100	0.059	0.043	0.024	0.032
0.091	0.102	0.145	0.114	0.023	0.032	0.029	0.049
0.107	0.098	0.127	0.160	0.074	0.037	0.031	0.026
0.065	0.051	0.137	0.496	0.033	0.061	0.045	0.010
0.024	0.060	0.108	0.111	0.092	0.039	0.044	0.049
0.079	0.069	0.099	0.127	0.039	0.027	0.019	0.022
0.058	0.067	0.095	0.138	0.033	0.020	0.020	0.016
0.082	0.110	0.125	0.144	0.053	0.032	0.022	0.018
0.075	0.097	0.069	0.079	0.021	0.021	0.038	0.038
0.142	0.127	0.158	0.134	0.051	0.042	0.019	0.019
0.029	0.036	0.066	0.064	0.051	0.028	0.033	0.024
0.102	0.093	0.152	0.147	0.098	0.053	0.081	0.076
0.083	0.049	0.055	0.072	0.005	0.011	0.003	0.012
0.042	0.038	0.034	0.054	0.011	0.015	0.007	0.007
0.223	0.229	0.246	0.300	0.025	0.018	0.021	0.018
0.032	0.019	0.018	0.048	0.017	0.019	0.034	0.046
0.061	0.065	0.102	0.103	0.069	0.045	0.029	0.020
0.090	0.073	0.071	0.097	0.082	0.038	0.025	0.017
0.122	0.110	0.141	0.175	0.036	0.031	0.038	0.034
0.089	0.153	0.097	0.110	0.025	0.076	0.051	0.034
0.000	0.008	0.057	0.107	0.000	0.000	0.000	0.000
0.050	0.073	0.101	0.131	0.018	0.027	0.027	0.016
0.091	0.084	0.111	0.116	0.033	0.015	0.008	0.016
0.040	0.027	0.022	0.027	0.040	0.035	0.016	0.008
0.073	0.051	0.073	0.088	0.038	0.020	0.024	0.025
0.418	0.439	0.468	0.437	0.014	0.038	0.024	0.020
0.051	0.033	0.083	0.154	0.002	0.000	0.007	0.015
0.071	0.057	0.079	0.096	0.052	0.035	0.033	0.030
0.077	0.091	0.081	0.109	0.168	0.140	0.092	0.082
0.094	0.098	0.134	0.183	0.035	0.027	0.028	0.046
0.041	0.050	0.078	0.077	0.067	0.019	0.030	0.036
0.074	0.056	0.096	0.094	0.042	0.019	0.021	0.018
0.049	0.043	0.058	0.057	0.021	0.013	0.012	0.014
0.095	0.152	0.143	0.164	0.021	0.017	0.020	0.015
0.074	0.068	0.099	0.088	0.034	0.035	0.044	0.037
0.080	0.071	0.088	0.093	0.061	0.042	0.027	0.058
0.068	0.057	0.139	0.075	0.068	0.062	0.043	0.023
0.049	0.032	0.037	0.029	0.009	0.009	0.008	0.008
0.055	0.078	0.108	0.123	0.018	0.025	0.034	0.035

85-88% Social Science Majors	89-92% Social Science Majors	93-96% Social Science Majors	97-01 % Social Science Major	85-88 Total Female Graduates	85-88 Physical Science	85-88 Life Science
0.371	0.370	0.336	0.343	428	20	39
0.410	0.457	0.474	0.464	2160	28	232
0.084	0.114	0.142	0.192	286	7	43
0.293	0.318	0.189	0.154	188	1	18
0.283	0.262	0.269	0.269	1596	133	146
0.324	0.355	0.267	0.264	1603	44	171
0.296	0.274	0.300	0.179	399	15	26
0.180	0.164	0.318	0.349	1138	5	27
0.386	0.393	0.383	0.417	1171	54	92
0.398	0.336	0.334	0.286	1046	21	61
0.148	0.174	0.086	0.096	244	10	20
0.207	0.211	0.279	0.252	426	22	32
0.198	0.280	0.358	0.392	394	30	56
0.414	0.396	0.348	0.289	930	5	27
0.222	0.191	0.229	0.245	225	10	23
0.297	0.316	0.297	0.288	654	19	54
0.219	0.275	0.333	0.242	1624	25	69
0.230	0.283	0.292	0.259	439	15	98
0.141	0.154	0.178	0.161	885	12	28
0.203	0.141	0.155	0.186	990	13	60
0.205	0.270	0.356	0.359	609	11	55
0.383	0.412	0.382	0.400	2088	79	255
0.152	0.268	0.269	0.337	158	2	14
0.139	0.181	0.186	0.155	682	0	0
0.258	0.268	0.280	0.262	337	4	17
0.393	0.402	0.416	0.377	692	18	63
0.448	0.404	0.323	0.151	495	9	20
0.269	0.262	0.175	0.247	551	18	40
0.000	0.068	0.094	0.066	146	0	61
0.410	0.437	0.390	0.320	529	2	27
0.381	0.367	0.338	0.338	3244	77	231
0.400	0.402	0.416	0.404	1093	55	84
0.344	0.453	0.436	0.392	509	0	48
0.485	0.447	0.408	0.393	627	7	26
0.429	0.418	0.436	0.455	963	6	71
0.377	0.406	0.412	0.439	1342	33	66
0.259	0.265	0.261	0.345	390	33	37
0.440	0.418	0.442	0.462	2264	86	167
0.382	0.393	0.396	0.452	411	6	33
0.225	0.184	0.235	0.228	280	8	19
0.151	0.148	0.122	0.110	913	7	45
0.347	0.324	0.346	0.334	943	55	52

85-88 Math & Computer Science	85-88 Social Science	89-92 Total Female Graduates	89-92 Physical Science	89-92 Life Science	89-92 Math & Computer	89-92 Social Science
21	159	430	17	28	13	159
74	885	2188	28	145	25	1001
19	24	281	4	42	20	32
11	55	211	4	10	9	67
37	452	1793	107	183	57	470
119	520	1589	44	156	58	564
13	118	391	9	20	24	107
105	205	1529	2	91	60	250
46	452	1281	48	89	34	503
34	416	1103	16	74	22	371
13	36	218	16	24	7	38
9	88	473	15	46	10	100
20	78	457	20	58	19	128
47	385	948	9	34	27	375
22	50	246	11	23	13	47
3	194	832	28	41	9	263
18	356	1845	22	71	28	507
11	101	445	5	102	8	126
15	125	885	7	17	17	136
68	201	1170	5	76	53	165
50	125	711	11	52	27	192
75	799	2100	66	232	65	865
4	24	157	3	24	12	42
0	95	647	0	5	0	117
6	87	451	6	33	12	121
23	272	652	17	55	10	262
20	222	513	3	14	18	207
21	148	546	8	28	11	143
2	0	237	0	104	9	16
1	217	551	0	18	0	241
170	1236	3624	79	205	127	1329
184	437	1337	59	122	187	538
18	175	715	4	70	19	324
42	304	523	8	26	10	234
40	413	952	11	53	18	398
28	506	1387	30	59	18	563
8	101	475	24	72	8	126
78	997	2318	86	157	80	970
25	157	379	9	27	16	149
19	63	353	10	20	22	65
8	138	1074	5	34	10	159
17	327	927	47	72	23	300

93-96 Total Female Graduates	93-96 Physical Science	93-96 Life Science	93-96 Math & Computer Science	93-96 Social Science	97-01 Total Female Graduates	97-01 Physical Science
491	15	52	12	165	700	27
2146	34	204	23	1018	2412	32
358	10	38	18	51	354	12
169	4	32	4	32	221	3
1849	120	268	53	498	1862	144
1721	50	219	54	460	1749	52
466	15	64	21	140	789	14
1534	4	165	67	488	1744	2
1307	69	129	25	501	1445	66
954	15	91	19	319	918	23
232	13	29	5	20	334	15
505	20	35	19	141	480	39
419	20	66	8	150	477	27
965	12	64	32	336	960	12
223	15	34	18	51	184	2
780	19	43	2	232	836	25
1947	22	66	13	649	2335	36
606	0	149	13	177	730	28
765	8	14	26	136	710	8
1396	6	142	40	216	1457	6
734	6	52	18	261	844	21
1936	9	273	74	739	1970	81
175	94	17	9	47	264	2
441	1	25	0	82	271	0
483	9	49	13	135	488	6
620	18	69	5	258	579	16
626	9	14	10	202	828	22
576	13	42	14	101	720	10
297	0	139	7	28	410	4
554	10	46	4	216	612	13
3460	109	273	114	1169	3477	115
1711	85	139	157	712	1675	69
724	8	97	20	316	821	18
498	6	39	15	203	506	15
1026	18	98	22	447	960	12
1332	30	77	16	549	1481	39
491	29	70	10	128	476	20
2378	98	235	104	1052	2372	76
331	9	29	9	131	343	9
324	7	45	14	76	347	16
1291	7	48	10	157	1888	7
1081	71	117	37	374	1127	66

97-01 Life Science	97-01 Math & Computer Science	97-01 Social Science	1985-2001 Total Female Graduates	1985-2001 Total Physical Science Graduates	1885-2001 Total Life Science Graduates	1985-2001 Total Female Math & Computer Science Graduates	1985-2001 Total Female Social Science Graduates
75	13	240	2049	79	194	59	723
253	65	1119	8906	122	834	187	4023
65	16	68	1279	33	188	73	175
22	7	34	789	12	82	31	188
212	91	500	7100	504	809	238	1920
280	46	461	6662	190	826	277	2005
391	8	141	2045	53	501	66	506
193	85	609	5945	13	476	317	1552
183	32	603	5204	237	493	137	2059
127	15	263	4021	75	353	90	1369
48	6	32	1028	54	121	31	126
38	18	121	1884	96	151	56	450
64	9	187	1747	97	244	56	543
61	23	277	3803	38	186	129	1373
27	14	45	878	38	107	67	193
60	10	241	3102	91	198	24	930
125	17	566	7751	105	331	76	2078
219	13	189	2220	48	568	45	593
34	33	114	3245	35	93	91	511
150	29	271	5013	30	428	190	853
82	14	303	2898	49	241	109	881
345	67	788	8094	235	1105	281	3191
29	9	89	754	101	84	34	202
29	0	42	2041	1	59	0	336
64	8	128	1759	25	163	39	471
67	9	218	2543	69	254	47	1010
22	7	125	2462	43	70	55	756
63	18	178	2393	49	173	64	570
179	8	27	1090	4	483	26	71
94	9	196	2246	25	185	14	870
334	105	1174	13805	380	1043	516	4908
182	137	677	5816	268	527	665	2364
150	38	322	2769	30	365	95	1137
39	18	199	2154	36	130	85	940
90	17	437	3901	47	312	97	1695
84	20	650	5542	132	286	82	2268
78	7	164	1832	106	257	33	519
209	88	1097	9332	346	768	350	4116
32	20	155	1464	33	121	70	592
26	8	79	1304	41	110	63	283
54	15	208	5166	26	181	43	662
139	39	376	4078	239	380	116	1377

APPENDIX D

DESCRIPTIVE STATISTICS FOR TYPE x SELECTIVITY x TIME

Descriptive Statistics for Type x Selectivity x Time

Time Period	Level of Selectivity	Colleges					
		Coeducation			Women's		
Physical Science							
1985 - 1988		*n*	*M*	*SD*	*n*	*M*	*SD*
	1st tier	6	.032	.018	6	.033	.028
	2nd tier	7	.037	.034	7	.024	.018
	3rd tier	4	.025	.015	4	.029	.008
	4th tier	4	.006	.005	4	.021	.019
1989 - 1992							
	1st tier	6	.030	.014	6	.027	.021
	2nd tier	7	.024	.018	7	.023	.015
	3rd tier	4	.026	.032	4	.018	.010
	4th tier	4	.010	.011	4	.017	.020
1993 - 1996							
	1st tier	6	.035	.019	6	.037	.019
	2nd tier	7	.029	.020	7	.024	.015
	3rd tier	4	.022	.023	4	.023	.007
	4th tier	4	.008	.011	4	.026	.018
1997 - 2001							
	1st tier	6	.034	.016	6	.036	.022
	2nd tier	7	.036	.025	7	.026	.013
	3rd tier	4	.028	.018	4	.026	.014
	4th tier	4	.008	.005	4	.014	.014

Descriptive Statistics for Type x Selectivity x Time (Continued)

Time Period	Level of Selectivity	Colleges					
		Coeducational			Women's		
Life Science							
1985 - 1988		*n*	*M*	*SD*	*n*	*M*	*SD*
	1st tier	6	.074	.020	6	.086	.026
	2nd tier	7	.080	.034	7	.067	.024
	3rd tier	4	.111	.076	4	.062	.014
	4th tier	4	.156	.177	4	.071	.068
1989 - 1992							
	1st tier	6	.064	.020	6	.072	.029
	2nd tier	7	.093	.038	7	.066	.019
	3rd tier	4	.111	.085	4	.047	.013
	4th tier	4	.175	.182	4	.067	.067
1993 - 1996							
	1st tier	6	.090	.029	6	.107	.029
	2nd tier	7	.105	.044	7	.090	.016
	3rd tier	4	.120	.092	4	.093	.056
	4th tier	4	.216	.173	4	.083	.058
1997 - 2001							
	1st tier	6	.105	.038	6	.121	.035
	2nd tier	7	.126	.045	7	.095	.019
	3rd tier	4	.142	.115	4	.272	.218
	4th tier	4	.189	.165	4	.244	058

Descriptive Statistics for Type x Selectivity x Time (Continued)

Time Period	Level of Selectivity	Colleges					
		Coeducational			Women's		
Math & Computer Science							
		n	*M*	*SD*	*n*	*M*	*SD*
1985 - 1988							
	1st tier	6	.033	.024	6	.030	.017
	2nd tier	7	.027	.013	7	.071	.045
	3rd tier	4	.042	.032	4	.044	.016
	4th tier	4	.047	035	4	.045	.045
1989 - 1992							
	1st tier	6	.022	.010	6	.024	.015
	2nd tier	7	.024	.009	7	.046	.043
	3rd tier	4	.024	.013	4	.045	.020
	4th tier	4	.049	.018	4	.036	.032
1993 - 1996							
	1st tier	6	.020	.012	6	.027	.015
	2nd tier	7	.023	.010	7	.035	.026
	3rd tier	4	.019	.008	4	.032	.014
	4th tier	4	.036	.014	4	.041	.034
1997 - 2001							
	1st tier	6	.021	.009	6	.032	.011
	2nd tier	7	.022	.014	7	.036	.025
	3rd tier	4	.015	.005	4	.017	.009
	4th tier	4	.034	.012	4	.042	.031

Descriptive Statistics for Type x Selectivity x Time (Continued)

Time Period	Level of Selectivity	Colleges					
		Coeducational			Women's		
Social Science							
1985 - 1988		*n*	*M*	*SD*	*n*	*M*	*S*
	1st tier	6	.360	.047	6	.385	.054
	2nd tier	7	.269	.075	7	.378	.086
	3rd tier	4	.184	.041	4	.309	.097
	4th tier	4	.156	.120	4	.147	.057
1989 - 1992							
	1st tier	6	.369	.043	6	.392	.071
	2nd tier	7	.298	.077	7	.364	.101
	3rd tier	4	.219	.068	4	.280	.091
	4th tier	4	.204	.111	4	.160	.034
1993 - 1996							
	1st tier	6	.357	.066	6	.383	.073
	2nd tier	7	.326	.060	7	.354	.093
	3rd tier	4	.214	.130	4.	.258	.067
	4th tier	4	.218	.098	4	.184	.035
1997 - 2001							
	1st tier	6	.366	.082	6	.375	.080
	2nd tier	7	.310	.065	7	.349	.088
	3rd tier	4	.206	.126	4	.201	.044
	4th tier	4	.227	.139	4	.188	.041

Note. N = 42 colleges

APPENDIX E

PAIRWISE COMPARISONS OF TYPE

Pairwise Comparisons of Type

Measure	(I) College Gender 1=Single Sex 0=Coeducational	(J) College Gender 1=Single Sex 0=Coeducational	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference Lower Bound	95% Confidence Interval for Difference Upper Bound
PHY	0	1	-7.760E-04	.006	.891	-1.219E-02	1.064E-02
	1	0	7.760E-04	.006	.891	-1.064E-02	1.219E-02
LIFE	0	1	3.359E-02	.021	.125	-9.790E-03	7.697E-02
	1	0	-3.359E-02	.021	.125	-7.697E-02	9.790E-03
MATH	0	1	-9.088E-03	.006	.163	-2.203E-02	3.857E-03
	1	0	9.088E-03	.006	.163	-3.857E-03	2.203E-02
SOCI	0	1	-2.666E-02	.022	.240	-7.196E-02	1.865E-02
	1	0	2.666E-02	.022	.240	-1.865E-02	7.196E-02

Based on estimated marginal means
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

APPENDIX F

PAIRWISE COMPARISONS OF SELECTIVITY

Pairwise Comparisons of Selectivity

Measure	(I) College Selectivity 1=highly 2=selective 3=moderate 4=less	(J) College Selectivity 1=highly 2=selective 3=moderate 4=less	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval for Difference Lower Bound	95% Confidence Interval for Difference Upper Bound
PHY	1	2	5.214E-03	.007	.458	-8.898E-03	1.933E-02
		3	8.511E-03	.008	.298	-7.862E-03	2.488E-02
		4	1.952E-02	.008	.021	3.143E-03	3.589E-02
	2	1	-5.214E-03	.007	.458	-1.933E-02	8.898E-03
		3	3.297E-03	.008	.676	-1.260E-02	1.920E-02
		4	1.430E-02	.008	.076	-1.597E-03	3.020E-02
	3	1	-8.511E-03	.008	.298	-2.488E-02	7.862E-03
		2	-3.297E-03	.008	.676	-1.920E-02	1.260E-02
		4	1.100E-02	.009	.221	-6.931E-03	2.894E-02
	4	1	-1.952E-02	.008	.021	-3.589E-02	-3.143E-03
		2	-1.430E-02	.008	.076	-3.020E-02	1.597E-03
		3	-1.100E-02	.009	.221	-2.894E-02	6.931E-03
LIFE	1	2	4.189E-05	.026	.999	-5.361E-02	5.369E-02
		3	-1.664E-02	.031	.590	-7.888E-02	4.560E-02
		4	-4.447E-02	.031	.156	-.107	1.778E-02
	2	1	-4.189E-05	.026	.999	-5.369E-02	5.361E-02
		3	-1.668E-02	.030	.578	-7.712E-02	4.376E-02
		4	-4.451E-02	.030	.144	-.105	1.593E-02
	3	1	1.664E-02	.031	.590	-4.560E-02	7.888E-02
		2	1.668E-02	.030	.578	-4.376E-02	7.712E-02
		4	-2.783E-02	.034	.413	-9.601E-02	4.036E-02
	4	1	4.447E-02	.031	.156	-1.778E-02	.107
		2	4.451E-02	.030	.144	-1.593E-02	.105
		3	2.783E-02	.034	.413	-4.036E-02	9.601E-02

Pairwise Comparisons of Selectivity (Continued)

Measure	(I) College Selectivity 1=highly 2=selective 3=moderate 4=less	(J) College Selectivity 1=highly 2=selective 3=moderate 4=less	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval for Difference Lower Bound	95% Confidence Interval for Difference Upper Bound
MATH	1	2	-9.347E-03	.008	.244	-2.536E-02	6.662E-03
		3	-3.701E-03	.009	.688	-2.227E-02	1.487E-02
		4	-1.509E-02	.009	.108	-3.366E-02	3.487E-03
	2	1	9.347E-03	.008	.244	-6.662E-03	2.536E-02
		3	5.646E-03	.009	.529	-1.239E-02	2.368E-02
		4	-5.739E-03	.009	.522	-2.377E-02	1.230E-02
	3	1	3.701E-03	.009	.688	-1.487E-02	2.227E-02
		2	-5.646E-03	.009	.529	-2.368E-02	1.239E-02
		4	-1.139E-02	.010	.263	-3.173E-02	8.961E-03
	4	1	1.509E-02	.009	.108	-3.487E-03	3.366E-02
		2	5.739E-03	.009	.522	-1.230E-02	2.377E-02
		3	1.139E-02	.010	.263	-8.961E-03	3.173E-02
SOCI	1	2	4.220E-02	.028	.135	-1.383E-02	9.823E-02
		3	.139	.032	.000	7.433E-02	.204
		4	.188	.032	.000	.123	.253
	2	1	-4.220E-02	.028	.135	-9.823E-02	1.383E-02
		3	9.713E-02	.031	.004	3.401E-02	.160
		4	.146	.031	.000	8.268E-02	.209
	3	1	-.139	.032	.000	-.204	-7.433E-02
		2	-9.713E-02	.031	.004	-.160	-3.401E-02
		4	4.867E-02	.035	.174	-2.255E-02	.120
	4	1	-.188	.032	.000	-.253	-.123
		2	-.146	.031	.000	-.209	-8.268E-02
		3	-4.867E-02	.035	.174	-.120	2.255E-02

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

APPENDIX G

PAIRWISE COMPARISONS OF TIME

Pairwise Comparisons of Time

Measure	(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a) Lower Bound	95% Confidence Interval for Difference(a) Upper Bound
PHY	1	2	3.867E-03(*)	.002	.040	1.780E-04	7.557E-03
		3	4.520E-04	.002	.802	-3.174E-03	4.078E-03
		4	-1.664E-04	.002	.943	-4.848E-03	4.515E-03
	2	1	-3.867E-03(*)	.002	.040	-7.557E-03	-1.780E-04
		3	-3.415E-03(*)	.001	.006	-5.785E-03	-1.046E-03
		4	-4.034E-03	.002	.081	-8.598E-03	5.304E-04
	3	1	-4.520E-04	.002	.802	-4.078E-03	3.174E-03
		2	3.415E-03(*)	.001	.006	1.046E-03	5.785E-03
		4	-6.184E-04	.002	.795	-5.418E-03	4.181E-03
	4	1	1.664E-04	.002	.943	-4.515E-03	4.848E-03
		2	4.034E-03	.002	.081	-5.304E-04	8.598E-03
		3	6.184E-04	.002	.795	-4.181E-03	5.418E-03
LIFE	1	2	1.309E-03	.003	.708	-5.728E-03	8.345E-03
		3	-2.457E-02(*)	.005	.000	-3.447E-02	-1.466E-02
		4	-4.567E-02(*)	.011	.000	-6.890E-02	-2.244E-02
	2	1	-1.309E-03	.003	.708	-8.345E-03	5.728E-03
		3	-2.588E-02(*)	.005	.000	-3.691E-02	-1.485E-02
		4	-4.698E-02(*)	.011	.000	-6.971E-02	-2.424E-02
	3	1	2.457E-02(*)	.005	.000	1.466E-02	3.447E-02
		2	2.588E-02(*)	.005	.000	1.485E-02	3.691E-02
		4	-2.110E-02(*)	.010	.040	-4.121E-02	-9.869E-04
	4	1	4.567E-02(*)	.011	.000	2.244E-02	6.890E-02
		2	4.698E-02(*)	.011	.000	2.424E-02	6.971E-02
		3	2.110E-02(*)	.010	.040	9.869E-04	4.121E-02

Pairwise Comparisons of Time

Measure	(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a) Lower Bound	95% Confidence Interval for Difference(a) Upper Bound
MATH	1	2	8.986E-03(*)	.003	.008	2.545E-03	1.543E-02
		3	1.364E-02(*)	.003	.000	7.006E-03	2.028E-02
		4	1.530E-02(*)	.004	.000	8.121E-03	2.249E-02
	2	1	-8.986E-03(*)	.003	.008	-1.543E-02	-2.545E-03
		3	4.656E-03(*)	.002	.032	4.376E-04	8.874E-03
		4	6.317E-03(*)	.003	.036	4.314E-04	1.220E-02
	3	1	-1.364E-02(*)	.003	.000	-2.028E-02	-7.006E-03
		2	-4.656E-03(*)	.002	.032	-8.874E-03	-4.376E-04
		4	1.662E-03	.002	.340	-1.829E-03	5.152E-03
	4	1	-1.530E-02(*)	.004	.000	-2.249E-02	-8.121E-03
		2	-6.317E-03(*)	.003	.036	-1.220E-02	-4.314E-04
		3	-1.662E-03	.002	.340	-5.152E-03	1.829E-03
SOCI	1	2	-1.249E-02(*)	.006	.043	-2.457E-02	-4.105E-04
		3	-1.312E-02	.010	.201	-3.356E-02	7.324E-03
		4	-4.391E-03	.014	.751	-3.225E-02	2.347E-02
	2	1	1.249E-02(*)	.006	.043	4.105E-04	2.457E-02
		3	-6.318E-04	.009	.942	-1.802E-02	1.675E-02
		4	8.097E-03	.012	.521	-1.726E-02	3.345E-02
	3	1	1.312E-02	.010	.201	-7.324E-03	3.356E-02
		2	6.318E-04	.009	.942	-1.675E-02	1.802E-02
		4	8.729E-03	.008	.282	-7.507E-03	2.497E-02
	4	1	4.391E-03	.014	.751	-2.347E-02	3.225E-02
		2	-8.097E-03	.012	.521	-3.345E-02	1.726E-02
		3	-8.729E-03	.008	.282	-2.497E-02	7.507E-03

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

APPENDIX H

TABLE OF WITHIN-SUBJECTS CONTRASTS

Table of Within-Subjects Contrasts

Source	Measure	TIME	*SS*	*df*	Mean Square	*F*	p	η^2	Δ	$1 - \beta$
TIME	PHYS	Linear	3.029E-05	1	3.029E-05	.325	.572	.009	.325	.0.86
		Quadratic	1.989E-04	1	1.989E-04	1.928	.174	.054	1.928	.271
		Cubic	2.008E-04	1	2.008E-04	5.218	.029	.133	5.218	.602
	LIFE	Linear	5.244E-02	1	5.244E-02	20.067	.000	.371	20.067	.992
		Quadratic	4.962E-03	1	4.962E-03	5.087	.031	.130	5.087	.592
		Cubic	2.020E-03	1	2.020E-03	3.664	.064	.097	3.664	.460
	MATH	Linear	5.054E-03	1	5.054E-03	18.953	.000	.358	18.953	.988
		Quadratic	5.302E-04	1	5.302E-04	3.519	.069	.094	3.519	.446
		Cubic	3.531E-06	1	3.531E-06	.054	.818	.002	.054	.056
	SOCIAL	Linear	3.766E-04	1	3.766E-04	.085	.772	.002	.085	.059
		Quadratic	4.449E-03	1	4.449E-03	4.744	.036	.122	4.744	.562
		Cubic	1.231E-05	1	1.231E-05	.017	.898	.000	.017	.052
TIME * TYPE	PHYS	Linear	4.751E-06	1	4.751E-06	.051	.823	.001	.051	.056
		Quadratic	5.675E-06	1	5.675E-04	.055	.816	.002	.055	.056
		Cubic	1.712E-04	1	1.712E-04	4.447	.042	.116	4.447	.536
	LIFE	Linear	2.460E-03	1	2.460E-03	.941	.339	.027	.941	.156
		Quadratic	3.936E-03	1	3.936E-03	4.035	.053	.106	4.035	.497
		Cubic	1.395E-05	1	1.395E-05	.025	.875	.001	.025	.053
	MATH	Linear	5.975E-06	1	5.975E-06	.022	.882	.001	.022	.052
		Quadratic	8.136E-06	1	8.136E-06	.054	.818	.002	.054	.056
		Cubic	2.308E-05	1	2.308E-05	.353	.556	.010	.353	.089
	SOCIAL	Linear	1.883E-02	1	1.883E-02	4.257	.047	.111	4.257	.518
		Quadratic	1.089E-03	1	1.089E-03	1.162	.289	.033	1.162	.182
		Cubic	4.031E-04	1	4.031E-04	.546	.465	.016	.546	.111

Table of Within-Subjects Contrasts (Continued)

Source	Measure	TIME	*SS*	*df*	Mean Square	*F*	p	η^2	Δ	1 - β
TIME * SELEC TIV	PHYS	Linear	9.098E-05	3	3.033E-05	.325	.807	.028	.976	.107
		Quadratic	4.593E-04	3	1.531E-04	1.485	.236	.116	4.454	.357
		Cubic	1.005E-04	3	3.352E-05	.871	.466	.071	2.612	.219
	LIFE	Linear	3.616E-03	3	1.205E-03	.461	.711	.039	1.384	.133
		Quadratic	4.515E-03	3	1.505E-03	1.543	.221	.120	4.629	.370
		Cubic	7.132E-04	3	2.377E-04	.431	.732	.037	1.294	.127
	MATH	Linear	1.765E-03	3	5.884E-04	2.207	.105	.163	6.620	.511
		Quadratic	3.955E-04	3	1.318E-04	.875	.464	.072	2.625	.220
		Cubic	2.954E-05	3	9.848E-06	.151	.929	.013	.452	.075
	SOCIAL	Linear	2.229E-02	3	7.430E-03	1.680	.190	.129	5.040	.400
		Quadratic	1.039E-03	3	3.462E-04	.369	.776	.032	1.107	.115
		Cubic	7.981E-04	3	2.660E-04	.360	.782	.031	1.081	.113
TIME * TYPE * SELEC TIV	PHYS	Linear	4.511E-05	3	1.504E-05	.161	.186	.014	.484	.077
		Quadratic	3.097E-04	3	1.032E-04	.1.001	.253	.081	3.003	.248
		Cubic	2.673E-04	3	8.909E-05	2.315	.297	.170	6.944	.532
	LIFE	Linear	6.607E-03	3	2.202E-03	.843	.480	.069	2.529	.213
		Quadratic	3.727E-03	3	1.242E-03	1.274	.299	.101	3.821	.309
		Cubic	1.495E-03	3	4.983E-04	.904	.449	.074	2.712	.227
	MATH	Linear	2.266E-03	3	7.552E-04	2.832	.053	.200	8.497	.628
		Quadratic	9.769E-04	3	3.256E-04	2.161	.111	.160	6.484	.502
		Cubic	2.398E-04	3	7.992E-05	1.222	.317	.097	3.665	.298
	SOCIAL	Linear	9.957E-03	3	3.319E-03	.750	.530	.062	2.251	.193
		Quadratic	2.043E-03	3	6.811E-04	.726	.543	.060	2.179	.188

Table of Within-Subjects Contrasts (Continued)

Source	Measure	TIME	*SS*	*df*	Mean Square
Error (TIME)	PHYS	Linear	3.171E-03	34	9.326E-05
		Quadratic	3.506E-03	34	1.031E-04
		Cubic	1.309E-02	34	3.849E-05
	LIFE	Linear	8.885E-02	34	2.613E-03
		Quadratic	3.317E-02	34	9.755E-04
		Cubic	1.874E-02	34	5.513E-04
	MATH	Linear	9.066E-03	34	2.666E-04
		Quadratic	5.123E-03	34	1.507E-04
		Cubic	2.224E-03	34	6.541E-05
	SOCIAL	Linear	.150	34	4.422E-03
		Quadratic	3.189E-02	34	9.379E-04
		Cubic	2.510E-02	34	7.381E-04

a Computed using alpha = .05