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# Measured vocational interests, expressed interests in college major, and interest congruence of college-bound women across time

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**Measured vocational interests, expressed interests in college major, and interest congruence of college-bound women across time**

by

**Brooke Marie Ruxton**

A dissertation submitted to the graduate faculty  
in partial fulfillment of the requirements for the degree of  
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Ames, Iowa

2007

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## Abstract

The career development of women is influenced by several social and individual variables that affect career decisions and achievement including gender role socialization and the pressures of maintaining multiple roles in addition to career. Women are largely underrepresented in science, technology, math, and engineering (STEM) related fields and this lack of interest has been the focus of a significant portion of vocational psychology literature. Interest congruence, a concept central to the study of women's vocational development, represents a theoretical and statistical formulation of the relation between measured vocational interests and expressed vocational intentions and it has been examined in relation to women's career development. The current cross-sectional descriptive study includes a large-scale ( $n = 31,021$ ) examination of trends in college-bound women's measured vocational interests, expressed interests in college major, and interest congruence across a thirty-year interval (1974-2005) based upon women's responses to the American College Testing (ACT) vocational and academic achievement assessments. This investigation also examines aspects of women's mathematics achievement in relation to measured and expressed interest variables. In addition, this study uses and examines the Brown and Gore (1994) C-index as a statistical measure of congruence between expressed and measured interests. Multiple unique trends were found across time, across and within the six Holland career areas for measured and expressed vocational interests, as well as for the interest congruence of college-bound women. The descriptive trend findings lend support to existing literature regarding women's career development and provide insight for future research directions.

## Introduction

Vocational psychologists have long been interested in understanding the career development of women, particularly in terms of women's choices to pursue careers that are traditionally held by men. Research regarding women's career development indicates that women do not develop career pursuits following the same assumptions that are often used to explain general career development. Thus, it is important to examine women's career development from a contextual perspective, incorporating relational factors (Crozier, 1999), role conflicts (McCracken & Weitzman, 1997), socialization (Eccles, 1994), and success variables (Betz, 2002).

Women have historically been underrepresented in employment and college degree earning across science, technology, engineering, and math (STEM) related vocational fields. Researchers have examined self-efficacy beliefs and success experiences in relation to math and science pursuits (Farmer, H.S., Wardrop, J. L, Anderson, M.Z., & Risinger, R. 1995; Lent, Lopez, & Bieshke, 1993). Researchers have also examined the impacts of external pressures, expectations, and gender role norms on women's choices of math and science careers (e.g. Bleeker & Jacobs, 2004; VanLeuvan, 2004; Gottfredson, 1996).

Few vocational psychology researchers have examined interest trends for any population across time. Studies that have been conducted include examinations of national distributions of employment at a single point in time (Gottfredson, Holland, & Gottfredson, 1975) and trends across a short period of time (Gottfredson & Daiger, 1977). Other large-scale studies have provided the groundwork for a rich source of information regarding vocational interests and intentions (Downes & Kroeck, 1996; Gottfredson & Daiger, 1977; Gottfredson et al., 1975). Among these few large-scale vocational investigations, researchers

have not specifically addressed the nature of career development issues across time for women, though gender differences among variables have been highlighted. A study that could incorporate both vocational interests and vocational intentions for women across time would provide the most comprehensive demonstration of vocational interest information for women to date.

The purpose of the current exploratory descriptive study is to identify and examine trends of college bound women in expressed and measured vocational interests, as well as interest congruence across time. Interest congruence, the statistical fit between expressed and measured interests, incorporates personality (measured interest) and environmental (expressed interest) information and can provide unique observations regarding the nature of career and interest development. The current dissertation study will build on existing literature by examining large-scale trends in college-bound women's interest congruence, measured interests and expressed interests across time and across levels of achievement.

The information gathered in this study can be used to provide descriptive data regarding historical trends in women's career development across time, particularly within math and science career areas. Results will stimulate development of new research questions addressing women's career development.

## Literature Review

The following literature review examines research and theory relevant to the career development of women, women's career interests in math and science, Holland's theory of vocational interests, large-scale investigations of interests over time, and interest congruence. These areas were chosen to reflect literature that is most relevant to the nature and objectives of the proposed study. The articles and chapters were selected based on searches conducted in PsychInfo and EBSCO Host databases online. This literature review is not an exhaustive summary of all issues potentially relevant to the proposed research but serves to highlight the most important and salient issues and questions in the literature.

### *Women's Career Development*

Counseling psychologists have a long and rich tradition of studying questions of vocational development: "How do individuals make career choices?" "What factors most strongly influence those choices?" "What individual differences are found across people's career development?" This history in counseling psychology has yielded a vast literature addressing career development issues and issues related to women's career development in particular (Phillips & Imhoff, 1997).

The general career development literature has generated multiple theories based on assumptions that work/occupational choice is the most important aspect of people's lives across time, that career decisions are based on rational problem-solving strategies regarding fit between individual's personality and environmental work settings, that career development is in fact developmental, and that achievement and ability are paramount for career success (Betz, 2002). However, in applying career development theories to women, several authors have taken a more contextual approach and have argued that career paths of

women are further influenced by family commitments, relationships, and environmental and structural barriers and often do not follow a linear or clearly developmental path (e.g. Betz, 2002; Crozier, 1999; Eccles, 1994; Phillips & Imhoff, 1997).

*Importance of Relationships and Roles.* Crozier (1999) applied theories of women's relational identity to the understanding of women's career development. She asserts that women are more likely than men to form a self-concept based on relationships. Women use relational characteristics to define their identity and are therefore more likely than men to pursue careers that allow them to focus on relationships and relationship factors. This may explain the prevalence of women in certain Holland occupational fields such as *Social* and *Artistic* career areas and the lack of women interested in the less relational career areas typified by *Realistic* and *Investigative* categories. Research addressing these relational and family influences has shown that career, personal, and relational variables are often interdependent for women, who may want to focus on all of these as priorities. These variables also may be prioritized differently based on women's phase of life, goals, identity, and other environmental characteristics (Lucas, 1997). In other research, college women scored lower than men on measures of psychological individuation from parents and higher than college-aged men on measures of identity development (Hackett, 1997). Findings such as this provide more evidence for the strength of relationships and family as a central focus of women's identities, which may be firmly established by the time they enter college.

Studies have also investigated the importance of multiple roles in women's career development. Women consistently deal with obstacles and pressures related to finding success across work, family, and relationship roles. Particular attention has been placed on the difficulties associated with balancing these roles as women enter the workforce in greater

numbers in today's society. McCracken & Weitzman (1997) found that women who are more aware of the multiple roles they must encounter are more confident in their ability to solve problems and hold stronger beliefs about their own achievement capabilities. The awareness of multiple role realism was found to be only weakly related to traditionality of career choice, with women who identified with their multiple roles being slightly more likely to choose less traditional career paths than women who did not acknowledge awareness of these common pressures.

*Achievement of Women.* Research examining career development of high-achieving women has shown that such women are more likely than average or low-achieving women to pursue “nontraditional” career areas that are not historically occupied by women, such as careers in science, technology, engineering and math (STEM) fields. High achieving women are also likely to hold weaker gender role assumptions than lower achieving women (Richie, Fassinger, Linn, Johnson, Prosser, & Robinson, 1997). Research has shown that women with significant levels of academic accomplishment generally report receiving strong support for career pursuits from significant others (VanLeuvan, 2004). High achieving women are also more likely to have high levels of career and academic self-efficacy and are likely to be resilient in the face of obstacles to their career development (Richie et al., 1997).

Interestingly, in their study Benbow and Stanley (1982) found no gender differences in gifted students' estimates of their math and science competence. This finding has not been true across all levels of achievement or across other research investigations. Similar studies have frequently shown males reporting greater levels of math and science self-efficacy than females across all levels of achievement and aptitude (Lapan, Shaughnessy, & Boggs, 1996; VanLeuvan, 2004). Based on the research reported here, it is not surprising that the

importance of success beliefs (beliefs regarding one's own capacity for accomplishment) combined with self-efficacy for skills in particular career areas has been shown to predict females' choice and persistence in careers (Schaefer, Epperson, & Nauta, 1997).

*Eccles' Model of Women's Career Development.* The findings related to achievement and career development of women can be conceptualized according to Eccles' model of women's identification of educational and occupational choices. According to this model, achievement and occupational choices are based on individually held beliefs about one's potential for success (self-efficacy beliefs) within each available choice option, and the values one associates with the perceived tasks involved in existing opportunities. Eccles asserts these values are formed based on cultural norms, experiences, aptitudes, and attitudes (1994).

Eccles highlights three features of the model that are important for understanding gender differences in educational and vocational decisions. First, she asserts that interests in educational and career paths are directly related to perceived vocational choices. Eccles suggests that gender differences in the choices women and men make regarding careers may be influenced by several mediating factors (e.g. self-schema and socialization factors) that ultimately create differences in interests. These interest differences then lead to differences in available perceived choices. Second, Eccles suggests that individuals' domains of possible vocational choices are narrowed according to experience and opportunity. She suggests that people fail to consider many possible choice options because they are unaware of all options, they have inaccurate information regarding one or many options or their potential to succeed in those options, or their options are restricted by a culturally defined gender role schema that they ascribe to (Eccles, 1994). Third, Eccles acknowledges that achievement-related choices

are made in a complex social environment, the pressures of which must be considered in order to adequately describe choice behavior. She suggests that choices are made from the possible field of options based on the interaction of several complex factors. These factors include individuals' expectations for success and self-efficacy for these options, the relation between available options and individuals' goals, identities and psychological needs, the individual's gender role schema, and the perceived potential costs associated with various options (Eccles, 1994).

In her model, Eccles places particular emphasis on the important position of gender role socialization for explaining gender differences in academic and occupational pursuits. She describes several studies that have shown men and women report significantly different core personal values, and hold categorically different values and priorities for various occupational activities (1994). Gender role differences also influence individuals' conceptualization of success and failure, especially for activities that are strongly related to a person's sense of identity. Other researchers have shown that identity does seem to develop differently for men and women (Crozier, 1999). Generally, women's identities are shaped more strongly by family influences than men's. The pressures that women relate to academic and occupational achievement often reflect a personal conflict between pursuing occupational success versus attaining a successful identity from important family relationships (McCracken & Weitzman, 1997).

*Summary of Women's Career Development.* The research regarding women's career development indicates that the strongly-held assumptions in vocational psychology may not be as accurate for women as they are for many men. A contextual approach to women's career development seems necessary. For women, it cannot be assumed that work will be the

most important aspect of life and development, but one of many roles women will hold (Betz, 2002; Crozier, 1999; Eccles, 1994; Phillips & Imhoff, 1997). In fact, women tend to identify themselves in more relational terms (Crozier, 1999) and experience psychological conflict in terms of defining their various roles related to work and family (McCracken & Weitzman, 1997). For women, it cannot be assumed that career decidedness is based on a rational fit between personality and the environment of work settings. Women consider multiple barriers to achievement and may not develop options based on realistic depictions of work environments alone (Eccles, 1994). For women, it also cannot be assumed that career development is in fact developmental, based on interest and personality. It also cannot be assumed that, for women, achievement and ability are paramount to defining success. Women may define success in terms of balancing their various roles and may make decisions about whether to enter work, and in what field, based on environmental factors and values in addition to their expectations for success (Betz, 2002; Eccles, 1994).

#### *Women in Math and Science*

*Gender Differences in Math and Science Career Exploration.* A large portion of research addressing issues in women's career development has focused on understanding women's vocational interests in science, technology, engineering, and mathematics (STEM) fields. Women currently make up approximately half (48.6%) of the college-educated employees in the U.S. workforce but are drastically underrepresented in science and engineering positions, constituting only approximately one quarter (24.7%) of college-educated employees in these fields (National Science Board, 2004). Under further investigation, even this small representation of women in science and engineering does not accurately capture their roles in fields generally considered "hard sciences." In 1999, women

constituted 54 percent of social scientists, 25 percent of mathematicians/ computer scientists, 22 percent of life scientists, 23 percent of physical scientists, and only 10 percent of engineers. These disappointing numbers actually represent a gradual increase over time of women's participation and placement in these fields (National Science Board, 2004). Also disappointing is that males in the science and engineering workforce continue to earn approximately 22 percent more income on average than women (In 1999, mean salary for men was \$64,000; for women, \$50,000) (National Science Board, 2004).

These gender differences in representations of men and women are present for college-bound men and women as well as those already in the workforce. In 2000, women earned 57 percent of all bachelor's degrees in the United States and also dominated completion of higher level graduate degrees (National Center for Education Statistics, 2004). However, of the bachelor's degrees earned by women in 2000, only 28 percent were in science and engineering fields, a relatively stable proportion since the late 1970s when 25 percent of women's degrees were in science and engineering (National Science Board, 2004). The patterns of women's educational attainment in college are similar to the patterns seen in the science and engineering workforce. Women earned 77 percent of the bachelor's degrees in psychology, 59 percent in biological sciences, 54 percent in social sciences, and 48 percent of degrees in mathematics in 2000. In the same year, men earned 79 percent of the bachelor's degrees in engineering, 72 percent of computer science degrees, and 59 percent of degrees in physical sciences (National Science Board, 2004).

A longstanding focus of educators across the country has been to ensure equality among boys and girls in math and science education. Surprisingly, at a secondary level, this appears to have been achieved. Girls are completing similar numbers and levels of math and

science courses, and are attaining achievement levels equal to the levels earned by boys (National Center for Education Statistics, 2004). In a longitudinal study of factors relating to career choices, researchers found a strong relation for women between persistence in STEM college majors and number of elective high school science courses taken. They did not find similar results with male participants (Farmer et al., 1995). However, despite this clear link between math and science courses and later persistence in STEM fields, researchers have shown that even women with strong high school mathematical ability are underrepresented in college math and science majors when compared with similarly achieving male peers (Schaefer, Epperson, & Nauta, 1997). These statistics would suggest that there is more to career development for women in STEM fields than high school achievement and aptitude. Even women with high achievement and aptitude in high school are not generally pursuing careers in math and science. Researchers that have examined the shortage of women in math and science based fields suggests that there are diverse factors that interact to influence young women's career choices in these areas.

*Social Learning Theories.* Bandura's social learning perspective has frequently been applied to factors that may shape women's career intentions in mathematics and science related fields (e.g. Lapan et al., 1996; Nauta, Epperson & Kahn, 1998; Schaefer et al., 1997). This theory suggests that self-efficacy beliefs for math and science and expectations for positive outcomes from pursuing these career areas will be related to choices to pursue and persist in STEM-related fields. Studies of high school students have shown that, despite equal participation in math and science courses, girls are more likely than boys to underestimate their abilities in math and science, and have lower expectations for success in these fields (VanLeuvan, 2004). Lent, Lopez, and Bieshke (1993) found that feelings of

competence in science for boys and girls mediated the relationship between their ability and their STEM career-related aspirations. Thus, if girls express lower feelings of math and science related self-efficacy than boys, they are less likely to aspire to STEM related fields, regardless of their level of performance in these courses. Interestingly, in a sample of college-bound men and women, Lapan et al (1996) found that women in general did report lower self-efficacy beliefs, less educational attainment, and consequently lower vocational interest in STEM fields than young men. Murrell, Frieze, and Frost (1991) also showed that women who did plan to pursue career choices in STEM fields held higher career and educational aspirations than those who planned to enter more female-dominated occupations.

*Cultural Influences.* In addition to social learning beliefs, a significant amount of research has examined the roles of cultural stereotypes and social norms in the math and science career development of women. Gottfredson's theory of circumscription and compromise asserts that, when choosing an occupation, individuals narrow their field of possible alternatives according to a number of principles. She suggests that sextype of occupation is a concern that may impact career decisions more strongly than actual vocational interests; although she does admit that this pressure to conform to a gender-based stereotype in occupational choice may in fact be more strong for men than women (Gottfredson, 1996). In a study relating women's attitudes regarding sextypes of occupations, researchers found that women who chose to pursue "nontraditional" (STEM) college majors and careers were less likely to hold sextyped attitudes about men's and women's roles than those who chose "traditional" vocational pursuits (Murrell et al., 1991).

According to Phillips and Imhoff (1997), ideas about what vocational roles are appropriate for men and women are formed early in childhood and can be seen in children's

stories, activities, and the attributions they make. These authors point to research that indicates that sex-typed stereotyping of occupations is becoming somewhat less prevalent than in previous years as more accurate vocational information has become available and women can find some realistic role models in traditionally male-dominated fields such as science and engineering (Phillips & Imhoff, 1997). However, others have argued that role models in STEM related fields continue to be scarce for young women. When women do not see adult females pursuing these occupational paths they may presume that such careers are not appropriate for women or present barriers and challenges that are too prohibitive (VanLeuvan, 2004).

Research that has examined the process of career choice for college-bound women has shown that aspirations for entering a math or science major are solidified before students attend college and these aspirations greatly impact their entry and persistence in STEM fields (Lapan et al., 1996). Several authors have examined the roles of significant others in the development of math and science career aspirations. Bleeker and Jacobs, (2004) conducted a 12-year longitudinal examination of mothers' stereotyped beliefs about math and science careers, their beliefs about their children's math/science related ability, and later math and science self-efficacy beliefs and occupational pursuits of those children. These researchers found that mothers' gender-related stereotypes were directly related to their perceptions of their seventh grade children's abilities in math and science. In follow-up studies, female adolescents whose mothers reported low perceptions of their abilities to succeed in math and science careers when they were in 7<sup>th</sup> grade were 66 percent less likely, 12 years later, to have chosen science careers than nonscience. The college-bound females in this sample whose mothers did not believe they could succeed in math or science were four times more

likely to choose life science or business college majors and careers than physical science or computer career areas. This effect was not found for males in the sample (Bleeker & Jacobs, 2004).

*Summary of Women in Math and Science.* The literature examining women's interests in math and science-related vocational fields continues to pose numerous questions and identify multiple influences that may contribute to women's choices to pursue or not pursue STEM-related career paths. A summary of research indicates that women's self-efficacy beliefs in math and science abilities may mediate the relation between actual ability and pursuit of STEM vocational options (Lent et al., 1993). Research that shows that women tend to have lower self-efficacy beliefs in these areas (Lapan et al., 1996; VanLeuvan, 2004) provides some explanation for the lack of women in STEM fields. Researchers have also shown that women who do enter STEM-related fields tend to have more experience with math and science courses in high school (Farmer et al., 1995) and have higher career and educational aspirations than women who pursue nonscience and mathematics career paths (Murrell et al., 1991).

External pressures and expectations for women may also contribute to the lack of women pursuing math and science-related career paths. Despite a decrease in the strength of gender-based norms regarding occupational choice, women still receive messages regarding appropriate roles and career opportunities (Gottfredson, 1996). Researchers have shown that women who hold sex-typed attitudes regarding roles are more likely to pursue "traditional" female-dominated occupations than women who do not hold these beliefs (Murrell et al., 1991). Female role-models with established careers in STEM fields are difficult to find and this limits the available career options many women identify (VanLeuvan, 2004). In

addition, females may be influenced by the gender biased beliefs of significant others in their lives, particularly mothers, when deciding what career paths to pursue (Bleeker & Jacobs, 2004).

### *Holland's Theory of Vocational Behavior*

John Holland's theory of vocational behavior has retained great status and application in vocational psychology research and practice. The theory is widely accepted as a model for individuals' career pursuits and satisfaction and is employed in most career assessments accepted today (e.g. Kuder Career Search, Self Directed Search, Strong Interest Inventory, Unisex American College Testing Inventory) (Spokane, 1996). The major tenants of Holland's theory will be described here briefly to augment understanding of the methods used in the present research.

Holland's theory describes the personality of individual workers using six interest types, referred to as career areas. These types are *Realistic*, *Investigative*, *Artistic*, *Social*, *Enterprising*, and *Conventional* and Holland argues that most people can be classified according to some configuration of these six types (Spokane, 1996). Briefly, according to Fitzgerald and Osipow (1996), the *Realistic* career area is described by interests in activities that require motor coordination, skills and strength. People of this type are concrete and prefer to solve problems with action rather than thought. The *Investigative* career area characterizes people who are intellectual and think through problems. These people are interested in gaining understanding and working alone to solve problems. People who are *Artistic* are interested in creativity and self-expression. They are independent and dislike structure imposed by others. *Social* people tend to seek close interpersonal relations and strive to help or teach others. People in the *Enterprising* career area are verbally skilled and

tend to create relationships in which they can persuade and lead others. These individuals aspire to power and prestige. Finally, the *Conventional* individual is concerned with rules, regulations, and self-control. This type of person prefers order and imposed structure.

In addition to organizing personalities of individuals, Holland asserts that work environments can be classified according to the same six dimensions. His basic proposal regarding career development is that people search for environments to allow them to “exercise their skills and abilities, express their attitudes and values, and take on agreeable problems and roles (Spokane, 1996).” The degree to which an individual’s personality, as expressed by dominant career areas, is congruent with their work environment has implications for that individual’s career decidedness, persistence in a career path, and job satisfaction (Fitzgerald & Osipow, 1996).

Holland acknowledged that individuals tend to have a mix of various personality traits and may be described as fitting into several career areas to differing degrees. He developed methods for identifying personalities and categorizing careers based on a three-letter Holland code (letters are *R*, *I*, *A*, *S*, *E*, and *C* and correspond to the six person and environment career areas). The three-letter code allows both individuals and careers to be captured across a combination of personality dimensions or environmental factors. The first letter of the code corresponds to the personality trait or work environment that fits most strongly with an individual or career. The second letter represents the next highest fit, and the third letter follows. For example, an individual whose personality traits match most highly with the *Social* career area, followed by *Enterprising* and *Artistic* interests would have a three letter Holland code of SEA (Gottfredson & Holland, 1996). There would also be a Holland code representing the career path that individual chooses to pursue. The Holland

codes for various careers were developed based on extensive research with individuals who report high satisfaction from working across different career areas and are published in the *Dictionary of Holland Occupational Codes* (Gottfredson & Holland, 1996).

Through research, Holland developed a statistical structure to describe the strength of the relations between career areas. He identified underlying patterns of relations between areas based on interest inventory results. Holland's hexagonal structure (See Appendix A) illustrates strength of relations between the six career areas. He showed that career areas that are most proximate on the hexagon (adjacent) are found to be more highly correlated than those that are two locations apart, (alternate), which are more highly correlated than those career areas that are most distal (opposite) (Osipow & Fitzgerald, 1996).

The hexagonal structure devised by Holland has since been revised by some researchers to reflect more recent analyses incorporating interests of multicultural participants (Tracey & Rounds, 1997). These revisions lend support to a spherical geometric structure as a potentially better descriptor for career area relations than the hexagon. The proposed spherical structure includes the same ordering of career areas and is purported to most closely resemble the structure of occupational interests found across diverse groups of individuals. This spherical structure has been shown to adhere to the same principles of proximity that Holland's original hexagon follows, but also allows for more variation of the structural distances based on demographic variables to describe individuals from different groups (Tracey & Rounds, 1997). With regards to gender, studies have shown that men and women may conceptualize scales reflecting *Realistic* and *Investigative* interests differently and discriminate between them differentially (Hansen, Collins, Swanson, & Fouad, 1993). However, researchers have also reported adequate fit to Holland's model for both males and

females, with no major differences in adherence to Holland's principles based on gender (Darcy & Tracey, 2007).

### *Large Scale Examinations of Interest Trends*

Despite the wealth of attention in vocational psychology literature devoted to interests and career choice behaviors, and the abundance of available information related to career statistics and distribution, relatively few researchers have chosen to examine trends and changes in interest development across time. The ability to examine interest and career choice patterns over time can provide rich information related to gender and societal differences in vocational constructs as they exist in reality. Large-scale cohort studies can inform vocational psychology regarding the state of the field and important changes that have occurred over time. These studies can also help us to identify important areas for research and make predictions regarding future vocational interest trends.

A handful of researchers have acknowledged some of these important contributions to be made by examining larger scale trends in interest research and have looked at such factors as employment distribution, distribution of measured interests, gender differences in employment, education levels and available occupations (Downes, M., & Kroeck, K.G., 1996; Gore, Ruxton & Maze, 2006; Gottfredson, Holland, and Gottfredson, 1975; Gottfredson & Daiger, 1978; Reardon, R. C., Vernick, S. H., & Reed, C. A., 2004; Rytina, N.F., & Bianchi, S. Z., 1984).

*Employment.* Gottfredson et al. (1975) attempted to address the issue of congruence between society and work roles of individuals by highlighting national distributions of occupations, interests, and gender in the world of work. They used 1970 Census data to examine employment distributions based on Holland career areas. These researchers found

sex differences in employment of individuals as predicted by gender role theories. Fifty-one percent of men with some high school or above were employed in *Realistic* occupations, while 42 percent of women at this education level were employed in *Conventional* work. For more educated individuals (some college or above) men were employed in *Enterprising* (42%), *Investigative* (21%) and *Social* (20%) career areas, while women worked in *Social* (70%) and some *Enterprising* (15%) career areas (Gottfredson et al., 1975).

Gottfredson and Daiger (1977) published a similar examination of employment trends that incorporated data from 1960 through 1970 to identify any differences that developed over this ten year period. The authors again observed different patterns of employment for men and women across career areas. These authors found that disproportionately more women than men were employed in *Conventional* and *Social* occupations across education levels and men were employed most often in *Realistic* and *Enterprising* career areas. From 1965 to 1970, Gottfredson and Daiger found a substantial decrease in employment in *Realistic* jobs for both men and women, while employment in *Enterprising* jobs increased. Employment levels across other career areas remained stable over time (1977).

In the Gottfredson and Daiger (1977) examination, the distribution of jobs among genders was similar for 1960 and 1970, though women held a greater proportion of *Enterprising* jobs in 1970 than in 1960 (from 16% to 23%). Women's labor distribution also changed in terms of employment in jobs with higher cognitive complexity requirements. In 1970, women held larger proportions of high level *Investigative* (11.5%) and *Artistic* (33.3%) jobs than in 1960 (8.1% and 27% respectively). Overall, results of this investigation suggest some changes over the 10 year span in the gender structure of occupational involvement.

The authors suggested these small changes were important because of the societal push to

expand career options for men and women. Even small changes in the structure of the world of work can have large implications for a vast number of people (e.g., consider that 3% of 100 million people is 3 million) (Gottfredson & Daiger, 1977).

In a study examining vocational interests at the detailed occupational level, rather than the global (Holland career area) interest level, Rytina & Bianchi (1984) used census data from 1970 and 1980 to specifically investigate changes in career distribution for women and the extent to which females were finding employment in jobs traditionally held by males. According to their results, more women than men entered the workforce in the 1970s; 57 percent of those entering were female. In 1980 women made up 43 percent of the total U.S. workforce compared to 38 percent in 1970. The authors' findings revealed few small change in the distribution of females working in traditionally male-dominated occupations across the decade. Females did significantly increase representation in managerial occupations (from 18% to 31%). The proportion of specific occupations held by 80 percent or more men (male-dominated occupations) decreased slightly and more occupations became gender neutral. There was no change in the number of occupations classified as female-dominated over this decade (Rytina & Bianchi, 1984).

*Education Levels and Aspirations.* Researchers have also examined large-scale employment trends based on education level. Not surprisingly, in both 1960 and 1970 individuals with the least amount of education were employed in narrowly defined, restrictive career areas (mostly *Realistic*), whereas individuals with higher levels of education had a more full range of career options available to them to express a variety of vocational interests (Gottfredson & Daiger, 1977). Gottfredson et al. (1975) examined career aspirations of college students in 1975 using national data supplied from American College

Testing assessment results. They found that college student aspirations were similarly distributed for both men and women in *Artistic* and *Enterprising* career areas. Interestingly, zero percent of women reported aspirations in *Realistic* career areas, and only seven percent aspired to careers in *Investigative* areas (Compared to 18% and 21% for men, respectively). In a preliminary trend investigation, Gore et al., (2006) explored the distribution of college-bound students' expressed interests based on a choice of intended major/ occupation that individuals made when registering for ACT assessment. Results showed similar distributions of interests and trends indicating slight increases among women's expressed interests in *Investigative* and *Realistic* career areas across time. These career areas are most often related to careers in STEM fields and are of great concern to researchers examining the interest development of women.

*Interest Distributions.* Gottfredson et al. (1975) investigated the distribution of vocational interests using national implementations of the Unisex American College Testing Interest Inventory (UNIACT), and the Self Directed Search (SDS) interest inventory. These two measures revealed similar patterns of results across college men and women. For men, measured interests fell most often into *Realistic* (20%, SDS; 20%, UNIACT), *Investigative* (34% SDS; 28% UNIACT), and *Social* (24% SDS; 28% UNIACT) career areas. In the *Enterprising* career area, where most (42%) of college educated men were actually employed, men's measured interest mean was only ten percent. For women, measured interests were most strong in the *Social* career area (62% SDS; 67% UNIACT). Women also showed a proportion of measured interests in *Artistic* (16%, SDS; 12% UNIACT) and *Investigative* (15% SDS; 10% UNIACT) career areas (Gottfredson et al., 1975).

When comparing measured interests between college and high school samples, women's measured interests were more similar than men's (Gottfredson et al., 1975). For high school male samples, measured interests in the *Realistic* career areas (40%, SDS; 50%, UNIACT) were significantly greater than measured interests for college males (20%, SDS & UNIACT). High school males also showed less measured interests than college males in *Investigative*, *Social*, and *Enterprising* career areas, though these differences were small (between 4% and 17%). High school educated women's measured interests were distributed similarly to college educated women's measured interests. Differences ranged between zero percent difference for *Realistic* career areas and 11 percent difference between *Artistic* career areas, with high school females having greater levels of measured interest in this area. Generally, college educated women had slightly higher measured vocational interests in *Investigative* and *Enterprising* career areas and high school women had slightly higher interests in *Social* and *Conventional* career areas (Gottfredson et al., 1975). These differences were small but support research related to differences in interests based on education levels, with more highly educated women showing greater interests in less "traditional" career areas such as *Investigative* and *Enterprising*. The similarities found between high school and college women in distributions of interest also lend support to previous research that showed that women's vocational interests tend to be formed before entering into college (Lapan et al., 1996).

In more recent studies, Downes & Kroeck (1996) investigated national distributions of occupational interests in relation to available jobs across career areas. The authors noted that information related to growth rates in occupational area is interesting in isolation, but by adding vocational interests they increased understanding of career satisfaction and

persistence. Researchers can also make predictions about which career areas may experience problems related to unemployment (too many interests, not enough jobs) and over-employment (too many jobs, not enough interests). Results of this investigation showed that measured interests, as measured by Self-Directed Search (SDS), were lower than available occupations for both *Enterprising* and *Conventional* career areas. Interests were higher than available occupations for *Investigative* and *Realistic* career areas. This trend was true for both men and women. The authors report that as many as 23 percent of new employees leave their jobs within one year of being hired. It is asserted that this dissatisfaction is potentially due to a lack of person-environment fit (Downes & Kroeck, 1996). Results of the present study may shed some light on these trends

*Three Decades of Employment Trends.* Reardon, Vernick, and Reed (2004) undertook the largest scale study of employment trends across time. They examined data from the US census in 1960, 1970, 1980 and 1990 and classified occupations according to Holland career area (*RIASEC*) codes. Across these three decades, total employment increased from 64.1 million to 115.7 million persons in the U.S. Across time, most workers were consistently employed in *Realistic* occupations, supporting findings from previous analyses of employment trends. While it remained the largest category, the proportion of workers in *Realistic* jobs decreased 18 percent between 1960 and 1990; from 55 to 37 percent of total workers. The proportion of workers who held *Enterprising* jobs increased by eight percent from 1970 to 1980 and then remained stable at approximately 25 percent of workers through 1990. Employment in *Investigative* careers saw the largest proportional increase. This career area doubled from three to six percent of total employment between 1960 and 1990. Distributions of workers in the other three career areas remained relatively

stable (*Artistic* careers accounted for 1% of workers, *Social* careers averaged 11.5% of workers, and the *Conventional* career area accounted for approximately 17% of employment). It is important to reiterate that while the gains seen in career areas such as the *Investigative* career area represent a small proportion of overall jobs, these changes affect a significant number of actual people (*Investigative* increased from two million to 6.7 million people). A change like this is capable of greatly impacting the nature of work and the existing U.S. workforce.

When Reardon et al. (2004) examined data by gender; trends showed that men were most frequently employed in *Realistic* and *Enterprising* career areas (between 79 and 85% of male workers). The distribution of women workers was consistently more heterogeneous with women's employment distributed across *Conventional*, *Realistic*, *Social*, and *Enterprising* career areas. The percentage of women working in *Enterprising* careers almost doubled across the three decades, increasing from 13 percent of women in 1960 to 24 percent in 1990. Consistent with a reported increase of interest for women in science and math related fields across time, women's representation in the *Investigative* career area increased from one percent of women in 1960 to four percent in 1990. Again, this indicates a small, but meaningful advance in the career choices of women. For women, the *Conventional* career area consistently showed the largest percentage of workers and this proportion remained relatively stable over time (30% to 34%). Women's employment in *Social* career areas was also stable (approximately 20% over time). Consistent with previously identified general trends in employment statistics, the proportion of women employed in *Realistic* careers decreased from 33 percent in 1960 to 20 percent in 1990 (Reardon et al., 2004).

The Reardon et al. (2004) study used national data regarding employment across career areas. This national data includes a large proportion of individuals who are not college educated, so we can expect these findings to reflect somewhat different preferences than a more discrete, college-educated or college-bound sample would. Reardon et al. (2004) addressed educational differences indirectly by reporting the cognitive complexity of careers across Holland career areas. They found that complexity of work demands were highest for *Investigative* careers, followed by *Artistic*, *Social*, *Enterprising*, *Conventional*, and *Realistic* in that order. It is not surprising, if we assume level of required education is related to cognitive complexity of work demands, that we see the largest proportion of U.S. workers employed in those career areas that are least complex (*Realistic* and *Conventional*). If this sample were divided across time according to education level, we would likely find differences in distribution of employment for college-educated versus non-college educated workers across career areas. Not surprisingly, fields which require higher levels of cognitive complexity (*Investigative*, *Artistic*, and *Social*) are also related to greater prestige and income (Reardon et al., 2004).

Reardon et al (2004) argue that their findings have implications for future growth of employment in the United States. They addressed gender issues and the relation of their findings to vocational interest literature regarding the lack of interest expressed by women in nontraditional (*Realistic*, *Investigative*, and *Enterprising*) career areas. These findings suggest that more women have begun to move into these less traditional careers, particularly business fields. The authors also acknowledge the importance of continuing to assess employment over time. It has been predicted that changes in information technology and

globalization will continue to have great impact on the nature of the U.S. workforce. These changes could be examined with more recent employment trends.

*Summary of Interest Trends.* Taken together, this research examining interests across time illustrates the importance of looking at large-scale trends in vocational interests, intentions, and employment. These studies have investigated single year census data (Gottfredson et al., 1975) and large-scale employment data across ten-year time periods (Gottfredson & Daiger, 1977; Rytina & Bianchi, 1984). Researchers have also examined interest trends for a large population sample (Gottfredson et al., 1975; Downes & Kroeck, 1996). Most recently, Reardon et al. investigated career information across three decades using national data from four separate points in time (2004). The results of these investigations provide general information related to the state of occupational decisions for one or several cohorts in time.

Each of these studies has made significant contributions to our understanding of general trends in vocational interests and employment, but each has failed to capture important elements included in some of the other investigations and none have described the development of careers according to measured and expressed vocational interests. While Reardon et al. (2004) did analyze data from a large period in time; they did not provide any information related to interest development, other than what can be inferred from employment trends. Conversely, Gottfredson et al. (1975) illustrated rich information related to measured interests of individuals, but did so for only one point in time. A study that could incorporate both vocational interest (as measured by interest inventories) and vocational intentions (as measured by expressed interest in careers or actual career pursuits) across time would provide an additional, comprehensive perspective that adds to the current

demonstrations of vocational trend information. In addition, a study that could provide trend information using time intervals of less than 10 years would allow researchers to examine more specific changes across discrete periods of time in greater depth.

*Interest Congruence (Expressed and Measured Interests)*

As previously mentioned, Holland's (1973, 1997) career theory has remained a pivotal influence in vocational psychology research and practice since its introduction to the field in 1973 (Spokane, 1996). Holland's six personality and environment divisions (Realistic, investigative, Artistic, Social, Enterprising, and Conventional) form the standard method for occupational classification used in interest measurement (Strong Interest Inventory, Year; Self-Directed Search, Year; UNIACT inventory, 1995) and vocational interest research (Spokane, 1996). One aspect of this theory that has received significant attention is Holland's statement of person-environment fit. Holland postulated that the match (congruence) between personality factors and work environment would predict such variables as job satisfaction, persistence in a career, and job performance (Brown & Gore, 1994). These principles have inspired numerous studies yielding mixed results. Nonetheless, they remain a strong focus of research in vocational psychology and researchers are continuing to investigate interest congruence as it relates to outcome variable and other theoretical models in vocational psychology.

Congruence research is typically conducted by calculating the match between measured interests (personality) and expressed interests (intended environment) using one of several established methods. This congruence index is then statistically related to factors such as persistence, satisfaction, and performance variables.

*Interest Congruence and Persistence.* Results for the relations between interest congruence and persistence have been mixed. Lent Brown and Larkin (1987) showed that, when added to effects of achievement, congruence did not account for additional variance in persistence within a college major. Conversely, Laing, Swaney, and Prediger (1984) found the highest rates of persistence for individuals with the greatest levels of interest congruence. Results of a study conducted by Tracey and Robbins (2006) showed that the relation between congruence and persistence was moderated by level of interest. These researchers found that, when interest was low, level of congruence was predictive of persistence. This relation was not found for high interest participants. Schaefers, Epperson, and Nauta (1997) also showed that, for engineering students, congruence added to the variance in persistence accounted for by achievement.

In a recent study that examined the interaction between interest congruence and achievement for engineering students, Leuwerke, Robbins, Sawyer, and Hovland (2004) may have highlighted specific factors in this complex relation. Their analysis of the interaction between congruence and mathematics achievement for engineering majors indicated that students with high mathematics achievement scores and low congruence with engineering had a lower probability of retention. However, when students had low congruence with engineering and low mathematics achievement, they were more likely to persist at the school. These results may be related to issues of self-efficacy and outcome expectations reported in previous descriptions of literature. Participants in this study with high mathematics achievement may have held higher beliefs about their abilities and outcome expectations and may have been more susceptible to disappointment when their personality and environment did not fit (Leuwerke et al., 2004).

*Interest Congruence and Vocational Outcomes.* In relation to job satisfaction and decidedness, Lent et al., (1987) showed level of congruence was associated with degree of career decidedness and was positively related to academic and technical self-efficacy. In addition, they found level of interest congruence to be inversely related to participants' identification of negative consequences associated with career decisions. Taken together, these findings indirectly support a relation between interest congruence and satisfaction or expected satisfaction as in the case of negative consequences. Slaney (1980) found that strength of expressed interests in occupational choice related to decidedness and congruence between measured interests and college major choice. In other words, students with higher congruence between measured interests and college major are more likely to have greater degrees of decidedness around their future occupation. Spokane (1985) found five to ten percent of the variance in vocational outcomes such as satisfaction and choice could be accounted for by interest congruence. However, Gore and Leuwerke, (2000) found that congruence accounted for only 4% of the variance in occupational considerations in their sample (with self-efficacy and outcome expectations making greater contributions to variance). They did highlight a small positive relation between congruence in occupation and self-efficacy beliefs ( $r=.14$ )

*Interest Congruence Development.* In a longitudinal study of vocational interests from eighth grade through twelfth grade, Tracey, Robbins, and Hofsess (2005) found a high degree of stability in measured interest scores and academic skill scores over time, consistent across Holland code (*RIASEC*) career areas. Despite stability of patterns of interests, interest scores for these participants increased in intensity over time, suggesting that students' interests become more salient as they become developmentally nearer to career entry. A

surprising finding in this longitudinal sample was that interest congruence between career choices and measured interests increased between grades eight and ten (consistent with developmental literature) but then decreased in grade 12. The authors postulate this decrease may be an effect of increased pressure to make career choices and increased realism about possible occupational paths when students near high school graduation and the beginning of a college career or vocational pursuit. During this time period the future becomes more salient and decisions become more meaningful. This finding is relevant to the proposed study that will examine interest congruence for college-bound females who are reaching this developmental level.

*Women's Interest Congruence.* Patterns of interest congruence for women are of particular interest to the current study and some researchers have investigated congruence based on gender (Betz, Heesacker, and Shuttlesworth, 1999; Slaney & Russell, 1981; Wolfe & Betz, 1981). Slaney and Russell (1981) found that women with high interest congruence between measured interests and expressed occupational intentions chose more congruent college majors as well. However, women with low interest congruence between measured interests and occupational intentions seemed to have less fit between measured interests and college major choice. Slaney (1980) found that, in general, women had stronger interest congruence between measured interests and college majors than males. Females also reported greater satisfaction with major, lending indirect support to the relation between career satisfaction and interest congruence. Betz, Heesacker, and Shuttlesworth (1999) examined interest congruence by gender and traditionality of career choice. These researchers replicated a 1981 study conducted by Wolfe and Betz which showed a strong relation between interest congruence and traditionality of career choices. Women with lower levels

of interest congruence were more likely to choose “traditional” careers to pursue. In the more recent study, researchers found 27 percent of women expressed interest in traditionally male fields, 29 percent in female dominated fields and 44 percent in gender neutral careers. Interest congruence was consistent across gender categorizations. This finding indicates that women in the study may be choosing careers more on the basis of their own interests, rather than on gender-role stereotypes (Betz et al., 1999). The results of this replication show promising changes in the equality of women’s vocational choices.

*Meta-analysis of Interest Congruence.* To examine the numerous issues and inconsistencies found in the interest congruence literature, Tranberg, Slane, and Ekeberg (1993) conducted a meta-analysis of 27 studies that investigated a relation between interest congruence and satisfaction in job or academics. To evaluate the nature of research in this area, Tranberg et al. evaluated mean levels of correlation across the 27 studies. The researchers found a mean correlation between satisfaction and interest congruence of 0.17. The mean correlation of congruence with job satisfaction was 0.20 and the mean correlation of congruence to academic satisfaction was very small, .095. None of these small correlations reached an appropriate level of significance to indicate meaningful relations.

When investigating moderating factors, the Tranberg et al. study did find some difference in the relation between satisfaction and congruence between measured Holland types. *Social* personalities yielded an overall mean correlation between congruence and satisfaction of 0.33. For *Realistic* personalities, this correlation was 0.05 across studies (1993). This finding suggests there may be differences between Holland types in the importance of the relation between congruence and satisfaction that should be further investigated (1993). The Tranberg et al. (1993) meta-analysis indicated a lack of significant

overall relation between interest congruence and satisfaction. Authors suggested these findings reinforced the importance of considering occupational fit as more than the match between interests and occupational environment. However, they do point out that there are significant limitations to research in this area. Most of the studies reviewed in the article used simplified measures of interest congruence taking into account only match between one or two letters of a three-letter Holland code and did not address the distance relations among the Holland areas. This suggests the need for further development and use in the literature of congruence measures that more firmly adhere to Holland's conceptualization of person-environment fit.

Meir (1995) proposed a reinterpretation of the data in the above and other meta-analyses. He argued that the meta-analyses used questionable procedures for establishing statistical significance (e.g. no examination of effect sizes). He argued that the .20 mean correlation found between interest congruence and satisfaction could mean more than four percent of shared variance between the two constructs in reality; a correlation of .20 based on multiple studies is more meaningful than this correlation would be with just one experiment (1995). Meir proposed the meta-analyses under question did not eliminate poor methods for calculating index congruence from their findings. He also argued that, when examining studies independently, 57 of the studies showed positive significant relations between congruence and satisfaction, and only two revealed negative correlations (1995).

*Measurement Issues and Interest Congruence.* Several authors have responded to the measurement issues raised in meta-analyses and reviews regarding interest congruence. Silvia (2001) created a conceptual argument that many of the measurement problems in the interest congruence literature are related to a lack of agreement in the definitions of

expressed and measured interests. He stated measured interests should be conceptualized as broad personality factors encompassing a general vocational interests description. He conceptualized expressed interests as a statement of vocational intentions that are typically measured using self-report responses to statements such as “What major do you plan to pursue in college?” Silvia argues that, instead of being equal constructs, or even related constructs that fall on a continuum of interests, we should think of expressed and measured interests as two distinct constructs, both reflecting different aspects of an individual’s vocational aspirations and personality. He uses social psychology research relating attitudes (measured interests) and choices (expressed intentions) to predictions of behavior. Silvia points out that, according to social psychology literature, attitude and choices are certainly related but a specific choice intention will always predict a behavior better than an attitude. This explains why expressed interests are most often found to be more strongly related to career behavior than measured interests that represent a more global conceptualization of an individual’s vocational interests.

Silvia proposes that researchers need to make clearer distinctions between the two constructs of expressed ( vocational intentions) and measured (vocational interests) interests and also need to focus more efforts on using these two constructs together to better understand the complexities of person-environment fit and its relation to other aspects of career decision making. This conclusion addresses the need for more examination of interest congruence relations as an index of combined vocational interests and intentions.

Other researchers have responded to specific measurement difficulties in interest congruence research as a product of the measures employed (Brown & Gore, 1994; Camp & Chartrand, 1992). These researchers have argued that there is no consistent method for

measuring interest congruence and that the measures vary greatly in specificity and adherence to Holland's conceptualization of person-environment fit. Camp and Chartrand (1992) assessed 13 existing indices of interest congruence and found variability in inter-correlations and relations between congruence and factors such as satisfaction, persistence, decidedness, and commitment. They proposed these inconsistencies were due to differing measurement sensitivity among indices. They showed that score distribution encompassed differing ranges and magnitudes of measurement.

Brown and Gore (1994) addressed the same measurement issues in an examination of 10 indices of interest congruence. They proposed that, according to Holland's theory, an adequate measure of interest congruence should be able to make the following three discriminations; 1. Indices should discriminate between individuals with identically ordered person (measured interest) and environment (expressed intentions or vocational interests) codes (SAE – SAE) and individuals with identical career areas but sequentially different codes (SAE – ESA). 2. Indices should discriminate between all levels of similar codes, from most congruent codes being those in which the first letter is the same and the second two letters are the reversed, (SAE – SEA) to least congruence for similar codes being same-letter codes with none of the three letters occupy the same position (SAE – ESA). 3. Indices should incorporate the proximity of hexagonal relations between the career areas included in Holland Codes (e.g. SAE person is more congruent than SAC in similarly ordered environment codes because A and C career areas are most distal on Holland hexagon). Brown and Gore (1994) identified only one of 10 indices studied that met all three criteria for operationalizing Holland's principles, the Kwak & Pulvino (K-P) index. However, they

reported the difficulties in calculating this index of congruence make it impractical to use in interest congruence research.

Brown and Gore (1994) responded by developing a new measure of interest congruence that could account for all three criteria, and be easily calculated. The congruence (C) index will be used in the present research and will be described in more detail herein.

## The Current Study

The previous literature review was developed to highlight several areas of concern for the interest development of women including the importance of contextual factors in women's career development, and issues related to women's career development in math and science related fields. The purposes of the current study are intended to build on existing literature by examining trends in college-bound women's interest congruence, measured interests and expressed interests across time and levels of achievement.

This dissertation study will contribute to the literature as a large-scale analysis of trends in interest development for women. It is the first study of this nature to examine measured and expressed interests across time using a large, nationally representative sample, and data across several short time intervals. The research focuses on multiple exploratory issues with particular emphasis on the following goals:

- To assess general trends in college-bound women's expressed vocational interests and measured vocational interests across time.
- To explore the distribution of interest congruence among college-bound women across time using Brown and Gore's (1994) C-index. In addition to exploration of general trends in interest congruence across time, the aim of this study is to examine the distribution of interest congruence based on participants' measured Holland career areas and to look at trends in expressed interest in college major based on level of interest congruence across time.
- To examine trends in expressed interests and interest congruence based on college-bound women's levels of achievement in math.

- To examine the appropriateness of the C-index as a measure of interest congruence in large-scale studies of this nature.

The information gathered in this study can be used to provide insight regarding the historical and sociological nature of women's career development across time, particularly development within career areas in which women are traditionally underrepresented. Results can also be used to make predictions regarding future vocational trends for women. An analysis of this nature provides a number of avenues for future researchers to continue to explore and attempt to explain. The inclusion of interest congruence trends across time helps to illuminate some of the complexities of the relations between expressed and measured interest and clarifies the usefulness of this statistical tool.

Results of this dissertation research are applicable across a variety of settings. There are implications for researchers, career counselors, university admissions officers, college deans, and employers. Results also provide rich descriptive and qualitative information that will lend support to existing literature regarding career development of women as well as provide directions for future research.

## Method

### *Participants*

Participants for this study include 35,000 college-bound females who completed the American College Testing (ACT) assessment and the Unisex American College Testing Interest Inventory (UNIACT; an optional inclusion with registration for the achievement measure). These individuals responded to demographic questions and vocational intention items over a span of 30 years. The original sample includes 5000 women from each of seven testing years; 1974-1975, 1980-1981, 1985-1986, 1990-1991, 1995-1996, 2000-2001 and 2004-2005. The final data set included a total of 31,021 participants. Three thousand, nine hundred seventy nine participants were removed from the sample due to “ties” that occurred when calculating interest congruence. This process will be described in greater detail later in this text. The final distribution of 31,021 participants is as follows; 1974-1975 cohort  $n = 4504$ ; 1980-1981  $n = 4102$ ; 1985-1986  $n = 4460$ ; 1990-1991  $n = 4590$ ; 1995-1996  $n = 4382$ ; 2000-2001  $n = 4505$ ; 2004-2005  $n = 4478$ .

All participants were randomly selected from the pool of all female ACT test takers with complete data for each year included in the study. Participants ranged in age from 13-48 at the time of ACT testing. Most participants ( $\bar{x} = 94.7\%$ ,  $n=29,377$ ) were between the ages of 16 and 19, with a mean across time of 42% ( $n=13,020$ ) aged 17 at the time of testing. Less than 2% ( $n=620$ ) of students completing the ACT testing materials over time were younger than 16 years old and approximately 3.5% ( $n=1085$ ) of the total sample took the test when they were older than 19 years of age. These demographics are consistent with expected age ranges and norms for typical ACT test takers.

Across years, the majority of participants, 73.6%, self identified as Caucasian American/White ( $\bar{x} = 73.6\%$ , total  $n=22,820$ ). This number appears to have decreased slightly in later years as more minority students completed the ACT assessment. In 1980-1981, 79.9% ( $n = 3,277$ ) of participants were Caucasian, this number decreased to 66.1% ( $n = 2,958$ ) by 2004-2005. Participants identified as other ethnic groups as follows: A total of 11.7% ( $n = 3,630$ ) of participants across time self-identified as African-American/Black, 3.0% ( $n = 942$ ) chose Mexican-American/ Chicano, 2.2% ( $n = 667$ ) were Asian-American, 1.6% ( $n = 499$ ) of participants identified as Puerto Rican or other Hispanic, and 1.2% ( $n = 374$ ) were American Indian/ Native Alaskan. Across the years of this study, the percentage of participants who identified as African American increased from 8.8% ( $n = 398$ ) in 1974-1975 to 15.5% ( $n = 696$ ) in 2004-2005. Proportions of other minority participants increased as well (Mexican American from 2.1% ( $n = 93$ ) to 4.7% ( $n = 210$ ); Asian American from .6% ( $n = 27$ ) to 2.1% ( $n = 143$ ), and Puerto Rican from 0.5% ( $n = 22$ ) to 2.0% ( $n = 91$ )), likely reflecting societal changes in the ethnic make-up of college bound youth across time. One point seven percent ( $n = 520$ ) of all participants across years classified their ethnicity as “other.” Responses to this item were missing for 2.5% ( $n = 788$ ) of the sample, and 2.5% ( $n = 781$ ) of participants responded they did not want to disclose ethnic information.

Socioeconomic status (SES) was determined by participants' self-report of household income and need for financial assistance for college. Across all years included in the present study the majority of participants reported “yes” they expect to apply for financial aid for college. This proportion increased from 59.7% ( $n = 2,689$ ) of the sample in 1974-1975 to 86.6% ( $n = 3880$ ) of the 2004-2005 cohort. The financial aid statistic is likely more reflective of the status and acceptance of the quality of United States financial aid programs

than participants' actual SES backgrounds. Across time the majority of participants estimated their family income level to be in the middle of available choices at \$24,000-\$41,999 annually. The proportion of participants with families in this income range decreased slightly across time (from 38.7% of the 1974-1975 sample (n = 1744) to 24.2%, n = 1081 in 2004-2005) as participants from lower income families increased. In 1974-1975 the percentage of participants who estimated family income to be less than \$12,000 per year was 11.2% (n=503). This percentage increased to 19.1% (n = 856) of the 2004-2005 cohort. The mean distribution of estimated family income across time is as follows; 14.6% (n = 4553) of participants estimated family income to be less than \$12,000, 14.6% (n = 4570) were between \$12,000 and \$23,999, 30.7% (n = 9543) of participants selected the \$24,000-\$41,999 range, 25.6% (n = 7823) of participants estimated family income to be between \$42,000 and \$59,999 and 6.6% (n = 2074) of participants across time reported family income to be \$60,000 or greater.

#### *Data Set*

The data for this study is composed of existing educational data which were provided by ACT as an intact data set with no identifying information included for participants. The ACT career transitions research department approved a proposal and provided permission to the rights of this sample to be used for the purposes of dissertation completion. Any further publication of the results of this study will be reviewed and approved by ACT in order to proceed. ACT also reserved the right to retain some level of authorship beyond first author position in any future publications using this data set (See Appendices B and C for ACT research proposal and data agreement with ACT). In addition to American College Testing approval, the Iowa State University institutional research review board (IRB) examined a

proposal for this study. The IRB determined this study to be exempt from human subjects review due to the nature of the intact data set (See documents in Appendix D)

### *Measures*

*Demographic Measures.* Demographic information was provided based on self-reports gathered from the Student Profile section of participants' ACT registration materials. Participants responded to questions regarding their gender, age, expectations for financial aid and family income. They also provided information about their high school GPA, courses taken, and class placement. See Appendix E for specific questions and response formats.

*Measured Interests/Vocational Interests.* Measured interests were assessed using scores from the Unisex American College Testing (UNIACT) Interest Inventory. The UNIACT inventory is included as an "optional" set of questions for students to complete when registering for the American College Testing achievement assessment. The first nationally normed edition of the UNIACT was published in 1977 and a revised (current) edition produced in 1989 (ACT Program, 2001). Data for the current study collected in the 1974-1975 cohort is based on an early version of UNIACT used by ACT in the beginning stages of the norming process. UNIACT results for this cohort may show artificial distributions of results that are impacted by testing error (Hanson, Prediger, & Schussel, 1977).

The UNIACT was developed as a gender-balanced measure of vocational interests. This measure is intended to assess vocational interest and was designed to decrease gender differences in responses. Developers included only gender-neutral items that produced equivalent mean raw scale scores for males and females. Thus, results use combined-sex

norms and do not limit the occupational options relevant to either gender (Hanson et al., 1977).

The UNIACT inventory (1977; See Appendix F) provides scores across eight scales reflecting an extension of John Holland's well-known career hexagon (See Appendix A) into ACT's research-based World-of-Work-Map (WWM; Appendix G). Six of the scales correspond to the six Holland career areas; *Investigative*, *Artistic*, *Social*, *Enterprising*, *Conventional*, and *Realistic*. These scales are re-named Science, Creative Arts, Social Service, Business Contact, Business Detail, and Technical by ACT. For purposes of this study, the re-named scales will be referred to according to the more standard Holland Code career areas. In addition to these six scales, two scales reflect bipolar work task dimensions that underlie Holland's hexagon. These dimensions are preferences for working with data versus ideas and preferences for working with people versus things and were extensively researched before inclusion as an underlying dimension (Prediger & Swaney, 2004).

The UNIACT inventory contains 90 items; 15 items for each of the six basic interest scales. Raw scores represent a sum of "like," "indifferent," and "dislike" responses to interest statements with "like" weighted as three points, "indifferent;" two points, and "dislike;" one point. Sample statements include "Read books or magazines about new scientific findings," "Use a computer," "Be the leader of a group or social club," and "Build furniture." The raw scores for each interest scale are converted to standard, combined sex-norm scores with a mean of 50 and standard deviation of 10. The Data/Ideas and People/Things scales are each derived as summaries of 30 of the basic interest scale test items (Hanson et al., 1977). All original UNIACT items were developed and tested over three phases with six different samples (N=10,388) to ensure gender neutrality of items.

These initial results indicated no significant raw score differences between males and females (Hanson et al., 1977).

The UNIACT inventory was revised between 1987 and 1989 with the revised edition of the assessment first published for use in 1989. This revision involved research with more than 15,000 participants. Forty percent of the original UNIACT items were revised or replaced but the scoring and scale divisions remained the same (ACT Program, 2001). Sample revised UNIACT statements include “Read about a new surgical procedure,” “Operate office machines,” “Entertain others by telling jokes or stories”, and “Assemble a cabinet from written instructions (See Appendix B for complete UNIACT revised edition).”

Because the current analysis represents cohort data over a period of thirty years, it is important to acknowledge reliability and validity data from both editions of the assessment. Tests of validity for the original version of the UNIACT inventory indicate the six interest scales met the theoretical expectations of the Holland model; scale scores in a career area were most strongly correlated with adjacent career area scale scores and least highly correlated with opposite career area scale scores (e.g. Social Service was correlated most highly with the Business Contact (.55) and the Creative Arts (.42) scales adjacent to it. The Social Service scale correlated least strongly with the Technical Scale (.21) located opposite across the circular interest structure based on Holland’s hexagon. Other correlations fell between those values, as expected). The work task dimensions were also found to correlate with interest scales as predicted by the model. There was high positive correlation between the Data/Ideas scale scores and Business contact (.53) and Business Detail (.34) scale scores; there is high negative correlation between Data/Ideas and Science (-.60) and Creative Arts (-.34) scale scores (Hanson et al., 1977).

Test-retest reliability for the revised edition of the UNIACT was assessed for 453 11<sup>th</sup> grade students over the 1989-1990 school-year. The average interval between assessments was 5.4 months. Reliability coefficients for the six interest scales ranged from .68-.78 for males and .69-.82 for females (ACT Program, 2001). Investigations with nationally representative samples of participants have revealed internal consistency reliabilities for scales ranging from .86 to .93 (ACT Program, 2001). In a comparison of five interest inventories, Savickas, Taber, and Spokane (2002) found median correlations between the six interest scales of the UNIACT and corresponding scales measuring RIASEC interests between .49 for Technical and Business Operations scales to .60 for the Business Contact scale. The UNIACT inventory showed strong convergent validity with the Strong Interest Inventory (SII; Harmon, Hansen, Borgen, & Hammer, 1994) and Holland's Self-Directed Search (SDS; Holland, Fritzsche, & Powell, 1994). Both of these inventories are designed to yield scale scores that directly reflect measurement of RIASEC career areas. The weakest correlation between the UNIACT scales and scales on the SII and SDS was .51 between the UNIACT Social Services scale and the SDS Social scale. The strongest correlation indicating convergent validity was the relation between the UNIACT Arts scale and SII Artistic scale ( $r=.73$ ) (Savickas et al., 2002).

*Expressed Interests.* Participant's expressed interests were assessed using two items from the ACT registration booklet Student Profile section to identify college major choices and certainty of choice. The college major choice items was: "What college major (program of study) do you plan to enter?" Students responded to this question by choosing a major from a list provided and entering the corresponding 3-digit code. This list is organized by general categories that represent broad topics for study and more specific major choices

within each category. Students also rated the certainty of their responses from one “very sure” to three “not sure.” The intact data set provided by ACT for this study included only participants who responded “very sure” or “fairly sure” to this item to decrease bias due to perceived forced choice or compliance with optional item responding.

The expressed choice of major questions and responses described above have been consistent for students registering for the ACT since the 1970s. However, in 1990 the list of occupations/majors was revised to reflect societal changes in occupations and majors due to modern trends. The significant changes include the addition of the following general areas: Marketing and Distribution, Cross-Disciplinary Studies, Engineering-Related Technologies, and Philosophy, Religion & Theology. The revised list also increased the specificity of general areas by dividing Business & Commerce choices into two general areas; Business & Management, and Business & Office. Engineering was also separated into Engineering (Pre-Engineering) and Engineering-Related Technologies. There are 85 additional major choices on the 1990 list. To facilitate consistent research design and analyses, research experts from the ACT Corporation established a complete transformation between the two major lists. Every item on the original list can be classified according to the current list of majors. In this study, the data provided by ACT for years prior to 1990 were already coded by ACT to fit into the current major choice structure. This allows for direct comparisons across cohort years.

The original major/occupation list included 200 choices categorized under 19 general areas including: Agriculture, Fine and Applied Arts, Community Service, and Trade, Industrial and Technical. Specific choices included Real Estate and Insurance, Geological Engineering, International Relations, Appliance Repair, and Microbiology. Students

responded to items about their choice of expected major by selecting an option from the list and recording a 3-digit number between 000 and 370.

The revised list of majors provided by ACT beginning in 1990 registration includes 285 choices in 23 general categories including: Agriculture Science and Technologies, Marketing and Distribution, Computer and Information Science, Cross-Disciplinary Studies, Foreign Languages, Health Sciences and Allied Health Fields, and Visual and Performing Arts. Specific selections include Fashion merchandising, Electronic Technology, Actuarial Sciences, Urban Studies, and Photography. Respondents make a choice by recording the corresponding 3-digit code from 400 to 934.

(See Appendix H for complete updated list.)

*ACT Assessment.* The ACT assessment is a standardized curriculum-based college entrance exam taken nationally by over two million high school students per year. The measure is an assessment of academic achievement used since 1959 by college admissions representatives to estimate aptitude for college success. This assessment is considered a valid measure of achievement and its predictive capabilities are widely accepted by college admissions offices (ACT, 1989; 2004). The ACT consists of four subtests and provides a cumulative composite score based on students' average performance across the four tests (Betz, Heesacker, and Shuttleworth, 1990). The ACT English score is based on 75 questions administered in 45 minutes, the Mathematics score is determined from 60 questions administered in 60 minutes, the Reading subtest includes 40 questions completed in 35 minutes and the Science Reasoning score is based on 40 questions administered in 35 minutes. All four scores, as well as the composite score are reported on scales ranging from one to 36 (Dorans, N. J., 2004).

## Design and Procedures

### *Analyses and Equations*

Analyses performed in this study were descriptive in nature. Due to the very large sample sizes, encompassing a large proportion of women taking the ACT assessment each year, inferential statistical methods were not the primary means of data analysis for this study. To compare trends across time, means, standard deviations, and proportional data including percentages and chi square statistics were used. Means and standard deviations were supplemented by effect sizes to provide additional meaning for the observational results.

Effect sizes were computed according to the following equation:

$$ES = \frac{\bar{X}_i - \bar{X}_j}{\sqrt{\frac{n_i\sigma_i^2 + n_j\sigma_j^2}{n_i + n_j}}}$$

According to this equation, the standard deviation of the difference between means was computed in a two step process. First, the sums of squared deviations for both groups were added, and the corresponding sum was divided by the total number of participants in both groups. Second, the square root of this pooled variance was taken to determine the pooled standard deviation. Effect sizes were interpreted consistent with other similar studies conducted using large sample sizes and similar normally distributed national test data (Harmston & Pliska, 2001). To interpret, an effect size less than .25 indicates a small effect (or difference). An effect size between .25 and .50 indicates a moderate effect, and an effect size greater than or equal to .50 indicates a large effect (Cohen, 1988). Cohen (1992) demonstrated that for power of .80 when comparing means, a sample of 586 participants is

needed for small effect sizes, a sample of 95 is needed to show moderate effect sizes, and a sample of 38 participants is necessary for large effect sizes. The sample in the present study includes a more than adequate number of participants for appropriate power.

### *Data Transformations*

Data transformations were performed to convert data provided from ACT into forms that could be used to examine measured interests and expressed interests and to calculate interest congruence. To examine measured career interests, the UNIACT data provided by ACT needed to be transformed from career area norm scores into a rank-order of Holland career areas for each participant. The highest three career areas for each participant were identified from normed scores and ordered from strongest measured interest area to least strong. The high-point career area was used to describe trends for measured interests across time.

To examine expressed interests, the 3-digit numerical major codes selected by participants were transformed to the appropriate 3-letter Holland codes. The *Dictionary of Holland Occupational Codes* (Gottfredson, & Holland, 1996) was used to look up each major from ACT's list and assign the appropriate Holland code to the data as designated by this resource. Previous research has shown some inconsistencies among various systems for assigning occupational codes and choosing an appropriate code source for research can have important implications for results. The *Dictionary of Holland Occupational Codes* was selected for use this study because it has been established as a widely accepted system that can be used to classify a broad range of occupational titles with a full three-letter Holland Code. Codes from the *Dictionary of Holland Occupational Codes* have been shown to have adequate convergent validity with other systems of assigning occupational codes (K-P index

=.62-.71 for congruence with Strong Interest Inventory and O\*NET systems) and offer the largest choice of occupations (Eggerth, Bowles, Tunick, & Andrew, 2005).

### *Interest Congruence Calculation*

Participants' measured three-letter Holland code from their UNIACT inventory normed scores and the three-letter Holland code representing their expressed choice of major were used to calculate interest congruence using the Congruence (C) index (Brown & Gore, 1994). As reported previously, the C index of congruence provides a measure of the relation between expressed vocational interests and measured vocational interests at the three letter Holland code level of specificity. This index was selected from several available methods for calculating index congruence because it is one of only two methods that operationalize all three characteristics of congruence implied by person-environment theory (Brown & Gore, 1994). To review, these three characteristics include a consideration of the order of Holland career areas between expressed and measured interests, rules for congruence of similar Holland codes, and examination of the proximity of Holland career areas. The C index is purported to be most easily calculated and has been shown to yield normally distributed scores across samples (Brown & Gore, 1994). The C index also offers flexibility, in that it can be used with a variety of vocational interest assessments. Consistent with Holland's theory and the propositions proposed by Brown and Gore, the C index of congruence is able to discriminate between individuals with identically ordered person (measured interest) and environment (expressed interests) codes (e.g. measured interest code is RIA and expressed vocational intentions are also described by RIA) and individuals with similar, but out-of-order codes (e.g. measured code RIA and expressed code AIR). The C index also calculates congruence based on the order of each letter in a three letter code, with different levels of

congruence based on the level of similarity of person (measured interest) and environment (expressed interests) placements (e.g. RIA and SIA). Finally, the C index allows for distinctions based on proximity of hexagonal relations between the personality types or career areas included in Holland codes (e.g. RIA is more congruent with adjacent code IAS than with alternate code ASE).

The index is calculated according to the following formula:

$$C = 3(X_1) + 2(X_2) + 1(X_3)$$

$X_i = 0, 1, 2,$  or  $3$  based on the hexagonal difference between letters. A value of three is assigned to identical person and environment (R and R), two is assigned to adjacent person and environment codes (R and I), one to alternate codes (R and A) and zero to opposite codes (R and S). For example, if an individual expresses interest in a major or occupation with a Holland Code of RIA and their measured Holland Code is AIS, their C index =  $3(1; \text{R and A are alternate}) + 2(3; \text{I and I are identical}) + 1(2; \text{A and S are adjacent})$ . The C index for this individual is calculated to equal 11. Using this formula, interest congruence scores range from 0 to 18. Brown and Gore (1994) found this index to be highly correlated with the K-P index for congruence ( $r = .84$ ; SII and  $r = .83$ ; SDS). The C index was also strongly correlated with Holland's original method of congruence measurement ( $r = .80$ ). The C-index is distributed normally with a mean of 9 (Brown & Gore, 1994)

Calculating C-index for each participant within each cohort included in this study involved complicated data transformations and some creativity, given the coding and presentation of the original data set provided by ACT. Data were provided by American College Testing as 3-digit numerical codes representing expressed choice of major for each participant and UNIACT normed scores for each career area. These original data were

transformed into three-letter Holland codes for expressed interest in major and measured interest as previously described. The rank-ordering for UNIACT normed scores was performed using statistical procedures in an Excel file. Participants with UNIACT scores that were “tied” or equal for different career areas (e.g. *Realistic* normed score = 85 and *Artistic* score also =85 and these two scores are the highest among the six career areas) were not included in the final sample for this study. Potential choices for dealing with “tied” scores included randomly choosing a “winner” to represent participants’ Holland area, developing a consistent strategy for winning such as alphabetical order, or removing these “tied” scores from the final data set. It was decided to remove the ties because, given the size of the original data, a decrease in number of participants was not likely to significantly affect results. Additionally, the other solutions for dealing with ties may have produced arbitrary changes in the make-up of the data set (e.g. an inaccurate representation of the distribution of a particular career area that either “won” or “lost” ties consistently). A total of 3,979 participants were removed from the final data set due to a tie between 1<sup>st</sup> and 2<sup>nd</sup>, or 2<sup>nd</sup> and 3<sup>rd</sup> letter UNIACT scores. The final data set included 31,021 participants (1974-1975 n = 4504, 14.5%; 1980-1981 n = 4102, 13.2%; 1985-1986 n = 4460, 14.4%; 1990-1991 n = 4590, 14.8%; 1995-1996 n = 4382, 14.1%; 2000-2001 n = 4505, 14.5%; 2004-2005 n = 4478, 14.4%). Participants remained relatively evenly distributed across years included in the study after ties were removed (equal distribution across 7 cohort years would be approximately 14.29% of the total sample for each year).

After UNIACT ranked scale scores and major choice data were transformed to Holland three-letter codes, these three-letter codes were again transformed into numerical codes where *Realistic* = 1, *Investigative* = 2, *Artistic* =3, *Social* =4, *Enterprising* = 5,

*Conventional* = 6 (e.g. a UNIACT Holland code of SIA became 4, 2, 3). Next, an absolute difference score between UNIACT Holland Code number and major choice Holland code was calculated for each position in the three-digit Holland Code (e.g. if measured interest is SIA or 4, 2, 3 and expressed interest is SEI or 4, 5, 2, three difference scores are calculated; position one:  $4-4=0$ , position two:  $2-5=3$ , position three:  $3-2=1$ ). Possible difference scores were zero (an exact match for that position in the hexagon), one (a difference of one position), two (a difference of two positions), three (a difference of three positions), four (a difference of two positions), and five (a difference of one position).

Next, these difference scores were weighted according to the C-index formula. A weighted value of three was assigned to identical measured and expressed interest choices (difference score of zero), a weight of two was assigned for adjacent positions (a difference score equal to one or five), a weight of one was assigned for alternate codes (difference score = two or four) and a weight of zero was assigned for opposite codes (difference score = three). Following the previous example with difference scores of 0, 3, and 1, the weighted scores for each position in this example would be 3, 0, and 2. These weighted scores were then inputted into the C-index formula ( $C = 3(X_1) + 2(X_2) + 1(X_3)$ ) to calculate interest congruence for each participant. To continue the example described above, calculations using the weighted difference scores were computed as  $C = 3(3) + 2(0) + 1(2)$  so  $C=11$ .

To ensure accuracy of C-index calculations, data from each cohort year were randomly checked and hand calculations for interest congruence were compared to data-based computer calculations. For the example described above where measured interest = SIA and expressed interest = SEI, hand calculations would be conducted as follows: First position S=S so  $X_1=3$ , second position I is opposite E so  $X_2 = 0$  and third position A is

adjacent to I so  $X_3=2$ . According to the C-index equation, the resulting value is 11 and the described computerized approach to yielding results was accurate. The checks for participants in this study indicated consistently accurate C-index scores across sample years.

### *Data Analyses*

*General Trends in Measured and Expected Interests.* General trends in measured and expected interests were examined by exploring the distribution and frequency of participants' highest Holland career areas across time. Trends in distribution among the six Holland career areas were examined for both measured interests (UNIACT scores) and expressed interests (choice in major). The researcher looked at changes in the percentage of participants with high codes in each career area across time. We also examined differences between career areas. Researchers paid particular attention to those career areas that represent more traditional career areas for women (i.e. *Social* and *Conventional*) and career areas that represent less "traditional" major choices in science, technology, engineering, and math (STEM) fields (i.e. *Realistic* and *Investigative*).

*General Trends in Interest Congruence.* To examine trends in calculated interest congruence, the investigator used mean C-index statistics for each cohort. The researcher observed increases and decreases in interest congruence between years in the sample. Effect sizes were calculated for the differences found between mean indices of interest congruence across time. Moderate or large effect sizes could indicate support for observed changes in calculated interest congruence across time.

*Interest Congruence by Measured Career Area.* To further examine trends in interest congruence, each cohort group was divided into smaller groups representing participants' measured high point career area (first letter of UNIACT Holland code). Relative strengths,

weaknesses, and changes in mean interest congruence within each career area were examined by calculating effect sizes for observed differences across the breadth of the 30 years under study. The investigator also examined trends based on differences in interest congruence between the six Holland career areas.

*Major Choice by Level of Interest Congruence.* In 1999 Betz, Heesacker, and Shuttleworth attempted to replicate a 1981 study conducted by Wolfe and Betz which showed a strong relation between interest congruence and traditionality of career choices. Women with lower levels of interest congruence were more likely to choose “traditional” careers to pursue. In the more recent study, Betz et al. found 27 percent of women expressed interest in traditionally male fields, 29 percent in female dominated fields and 44 percent in gender neutral careers. Despite previous findings regarding interest congruence, these researchers found interest congruence to be consistent across career choices (1999). The primary researcher hoped to further investigate these findings to determine whether trends in major choice could be found based on level of interest congruence. To explore this possibility, participants from each year were divided into high, medium, and low levels of interest congruence and trends in expressed interest were examined within each category.

In our sample, participants with measured interest congruence between 14 and 18 (approximately one standard deviation or more above the mean interest congruence in this sample) were categorized as having “high” levels of interest congruence. Women with interest congruence one standard deviation or more below the mean interest congruence (interest congruence = 1-5) were categorized as “low” interest congruence levels. Women with interest congruence from 6-13 fell into the “middle” interest congruence category.

To examine expressed interests in major based on these interest congruence categories, the investigator conducted multidimensional chi-square tests. These analyses allowed the investigator to determine whether the distribution of participants' major choices within each interest congruence level reflected the distribution of interest congruence for the larger (entire) cohorts. These analyses also facilitated examination of trends based on the percentage of participants within each interest congruence level who expressed interest in each career area across time.

*General Trends in Achievement.* Statistical analyses were conducted to determine whether interest congruence and expressed interests in major among college bound women were differentially distributed based on experience factors. Previous research has shown an indirect relation between ACT Math and Science composites and choice of a math or science major in college, mediated by self-efficacy variables (Nauta & Epperson, 2003). For the purposes of this study, the researcher divided students into low, middle, and high achievement groups based on their Mathematics ACT scores. Mathematics scores were used because a high score on the math subtest is reflective of a student who is likely to achieve well in math and science related fields, and math scores are a more true representative of these logic and analytical capabilities than science scores which are illustrative of verbal abilities to understand and respond to written information (Harmston & Pilska, 2001).

Participants from each sample year were divided into high, middle, and low achieving math rankings based on their performance. In our sample, participants who scored one standard deviation or more above national average scores ( $\bar{X} \approx 21, SD \approx 5$ ) on the math subtest were categorized in the "high" math achievement group (math score = 26-36).

Participants with mathematics scores between 0 and 15 (approximately one standard

deviation or more below the mean math score) were categorized as having “low” levels of interest congruence. Women with math scores from 16-25 fell into the “middle” math achievement category.

After participants were divided into the three groups based on ACT math performance, both expressed interest in college major and interest congruence were examined within each achievement category. To examine trends in expressed interest among math achievement categories, the researcher performed multi-dimensional chi-square tests for each cohort year under study. These tests allowed the investigator to determine whether there were differences in the distribution of expressed interests in college major based on achievement level. Trends within and between math achievement groups were examined across time. To examine trends in interest congruence among math achievement categories, the investigator used mean interest congruence levels and calculated effect sizes for differences between and within math achievement groups across time.

*Alternative Methods to Examine Interest Congruence.* A secondary goal of the present study was to examine the efficacy of the C-index as a measure of interest congruence. The C-index certainly allows researchers to examine congruence at the highest level of specificity by incorporating the match between all three Holland code letters as well as the strength of the comparison between Holland career area positions. However, while the C-index describes the construct of interest congruence well, this index is complicated and complex to calculate for a large data set. The researcher wished to examine whether differences could be found within this sample between interest congruence based on the C-index and a simple comparison of the first letter of participants’ Holland codes for expressed and measured interests (referred to as a *matching method*).

The researcher conducted multi-dimensional chi-square tests to compare the proportional distribution of individual's expressed interests for college major within each measured interest career area. Using these statistics the researcher examined the distribution of expressed major choice represented by first letter of Holland code within each Holland career area category of measured interests (matching method). The investigator then compared this distribution to the distribution of interest congruence calculated with the C-index among UNIACT Holland codes.

To summarize, the current research focuses on multiple exploratory issues with particular emphasis on the following goals:

- To assess changes in college-bound women's expressed vocational interests and measured vocational interests across time.
- To explore the distribution of interest congruence among college-bound women across time and across Holland career areas.
- To examine differences in patterns of expressed and measured interests and interest congruence based on college-bound women's levels of achievement in math.
- To examine the appropriateness of the C-index as a measure of interest congruence in large-scale studies of this nature.

## Expected Results

This study is the first research endeavor to examine trends in interests and in interest congruence for college-bound women across time. The unique nature of the study including the large data sets, multiple cohort years, and nationally representative sample of college-bound women allows for examination of several trends for the first time. This study is an exploratory investigation and the investigator hopes to make descriptive statements regarding trends in expressed and measured interests, as well as interest congruence, that may guide future research in this area.

The researcher was able to make some predictions about expected results based on existing research related to women's interests in "traditional (mostly *Social* and *Conventional*)" career areas and research regarding women's intentions to pursue "non-traditional" science, technology, engineering, and math (STEM) careers (mostly *Investigative* and *Realistic* career areas). Summaries of expected trends within each are of this study are as follows.

### *Expected General Trends in Measured and Expressed Interest*

*Expected Expressed Interest in College Major Trends.* The investigator expected distributions of expressed vocational intentions for major choice to show increases, decreases and stability for different career areas across time, consistent with existing cohort research (Gore, Ruxton, & Maze, 2005). Women's expressed interests in *Social* career areas (traditionally female careers) were expected to account for the greatest proportion of interests across time. This interest area was expected to be relatively stable across time with some potential slight decreases in the proportion of participants from more recent cohorts.

Participants' expressed interest in *Enterprising* and *Investigative* career areas was expected to

reflect growing interest across time. Finally, the investigator expected interest in both *Conventional* (a very traditionally female career area) and *Realistic* career areas to be low for college-bound women across time. Typically, *Conventional* career areas may be considered to be more trade-based positions that are not well represented by college majors, even though interest in these career areas would be expected in a full national sample incorporating college-bound and non college-bound women. Interest in the *Realistic* career area was predicted to be low due to the traditionally male-dominated nature of those fields such as manufacturing and engineering. This researcher did, however predict that interest in *Realistic* majors would increase slightly across time and interest in *Conventional* majors might decrease.

*Expected Measured Interest Trends.* The investigator expected trends for participants' measured UNIACT interests to be similar to the trends that emerge for participants' expressed interests in major choices. Generally, the investigator expected highest interest to be measured in *Social* career areas, followed by *Artistic*, *Enterprising*, and *Investigative* interests, with *Realistic* and *Conventional* career areas showing the lowest degree of measured interest. Trends for measured interests across time were expected to be somewhat more stable than for expressed interests.

*Expected Trends in Interest Congruence Across Time.*

*Expected General Trends in Interest Congruence.* In general, the researcher expected societal changes in perceptions of women's acceptable career choices to be reflected in their interest congruence across time. Mean interest congruence for the cohorts in this study was expected generally to increase across time as women's measured and expressed interests become more closely matched.

*Expected Trends in Interest Congruence by Measured Career Area.* When examining trends in interest congruence more closely based on participants' measured interest in each of the six Holland career areas the researcher expected to see some differentiation of interest congruence results between these career areas. The direction and degree of these differences between career areas across time were somewhat difficult to predict because interest congruence has never been examined in this long-term, cohort sample manner. The researcher expected to see some increases in level of interest congruence for those career areas that represent non-traditionally female choices of major such as *Investigative* and *Realistic* career areas. It was predicted that interest congruence for more traditional major choices for women, *Social* and *Conventional*, would likely be stable or might actually decrease across time as less women express interest in these types of majors, even though they may continue to follow gender-normed interests when interests are captured by an interest assessment. In general the investigator believed that career areas such as *Social*, *Artistic* and *Enterprising* areas that have always been acceptable for college-bound women would show high levels of interest congruence across time. Women who express interests in majors in these areas are likely to do so in accordance with their vocational "personality" and were likely to have done so at any point in time, since there has never been much stigma attached for women expressing interests in these areas. The researcher expected to observe the lowest levels of interest congruence across time for women with measured interests in the *Realistic* career area because women historically would not be likely to express interest in entering these majors and prevalence of female expressed interest has been low.

*Expected Trends in Major Choice by Level of Interest Congruence.* When examining choice of major according to level of interest congruence, the researcher expected that

participants with high levels of interest congruence would be more likely to be widely distributed between career areas. The investigator expected these women to express interests across all majors, including those majors that describe non-traditional career choices for women. Women with lower levels of interest congruence were expected to have less broadly distributed expressed interest. These women would likely choose majors that reflected more “traditional” career areas for women, likely a result of personal and social pressures, and lack of individual identity development for these women.

#### *Expected Results Based on Achievement Level*

##### *Expected Trends in Expressed Interest in College Major based on Achievement Level.*

The researcher expected to find differences in college-bound women’s expressed interest in college major career areas based on level of math achievement. It was expected that women who score higher on the math portion of the ACT exam are more likely to express interest in majoring in STEM-related fields than women with lower scores. The investigator proposed that women in the high achieving math group would express interest in *Investigative* and *Realistic* majors than middle and low-achieving women. These interests for high-achieving women were expected to increase across time. It was expected that the middle-achieving group would account for the majority of participants in this study and that their interest in college majors would reflect proposed results for general trends in expressed interests across time. Finally, it was expected that women in the low-achieving math group would likely express interests in more traditionally “female” career areas such as *Conventional* and *Social* areas with greater frequency across time than the other two achievement level groups.

*Expected Trends in Interest Congruence based on Achievement.* The researcher also expected to find differences in interest congruence for high, middle, and low achieving

females based on ACT mathematics subtest scores across time. Based on previous findings, it is likely that high achieving women in math and science will express interest in STEM-related fields with greater frequency than low-achieving women. The researcher would then expect interest congruence for these higher achieving women to illustrate the societal changes described above more strongly than low-achieving women. High achieving women were expected to show higher and increasing interest congruence across time in STEM related career areas (*Investigative* in particular, and *Realistic*). For low achieving women, the investigator would expect more frequent expressed interests in majors that represent traditional women's career areas such as *Social* and *Conventional*. The researcher would also expect lower levels of interest congruence for these participants. It was also predicted that women with low math achievement would have more stable interest congruence across time than women with higher levels of math achievement. Women who have lower achievement may not be impacted as greatly by interventions and societal messages intended to increase women's participation in STEM fields as high achieving women.

*Expected Findings for Interest Congruence Methods.*

When comparing the C-index as a measure of interest congruence to a simpler matching method, some differences across time are expected. It is expected, based on the literature and rationale for the C-index as a measure of interest congruence, that this index will produce more thorough results that will allow the investigator to make greater distinctions between levels of interest congruence than a simpler matching method. The C-index was predicted to measure interest congruence at a level of greater specificity than other methods. For this study, it was expected that the distribution of participants' interest congruence by measured career area would show similar trends across time for both methods

of interest congruence. However, it was expected that the distribution using the C-index might likely show more variation across time than a matching method for measuring interest congruence.

*Summary of Expected Results.*

The expected results for the current study can be summarized as follows:

- ◆ It is expected that general trends in college-bound women's expressed vocational interests (as described by intent to pursue college majors) will include some differences across time within and between Holland career areas. It is expected that these differences will reflect moderate changes across time particularly for the *Social*, *Realistic*, and *Investigative* career areas.
- ◆ The researcher expects general trends in college-bound women's measured vocational interests (using Holland codes from the UNIACT interest inventory) to reflect changes across time similar to those found for expressed interests in college major.
- ◆ It is expected that the C-index of congruence will show differing levels of congruence for college-bound women across time. This index is expected to highlight a specific measure of interest congruence.
- ◆ The investigator expects there to be differences in the level of measured interest congruence using the C-index both within and between measured Holland career areas.

- ◆ The investigator also expects that participants' level of interest congruence will show differing patterns of expressed interests in college major across time.
- ◆ It is expected that the distribution of college-bound women's expressed interests in college major will show different trends based on their level of math achievement as measured by math score on the ACT assessment.
- ◆ The investigator also expects to find differences in the level of interest congruence for women across time within and between levels of math achievement.
- ◆ It is expected that the C-index as a measure of interest congruence will demonstrate trends that are similar to, but different than trends in interest congruence found using a simple matching method.

These expected results are based on existing literature on women's career development, women's interests in math and science pursuits, and interest congruence. Actual results may show some unexpected patterns that can provide information about the nature of women's career development and trends in women's vocational interests.

## Results

### *General Trends in Measured and Expressed Interest*

As described, one of the purposes of this study was to examine trends in measured and expressed interests for college-bound women across time. The investigator hoped to understand how women's interests have been distributed between career areas and how this distribution has changed across time.

*Expressed Interest in College Major.* As addressed, expressed interest in college major was assessed through the use of ACT Student Profile Section, in which students indicate the field in which they intend to major in college. Students in this study were only those who indicated they were “fairly” or “very” sure of their college major. The investigator was interested in examining trends in these expressed interests according to Holland career areas across time.

As seen in Table 1 and Figure 1, there are some observable trends and shifts in expressed choice of major over time. Between the 1974-1975 ACT test administration and the administration of 2004-2005, college bound women's expressed interest in *Realistic* college majors increased. This interest rose steadily across time with 1.8% (n=82) of participants choosing *Realistic* college majors in the 1974-1975 cohort increasing to 3.2% (n=144) of women in 2004-2005. This proportion remains small but represents a growing shift in this area of interest. Conversely, expressed interest in the more traditional *Conventional* career area decreased from 6.4% (n=290) of women in 1974-1975 to 1.9% (n=85) in 2004-2005.

Table 1.

*Percent of Women with Expressed Interest in Career Areas across Time.*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
Realistic	1.8	1.7	1.9	2.1	2.4	3.2	3.2
Investigative	29.5	32.8	28.1	34.5	40.2	39.2	40.3
Artistic	10.6	8.3	7.4	6	6	9.3	8.4
Social	37.3	27.4	25.7	30.8	31.9	29.1	30.8
Enterprising	14.3	24.4	29.3	22.5	16.7	16.8	15.4
Conventional	6.4	5.4	7.6	4.2	2.7	2.3	1.9

Another interesting trend can be observed in the *Social* and *Enterprising* career areas. Interest in *Enterprising* career areas appeared to peak in the 1985-1986 testing year with 29.3% (n=1305) of women expressing interest in corresponding majors and then steadily decrease and plateau to between approximately 15 and 17% of women in the last 10 year period investigated. Interest in the *Social* college major choices followed a reverse pattern across the same time. Thirty-seven point three percent (n=1682) of women expressed interest in this career area in 1974-1975. Interest in college majors described by the *Social* career area dropped to 25.7% (n=1146) of women in 1985-1986 and then increased back to 30.8% ((n=1380) of women expressing interest in majors described by the *Social* career area by 2004-2005.

The career area with the most significant increase in the proportion of participants expressing a major choice was the *Investigative* career area. From the 1974-1975 test administration to the 2004-2005 year, the proportion of participants who expressed interest in majoring in an *Investigative* career area increased steadily from 29.5% (n=1328) of college-

bound women to 40.3% (n=1805). After the 1985-1986 testing year, the *Investigative* career area consistently captured the largest proportion of participants' interests. This suggests an expansion of women's possible career choices. It appears reflective of societal shifts in expectations for women to pursue more traditional social career areas to acceptance of women in traditionally male-dominated scientific and intellectual fields.

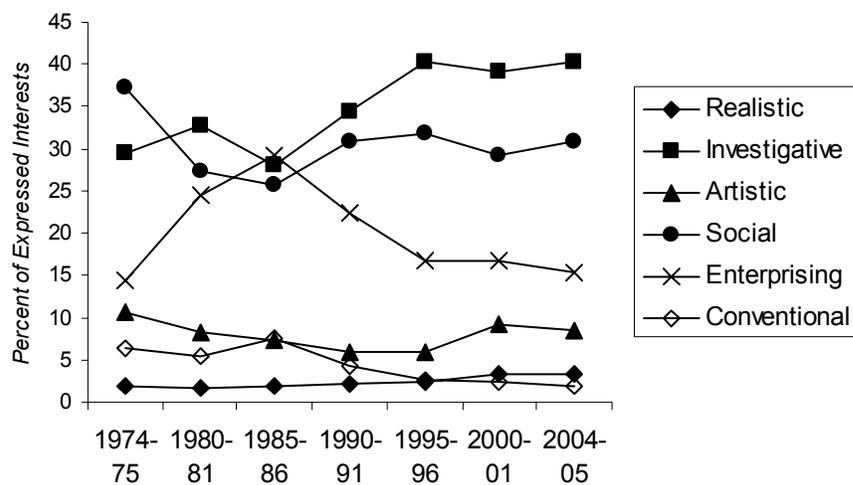


Figure 1. *Expressed Interest in College Major Across Time*

*Measured Interests.* Measured interests were assessed using the Unisex Addition of the ACT Interest Inventory (UNIACT). Proportions of college-bound women with measured high-point interests across Holland career areas are listed in Table 2. Several trends in measured interests of college-bound women can be identified over time. First, it should be noted that when examining the first sample included in this study, 1974-1975, measured interests are almost evenly divided among participants, with each career area capturing a similar proportion of students (range from 15.1% n=678 for *Realistic* to 21.6% n= 974 for

*Investigative* measured interests). This cluster of interests is more likely a reflection of norming issues for early versions of the UNIACT assessment addressed earlier in this text, than an indication of a realistic distribution of measured interests. To attempt to examine more true changes in measured interests across time that are not influenced by testing biases, the investigator examined the trends occurring from the 1980-81 testing year through the final cohort sample in 2004-2005 (See Figure 2).

Table 2.

*Percent of Women with UNIACT Measured Interests in Career Areas across Time.*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
Realistic	15.1	7.6	3.3	4.6	8.4	7.2	10.0
Investigative	21.6	16.9	16.4	21.0	22.9	22.3	23.2
Artistic	15.9	17.7	17.2	13.4	14.2	19.7	18.9
Social	15.5	18.3	21.9	20.8	22.1	19.7	18.2
Enterprising	16.74	14.0	16.7	18.6	13.5	15.1	14.9
Conventional	15.5	25.4	24.6	21.6	18.9	16.0	14.8

Some interesting trends in measured interests emerge when examining career areas that encompass many of the “traditional” career areas for women. In the *Conventional* career area, there appears to be a steady decline in measured interests, from 25.4% (n = 1043) of women in 1980-1981 to 14.8% (n = 663) in 2004-2005. The same cannot be said for the other most traditionally female-dominated career area, *Social*. Proportions of women with measured interests in the *Social* career area have increased and decreased slightly across time, with no apparent meaningful net change. This proportion of women with measured

interests in a *Social* career area rose from 18.3% (n = 749) in 1980-1981 to 22.1% (n = 968) in 1995-1996 and then decreased again to describe 18.2% (n = 815) of the 2004-2005 sample. Similarly, the proportion of women with measured interests in the *Artistic* career area decreased from 17.7% (n = 727) in 1980-1981 to a low point of 13.4% (n = 613) of women in the 1990-1991 testing year and then rose again to represent 18.9% (n = 848) of participants in the 2004-2005 sample.

The *Realistic* and *Investigative* career areas are most often used to describe the traditionally more male-dominated science, technology, engineering, and mathematics (STEM) fields. There was a slight net increase in the proportion of women who measured with strongest interests in both of these career areas across time. The *Realistic* career area consistently encompassed the lowest proportion of women across each year. However, the proportion of women who measured with interests in this area decreased from 7.6% (n = 312) in 1980-1981 to 3.3% (n = 148) in 1985-1986 and then steadily rose until it described measured interests for 10.0% (n = 447) of women by 2004-2005. The proportion of women with measured interests in the *Investigative* career area rose from 16.9% (n = 695) in 1980-1981 to 23.2% (n = 1037) in 2004-2005. Beginning in the 1995-1996 cohort, the proportion of women with measured interests in the *Investigative* career area was greater than the proportion of women in both the *Social* and *Conventional* career areas. In fact, the *Investigative* career area included the highest proportion of women across all six career areas from this time through the end of time under study. These results demonstrate some notable shifts in the distribution of measured career interests across career areas over time.

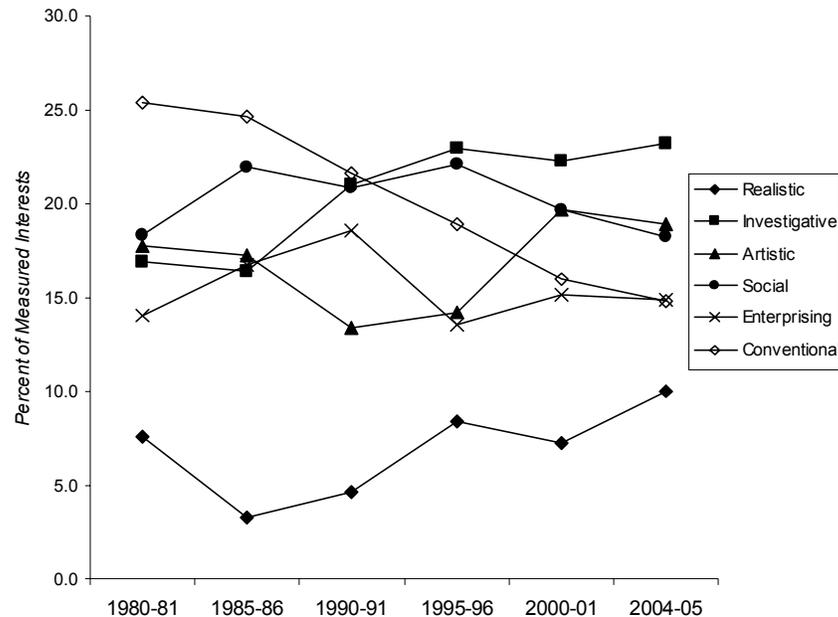


Figure 2. *Measured Career Interests across Time*

#### *Interest Congruence across Time.*

A central purpose of this study was to examine various trends related to interest congruence across time. The researcher explored trends in the C-index as a measure of interest congruence for college-bound women across time. Patterns in interest congruence were then examined based on participants' measured Holland career areas and expressed interest in major choice was then investigated based on level of interest congruence. Results are as follows.

*General Trends in Interest Congruence.* The C-index as a measure of interest congruence ranges from zero to 18 with an index of zero representing no match between measured and expressed interests and an index of 18 indicating the strongest level of interest congruence and equally matched expressed and measured interests across the three Holland

code digits. The C-index of interest congruence was relatively stable across time ranging from the lowest mean interest congruence of 10.24 (cohort n = 4478) in 2004-2005 to the greatest mean interest congruence score of 10.81 (cohort n = 4460) in 1985-1986 (See Table 3). Effect sizes for the differences in mean interest congruence between years were very small ranging from an effect size of .01 for the difference in interest congruence means between the 1995-1996 and 2000-2001 samples to the strongest effect size of 0.16 for the difference in mean levels of interest congruence between the 1980-1981 sample and the 1985-1986 sample. The effect size for the total change in interest congruence between the 1974-1975 ( $\bar{x}=10.61$ , n=4504) participants and the 2004-2005 ( $\bar{x}=10.24$ , n = 4478) sample was 0.1, indicating that very small differences in means occurred across time. These very small effect sizes indicate that the differences in interest congruence across time do not appear meaningful and interest congruence as measured by C-index is a generally stable construct.

Table 3.

*Mean Interest Congruence across Time*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
Mean	10.61	10.25	10.81	10.43	10.3	10.33	10.24
Standard Deviation	3.876	3.569	3.556	3.651	3.648	3.669	3.733
Participants (n)	4504	4102	4460	4590	4382	4505	4478

*Interest Congruence by Measured Career Area.* The investigator further examined potential trends in interest congruence by dividing participants into career area groups that

represented their highest measured interest career area according to UNIACT results. As shown in Table 4, interest congruence appeared mostly stable across time within each measured career area. Any observed changes were generally slight decreases in congruence over time and effect sizes were very small to moderate for these changes.

While the changes in interest congruence within career area generally appear small, some moderate effect sizes were found for changes in *Artistic*, *Social*, and *Conventional* career areas across time. Mean interest congruence decreased between the 1974-1975 participant cohort and the 2004-2005 group in all three career areas. The mean *Artistic* congruence decreased from 11.53 (n=718) in 1974-1975 to 10.63 (n=848) for the 2004-2005 cohort (ES for total change = 0.29). The mean interest congruence measured for the *Social* career area was 12.15 (n=697) in the 1974-1975 cohort and decreased to 10.88 (n=815) in 2004-2005 (ES for difference = 0.35). Finally, in the *Conventional* career area, mean interest congruence decreased from 10.27 (n=697) to 9.07 (n=663; ES for difference = 0.36) over time. Mean interest congruence increased only for the *Realistic* career area with a change from 7.71 (n=678) in the 1974-1975 group to 8.42 (n=447) in 2004-2005. This difference yielded a small effect size of 0.20 representing a modest but interesting change in interest congruence for the *Realistic* career area across time. This apparent increase in mean interest congruence is worth noting, given the particular focus for this investigation on non-traditional career areas for women including the *Realistic* career area.

Table 4.

*Mean Interest Congruence by Measured Career Area.*

UNIACT	1974-75	1980-81	1985-86	1990-91	1995-95	2000-01	2004-05
<b>Realistic</b>							
Mean	7.71	7.92	7.68	8.31	8.31	8.18	8.42
Std Dev	3.709	3.38	3.638	3.413	3.526	3.58	3.363
n	678	312	148	212	366	325	447
<b>Investigative</b>							
Mean	11.53	11.14	11.15	10.96	11.39	11.56	11.29
Std Dev	3.809	3.527	3.611	3.672	3.565	3.657	3.638
n	974	695	731	966	1003	1006	1037
<b>Artistic</b>							
Mean	11.53	10.61	10.82	10.56	10.45	10.61	10.63
Std Dev	3.206	3.16	3.143	3.032	2.949	2.924	3.041
n	718	727	766	613	623	889	848
<b>Social</b>							
Mean	12.15	11.08	11.12	11.04	10.97	10.7	10.88
Std Dev	3.637	3.446	3.603	3.564	3.6	3.61	3.676
n	697	749	975	956	968	887	815
<b>Enterprising</b>							
Mean	10.04	10.46	11.02	10.46	10.13	10.05	9.71
Std Dev	3.761	4.097	3.957	4.357	4.251	4.298	4.46
n	740	576	743	852	592	679	668
<b>Conventional</b>							
Mean	10.27	9.38	10.56	9.67	9.09	9.06	9.07
Std Dev	3.409	3.192	3.219	3.115	3.126	3.11	3.329
n	697	1043	1097	991	830	719	663

While interest congruence within measured Holland career areas remained mostly stable across time, there were interesting trends found in mean interest congruence between measured interest career area groups (See Table 4 and Figure 3).

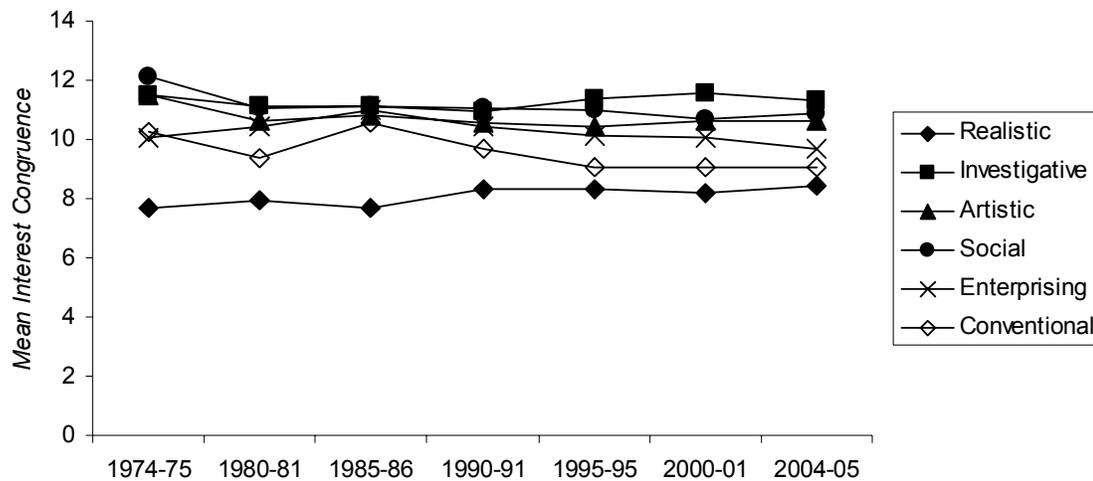


Figure 3. Mean Interest Congruence by Measured Career Area across Time

Several significant effect sizes were found for differences in mean interest congruence levels between career area groups. See Figure 4 for a representation of mean levels of interest congruence within each measured career area collapsed across time. Interest congruence for the *Realistic* career area was consistently significantly below the level of interest congruence for other career areas. The mean interest congruence found for the *Realistic* career area across time was 8.08 ( $n = 2488$ ). This level of mean interest congruence was lower than the mean for all other career areas with a moderate effect size for the difference between the *Realistic* and *Conventional* ( $\bar{x} = 9.59$ ,  $n = 6040$ ) career areas (ES for difference across time = 0.46) and strong effect sizes for the difference in mean interest congruence between *Realistic* and all other career areas (ES range from 0.55 for *Realistic-*

*Enterprising* difference to 0.89 for the difference between the *Realistic* and *Investigative* career areas). The *Conventional* career area, with a mean interest congruence level of 9.59 (n = 6040), had the next lowest mean interest congruence across time. This was found to be significantly different from the mean interest congruence for *Investigative* ( $\bar{x} = 11.29$ , n = 6412), *Social* ( $\bar{x} = 11.13$ , n = 6047) and *Artistic* ( $\bar{x} = 10.74$ , n = 5184) career areas. Effect sizes for the difference between each of the three areas and the *Conventional* career area were moderate (ES = 0.50, 0.45, and 0.37, respectively). Mean interest congruence levels for the other 4 career areas; *Investigative*, *Artistic*, *Social*, and *Enterprising*, were relatively similar across time ( $\bar{x}$  ranged from 10.27 to 11.29). Effect sizes for differences among mean interest congruence for these areas were very small ranging from 0.12 (*Artistic* and *Social*) to 0.26 (*Investigative* and *Enterprising*).

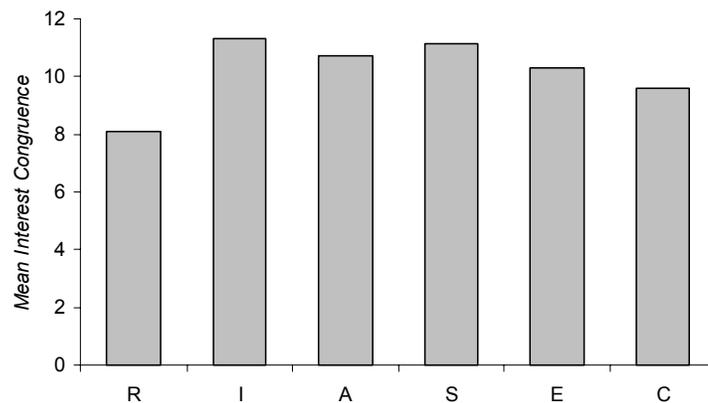


Figure 4. *Mean Interest Congruence by Measured Career Areas Collapsed Across Years*

*Expressed Interest in College Major by Level of Interest Congruence.* The researcher divided the sample for each year into high, medium, and low levels of interest congruence to

examine participants' major choice within these levels. Participants with measured interest congruence between 14 and 18 were categorized as having "high" levels of interest congruence. Women with interest congruence from 1 to 5 were placed in the "low" interest congruence group. Participants with interest congruence from 6-13 fell into the "middle" interest congruence category. Participants were not evenly distributed between categories. The "low" interest congruence category captured approximately 9% of participants each year (range from 8.17%-9.47%; total low congruence n = 2712), the "high" category included approximately 21% of participants each year (from 18.58% to 24.09%; total high congruence n = 6518) and the "middle" category included the most participants, approximately 70% each year (range from 66.59%-72.33%; total middle congruence n = 21791).

To examine whether differences in major choice were present between interest congruence level groups, multi-dimensional chi-square tests were performed. These tests allows the researcher to determine whether the distribution of expressed interests in college major choice among Holland career area varies based on level of interest congruence. These investigations compare the obtained distribution of major choice for each of the three levels of interest congruence (low, middle, high) to the distribution that would be expected based on the entire sample's distribution each year. The statistically significant ( $p < 0.001$ ) chi-square tests for each year indicated the distribution of major choices among Holland career areas was significantly related to level of interest congruence for each year under study (1974-1975  $\chi^2 = 182.70$ ; 1980-1981  $\chi^2 = 161.305$ ; 1985-1986  $\chi^2 = 346.69$ ; 1990-1991  $\chi^2 = 133.04$ ; 1995-1996  $\chi^2 = 66.28$ ; 2000-2001  $\chi^2 = 79.42$ ; 2004-2005  $\chi^2 = 129.01$ ; all years  $df = 10$ ,  $p < 0.001$ ).

Further analyses were conducted to examine the meaning of significant chi square tests. Goodman and Kruskal's tau was calculated as a measure of association. This statistic

reflects the decrease in the probability of error of guessing the value of the dependent variable when knowledge of participants' classification in the independent variable is taken into account (Goodman & Kruskal, 1954). The Goodman and Kruskal's tau coefficient was calculated to determine how well expressed interest in college major could be predicted based on level of interest congruence (high, medium or low). A value of one indicates a perfect ability to predict (knowledge of interest congruence level completely specifies Holland career area for expressed interest in college major), a value of zero means the independent variable is of no help predicting the dependent variable. Results indicate that, while there are significant differences in distribution shown by chi-square results, interest congruence level is not predictive of expressed interest in college major career area across time,  $\tau$  values are very small (1974-1975,  $\tau = .011$ ; 1980-1981,  $\tau = .007$ ; 1985-1986,  $\tau = .012$ ; 1990-1991,  $\tau = .005$ ; 1995-1996,  $\tau = .003$ ; 2000-2001 cohort,  $\tau = .002$ ; 2004-2005,  $\tau = .003$ . All measures are significant at  $p < 0.001$ ).

An additional  $\tau$  value was calculated to determine how well the distribution of level of interest congruence could be predicted based on expressed interest in college major. Again, a value of one indicates a perfect ability to predict, a value of zero means the independent variable cannot predict the dependent variable. Results demonstrate that, while there are significant differences in distribution shown by chi-square results, expressed interest in college major career area across time is not predictive of interest congruence level (1974-1975,  $\tau = .018$ ; 1980-1981,  $\tau = .021$ ; 1985-1986,  $\tau = .051$ ; 1990-1991,  $\tau = .014$ ; 1995-1996,  $\tau = .005$ ; 2000-2001 cohort,  $\tau = .008$ ; 2004-2005,  $\tau = .014$ . All measures are significant at  $p < 0.001$ ).

These chi-square tests indicate that there are differences in the distribution of participants' expressed interests in college major choice based on level of interest congruence. However, follow-up association tests show that these differences in distribution do not allow us to make predictions about either the level of interest congruence based on expressed college major, or expressed choice in college major based on level of interest congruence. The results from these association tests are not particularly surprising, we expect a difference in distribution of expressed interests in college major based on level of interest congruence, however, we would not expect the level of interest congruence to strongly predict expressed interests or vice versa. The investigator chose to further examine characteristics of the different distributions of expressed interest in college major based on level of interest congruence. The percentage of participants within each interest congruence level who expressed interest in majors from each career area is shown in Table 5. The multi-dimensional chi-square tests show this distribution is significantly different from the distribution of interests in the total sample for each level of interest congruence.

Interestingly, as seen in figures 5, 6, and 7, the trends for each career area across time follow relatively similar patterns of increases and decreases for low, middle, and high interest congruence groups. Career areas are also ordered in similar patterns; the *Investigative* career area consistently captures the greatest proportion of participants' interests after the 1985-1986 sample, followed by the *Social* career area, then *Enterprising*, followed by the *Artistic* career area. The *Realistic* and *Conventional* career areas consistently represent the smallest proportion of participants. These trends among low, medium, and high interest congruence groups are also similar to those found in the inclusive samples for each year (See Figure 1).

Table 5.

*Interest Congruence Level and Distribution of Major Choice.*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
Low							
Realistic	2.4	3.5	4.1	3.5	4.7	6	5.2
Investigative	25.7	38.1	40.8	45.9	40.9	41.4	43.2
Artistic	6.7	7.8	5.1	3.5	3.2	5	3.5
Social	54.8	35.9	28.1	31.7	40.9	32.4	34.7
Enterprising	8.6	10.7	18.8	13.6	9.1	14.5	13.2
Conventional	1.9	4	3.1	1.9	1.2	0.7	0.2
Middle							
Realistic	1.9	1.7	2.1	2.1	2.3	3.3	3.5
Investigative	28.9	33.6	29.4	34.9	41	38.6	40.4
Artistic	10.1	7.2	6	5.6	6	9.1	8
Social	38.7	26.8	25.6	31.5	31	30.1	32.1
Enterprising	15.4	26.8	32.4	22.8	17.3	17.1	14.7
Conventional	5	3.9	4.5	3	2.4	1.8	1.2
High							
Realistic	1.3	1	0.5	1.3	1.4	1.6	1.3
Investigative	32.5	26.8	20.7	28.6	37.2	40.4	38.5
Artistic	13.6	12.9	12.5	8.5	7.6	11.9	12
Social	26.9	25.6	25.3	27.8	30.9	24.3	24.6
Enterprising	13.5	22	22.8	24.7	18.3	16.8	18.6
Conventional	12.2	11.7	18.3	9.1	4.5	4.9	5

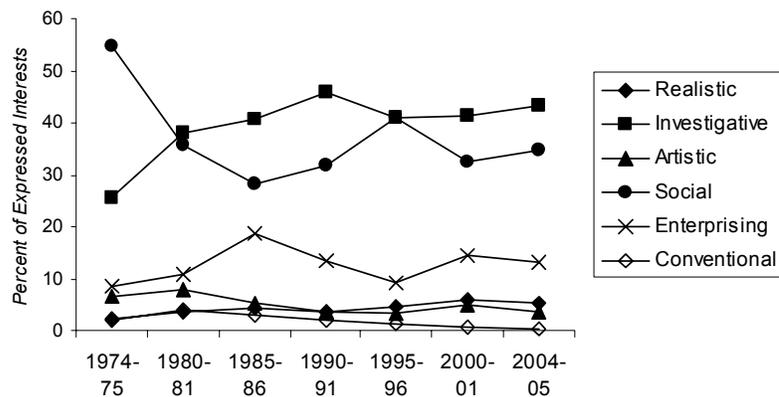


Figure 5. *Expressed Interest in Major for Low Congruence Participants*

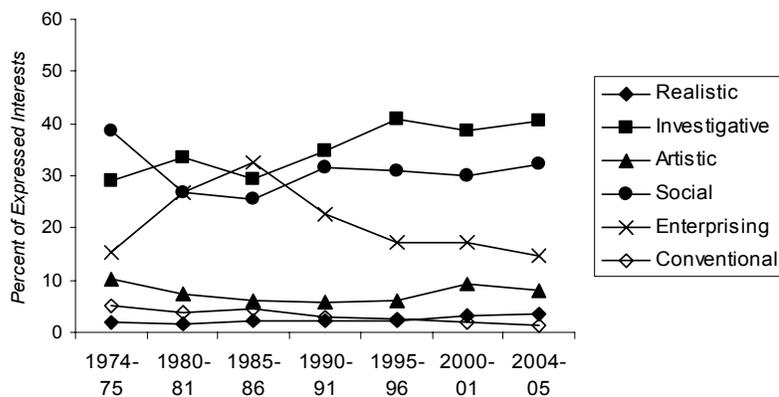


Figure 6. *Expressed Interest in Major for Middle Congruence Participants.*

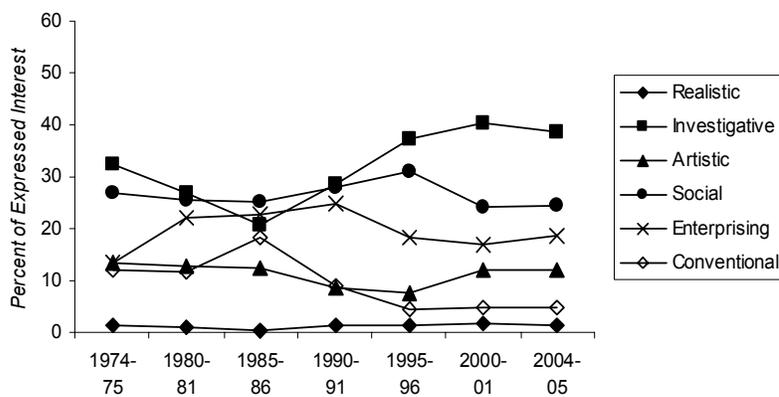


Figure 7. *Expressed Interest in Major for High Congruence Participants.*

Despite similarities among the patterns of distribution of expressed interest based on level of interest congruence, some differences in the proportion of individuals expressing interest in different career areas are worth noting. Generally, the high interest congruence group appears to be more broadly distributed among career areas; the career areas with the greatest proportion of individuals encompass smaller percentages than in the low and middle interest congruence groups and the career areas with the smaller proportions of interest include slightly larger percentages of individuals.

Also interesting is that, contrary to previous hypotheses (Betz et al., 1999) that women with high interest congruence would be more likely to express interests in less traditional career areas such as the *Realistic* and *Investigative* career areas, the reverse is actually true in this sample. In our sample, *Investigative* interests are strongest across all interest congruence levels. However, for the high interest congruence group the proportion of women represented by interests in *Investigative* career areas is lower ( $\bar{x}$ =32.1%, total n=2083; range is from 32.5%, n=353 in 1974-1975 to 38.5%, n=351 in 2004-2005) than for low and middle interest congruence groups. The proportion of women interested in *Investigative* careers is highest across time for the low interest congruence group ( $\bar{x}$ =39.4%, total n=1065; range is from 25.7%, n=108 in 1974-1975 to 43.2%, n=183 in 2004-2005) followed by the middle interest congruence group ( $\bar{x}$ =35.3%, total n=7697; range is from 28.9%, n=867 in 1974-1975 to 40.4%, n=1271 in 2004-2005). Similar trends are found when further examining the proportion of women interested in majors that fall into the *Realistic* career area. The low interest congruence group has the greatest proportion of women with expressed interest in the *Realistic* career area ( $\bar{x}$ =4.2%, total n=114; range is from 2.4%, n=10 in 1974-1975 to 5.2%, n=22 in 2004-2005), followed by the middle interest congruence

group ( $\bar{x}$ =2.4%, total n=532; range is from 1.9%, n=58 in 1974-1975 to 3.5%, n=110 in 2004-2005) across time. The high interest congruence group encompasses the smallest proportion of women with expressed interest in the *Realistic* career area ( $\bar{x}$ =1.2%, total n=78; range is from 1.3%, n=14 in 1974-1975 to 1.6%, n=15 in 2004-2005). The distribution of the mean proportion of individuals within each level of interest congruence by expressed interests in college major is shown in Figure 8. Examination of Figure 8 reveals, for example, that a summation of the percentage of expressed interests across the six Holland Code career areas within the low interest congruence category totals 100 percent; expressed interests of all women in the sample across all cohorts over time who were classified as low congruence are represented. In a similar fashion, summing the percent of respectively middle or high interest congruence expressed interests over the six career areas also yields totals representing all women in each congruence category.

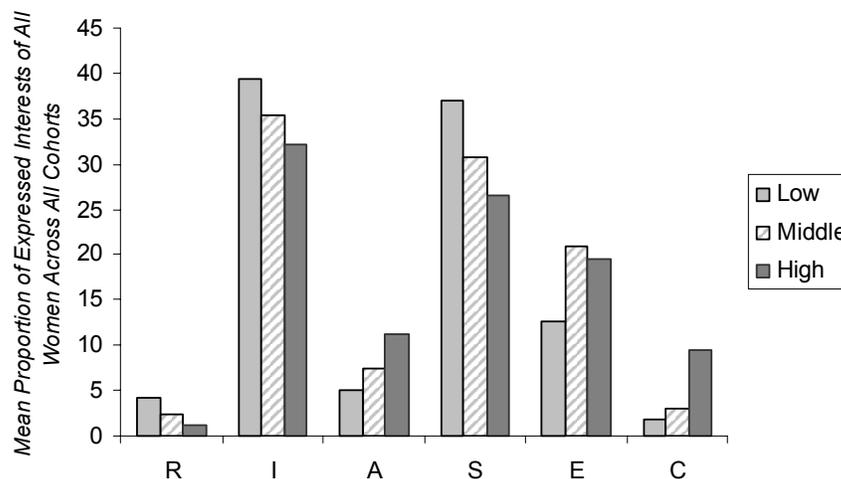
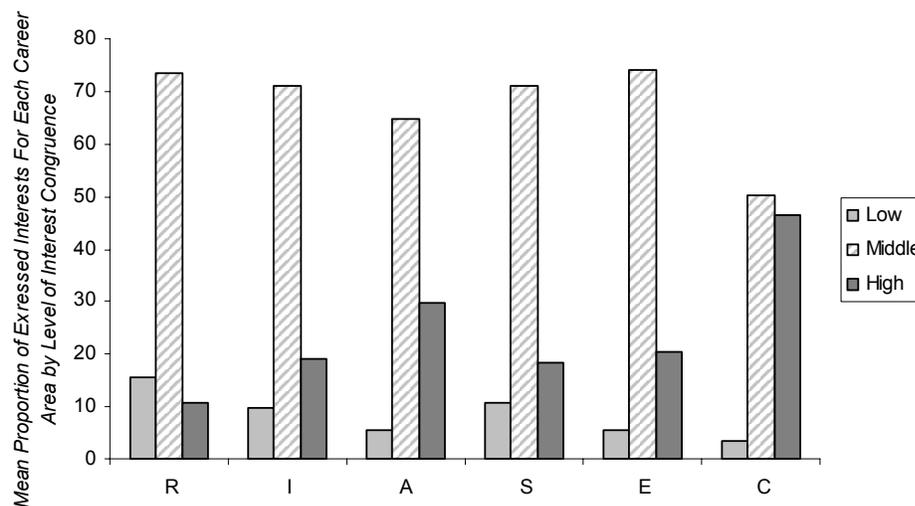


Figure 8. Mean Expressed Interests in Major by Interest Congruence Level  
Collapsed Across Years

A further exploration of expressed interest and congruence for all cohorts collapsed over time is provided by Alternative Figure 8. This figure depicts the proportion of all women, collapsed across all cohorts over time, who expressed interest in a given Holland career area delineated by level of congruence. For example, for all women in the study over all years who expressed *Realistic* interests in college major, over 70 percent were classified by the middle level of interest congruence, while less than 10 percent were classified as having high levels of interest congruence between expressed and measured interests.



Alternative Figure 8. *Percent of Expressed Interest in Career Area by Congruence Level Collapsed Over All Cohorts Across Time.*

### *Achievement*

The primary investigator for this study proposed to examine trends in expressed interests and interest congruence for college-bound women based on achievement as measured by the ACT math subtest. To examine achievement trends, participants from each sample year were divided into high, middle, and low achieving math rankings based on their

performance on the ACT math subtest. Participants who scored one standard deviation or more above national average scores on the math subtest were ranked in the “high” math achievement group. Participants who scored one or more standard deviations below the national average were categorized in the “low” math achievement group and all others were placed in the “middle” math achievement group. Participants were not evenly distributed between categories. The “low” math achievement category decreased from capturing 25.9% (n = 1165) of participants in 1974-1975 to 15.9% (n = 712) of participants in 2004-2005 indicating a general increase in participants’ level of performance over time. The “middle” math achievement category captured an increasing proportion of women over time. This “middle” math achievement group encompassed 60.7% (n = 2732) of participants in 1974-1975 to 72.4% (n = 3243) of the cohort in 2004-2005. The “high” math achievement category captured a total mean of approximately 11% of participants each year. This proportion decreased slightly from 13.4% (n = 603) of participants in 1974-1975 to 11.7% (n = 523) in 2004-2005. The overall distribution of all participants among the three categories across time was as follows: low math included 6,911 (22.3%) participants, middle math captured 20,635 (66.5%) of women, and high math included a total of 3,471 (11.2%) participants. Four women (0.01%) in the 1974-1975 cohort were not included in achievement categorization due to missing math scores.

*Achievement and Expressed Interest in College Major.* To examine whether differences in major choice were present between math achievement level groups, multi-dimensional chi-square tests were performed. This analysis allowed the researcher to determine whether the distribution of participants’ expressed interest in college major was different based on participants’ levels of math achievement. The multi-dimensional chi

square test allows the investigator to compare the distribution of interest in college major within each math achievement group to the distribution of expressed interest for the total sample. The significant chi-square tests from each year indicated participants' expressed choice in major were uniquely distributed based on level of math achievement (1974-1975  $\chi^2 = 105.21$ ; 1980-1981  $\chi^2=125.58$ ; 1985-1986  $\chi^2=128.21$ ; 1990-1991  $\chi^2=135.64$ ; 1995-1996  $\chi^2=99.80$ ; 2000-2001  $\chi^2=76.58$ ; 2004-2005  $\chi^2=80.96$ ; all years  $df=10$ ,  $p<0.001$ ).

Additional measures of association were completed to determine how well achievement level could predict participants' expressed interest in college major, as well as how well expressed interest could be used to inform expected level of math achievement. Goodman and Kruskal's tau was calculated for each year to determine how well expressed interest in college major could be predicted based on level of math achievement (high, middle or low). A value of one indicates a perfect ability to predict, a value of zero means the independent variable is of no help predicting the dependent variable (math achievement level is not predictive of expressed interest in college major). Results indicate that, while there are significant differences in distribution shown by chi-square results, the differences do not allow math achievement level to predict expressed interest in college major career area across time. All Goodman and Kruskal's  $\tau$  values are significant and very close to zero, no association (1974-1975,  $\tau = .008$ ; 1980-1981,  $\tau = .009$ ; 1985-1986,  $\tau = .009$ ; 1990-1991,  $\tau = .010$ ; 1995-1996,  $\tau = .009$ ; 2000-2001 cohort,  $\tau = .007$ ; 2004-2005,  $\tau = .006$ . All measures are significant at  $p<0.001$ ).

Goodman and Kruskal's  $\tau$  was also calculated to determine how well the distribution of level of math achievement could be predicted based on expressed interest in college major.

Again, a value of one indicates a perfect association; a value of zero indicates the independent variable cannot predict the dependent variable. Results demonstrate that, while there are significant differences in distribution between achievement level groups as shown by chi-square results, expressed interest in college major career area across time is not predictive of math achievement level (1974-1975,  $\tau = .007$ ; 1980-1981,  $\tau = .008$ ; 1985-1986,  $\tau = .008$ ; 1990-1991,  $\tau = .007$ ; 1995-1996,  $\tau = .006$ ; 2000-2001 cohort,  $\tau = .006$ ; 2004-2005,  $\tau = .005$ . All measures are significant at  $p < 0.001$ ).

These significant chi-square tests and measures of association do indicate that the distribution of participants' expressed interests in college major is different between math achievement level categories, even though the decrease in error probability is very small. To further explore the meaning of these significant chi-square tests the researcher examined the distribution of major choice within each level of math achievement ("low," "middle" and "high"). The percentage of participants each year within each math achievement level who expressed interest in majors from each career area is shown in Table 6.

Interestingly, the trends within each expressed career area across time follow relatively similar patterns of increases and decreases for low, middle, and high math achievement groups across time. Career areas are also ordered in similar patterns; for middle and high achievement groups, the *Investigative* career area consistently captures the greatest proportion of participants' interests, followed by the *Social* career area, these two interest areas are distributed in reverse order for the low math achievement group with *Social* expressed interests capturing a greater proportion of participants than *Investigative*. For all math achievement groups, the remaining four career areas are captured by *Enterprising* as the third highest proportion of women's interests in college major, followed by the *Artistic* career

area. The *Realistic* and *Conventional* career areas consistently encompass the smallest proportion of participants. These trends among low, medium, and high math achievement groups are also similar to those found in the total participant samples for each year and similar to trends observed according to interest congruence levels (Refer to Figures 1, 5, 6, and 7 for comparisons of trends).

Despite similarities, some differences in the proportion of individuals expressing interest in different career areas based on level of math achievement are of note (See Table 6 and Figures 9, 10 and 11). Generally, the high math achievement group appears to be much less evenly distributed among career areas than other levels of achievement. Expressed interests in the *Investigative* career area consistently account for almost half of participants in the high math achievement group (44.9%, n = 271 of participants in 1974-1975 to a high point of 53%, n = 232 of individuals in 1995-1996, decreasing again to 50.3%, n = 263 in 2004-2005). The proportion of individuals with expressed interests in *Investigative* majors is large but captures less of the samples across time for the middle and low math achievement groups. For the middle math achievement group, 28.3% (n = 773) of participants expressed interests in *Investigative* college majors in 1974-1975, this proportion increased substantially to 40.5% (n = 1313) in 2004-2005. Twenty-four point four percent (n = 284) of participants in the 1974-1975 low math achievement category expressed interests in an *Investigative* college major, increasing to 32.2% (n = 229) for the 2004-2005 cohort. For several career areas including the *Social*, *Enterprising*, and *Artistic* areas, the trends and shifts are similar across achievement groups and time but proportions of sample distribution are smallest in the high math achievement groups.

Table 6.

*Percent of Participants with Expressed Interest in Career Areas within Each Level of Math Achievement.*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
<b>Low Math</b>							
Realistic	1.6	2.2	2.3	2.1	2.7	3.5	3.9
Investigative	24.4	25.3	21.2	27.4	31.1	34	32.2
Artistic	10	8.3	8.3	5.9	5.2	8.9	7.6
Social	41.3	31.3	31	38	40.6	35.3	37.2
Enterprising	14.8	25.7	29.4	22.7	17.8	15.6	17.8
Conventional	7.9	7.1	7.8	3.8	2.7	2.8	1.3
<b>Middle Math</b>							
Realistic	1.8	1.5	1.8	2.1	2.1	3.2	3.1
Investigative	28.3	32.9	28.6	34.4	40.8	38.1	40.5
Artistic	11.6	8.6	7.2	6.1	6.3	9.7	8.4
Social	37.3	27.2	24.9	30.3	31.4	29.8	31.2
Enterprising	14.7	24.8	30	23	16.7	17.2	14.9
Conventional	6.4	5	7.6	4.1	2.7	2	1.4
<b>High Math</b>							
Realistic	2.5	1.5	1.2	2.1	3.4	3.3	3.3
Investigative	44.9	50.9	46.6	52.4	53	51.6	50.3
Artistic	7.8	7	6.1	6	5.7	7.7	9.4
Social	29.7	18.5	14.6	16.6	19.6	18.1	19.5
Enterprising	11.4	18.9	24	17.6	15.1	15.8	14.9
Conventional	3.6	3.1	7.5	5.3	3.2	3.5	2.7

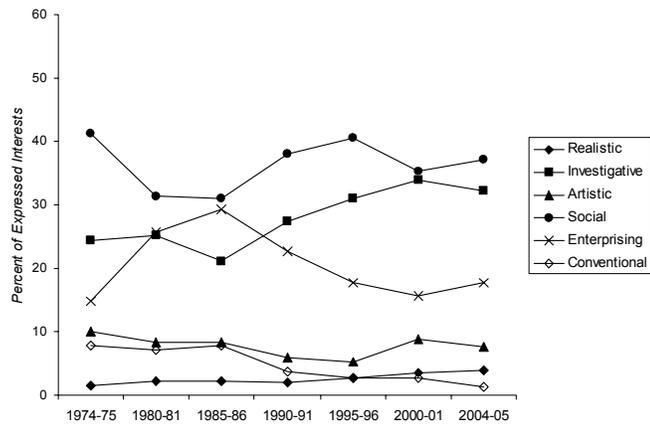


Figure 9. *Low Math Achievement Expressed Interests.*

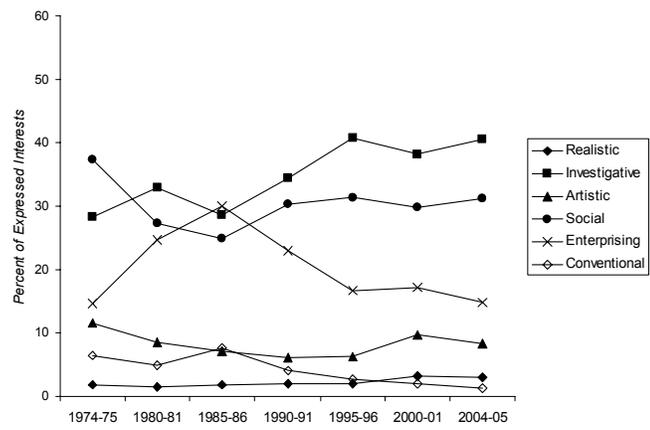


Figure 10. *Middle Math Achievement Expressed Interests*

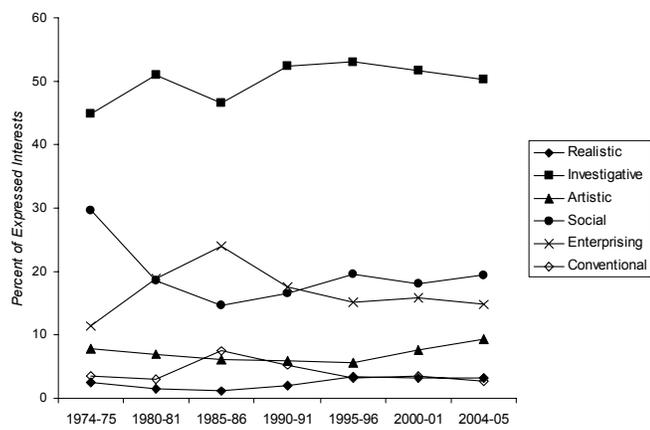


Figure 11. *High Math Achievement Expressed Interests*

As noted previously, in the low math achievement group, the majority of women consistently expressed interests in majors described by the *Social* career area. For the low math achievement group the proportion of women with expressed interests in *Social* careers was 41.3% (n = 481) of the 1974-1975 sample, down to 31.0% (n = 399) of these women in 1985-1986 and back to 37.2% (n = 265) of low math achieving women in 2004-2005. For the middle achievement group, these proportions were slightly lower; 37.3% (n = 1018) in 1974-1975 to 24.9% (n = 687) in 1985-1986, and 31.2% (n = 1013) of middle math achievement women in 2004-2005. Expressed interests in the *Social* career area represented even less women in the high math achievement group (29.7%, n= 179 in 1974-1975, 14.6%, n = 60 in 1985-1986, 19.5%, n = 102 for 2004-2005). To further explore the trends found in women's expressed interests in college major based on level of math achievement, means proportions of individuals in low, middle, and high math achievement groups with expressed interests in college major across career areas have been collapsed across time in Figure 12.

Examination of Figure 12 reveals, for example, that a summation of the percentage of expressed interests across the six Holland Code career areas within the low math achievement category totals 100 percent; expressed interests of all women in the sample across all cohorts over time who were classified as low math achievement are represented. In a similar fashion, summing the percent of respectively middle or high math achievement level expressed interests over the six career areas also yields totals representing all women in each achievement category. These distributions appear to fall as expected based on assumptions about women's interest in more "traditional" career areas and their math and science abilities.

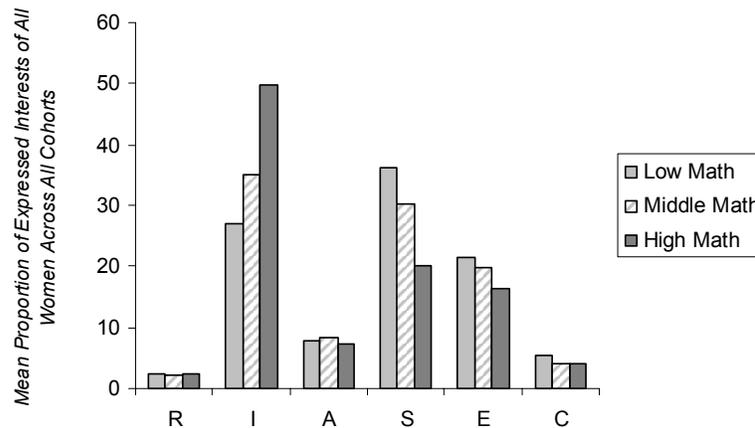
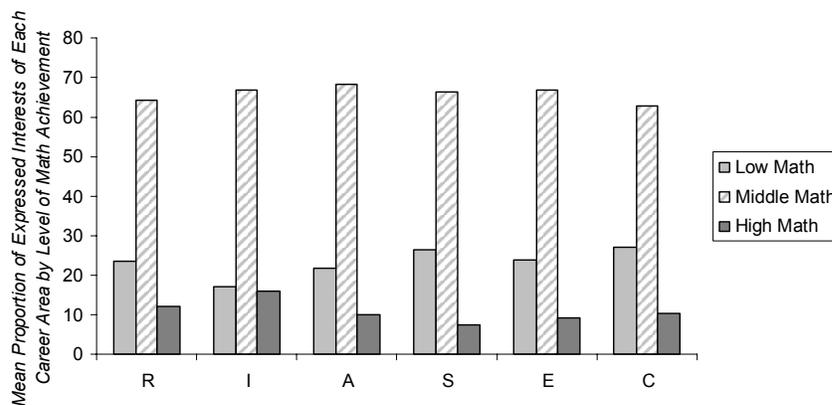


Figure 12. Mean Expressed Interests in Major by Math Achievement Level Collapsed Across Years.

A further exploration of expressed interest and achievement for all cohorts collapsed over time is provided by Alternative Figure 12. This figure depicts the proportion of all women, collapsed across all cohorts over time, who expressed interest in a given Holland career area delineated by level of math achievement. For example, for all women in the study over all years who expressed *Investigative* interests in college major, approximately 70 percent were classified by the high level of math achievement, while around 15 percent were classified as having low levels of math achievement.



Alternative Figure 12. Percent of Expressed Interest in Career Area by Math Achievement Level Collapsed Over All Cohorts Across Time.

*Achievement and Interest Congruence.* The researcher examined mean interest congruence when samples were divided by math achievement level. Interest congruence as measured by C-index for each achievement level is listed in Table 7.

Table 7.

*Interest Congruence by Math Achievement Level.*

	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
<b>Low Math Achievement</b>							
Interest Congruence	10.56	10.12	10.78	10.36	10.05	10.04	9.91
Standard Deviation	3.866	3.635	3.656	3.71	3.56	3.641	3.913
n	1165	1156	1287	1042	826	723	712
<b>Middle Math Achievement</b>							
Interest Congruence	10.58	10.25	10.8	10.45	10.31	10.33	10.28
Standard Deviation	3.837	3.55	3.525	3.631	3.693	3.667	3.702
n	2732	2492	2761	3115	3118	3174	3243
<b>High Math Achievement</b>							
Interest Congruence	10.9	10.61	10.93	10.44	10.73	10.69	10.41
Standard Deviation	4.055	3.498	3.449	3.651	3.448	3.688	3.65
n	603	454	412	433	438	608	523

Interest congruence for low, middle, and high math achievement groups was consistently similar across time with mean interest congruence scores among all three levels of achievement ranging from a low 9.91 (n = 712) on a scale from zero to 18 for the low math achievement group in 2004-2005 to the highest interest congruence of 10.93 (n = 412) for the high math achievement group in 1985-1986. Mean interest congruence follows the

same patterns of high and low points within each math achievement level with high interest congruence in the 1985-1986 year and low interest congruence found in 2004-2005. Only small effect sizes ( $ES = .08$  to  $.13$ ) were found for differences between interest congruence scores, indicating these mean levels of interest congruence are relatively stable within and between math achievement levels.

*Alternative Methods to Examine Interest Congruence.*

A secondary aim of the present study was to examine the appropriateness of the C-index as a measure of interest congruence for use in large-scale studies of this nature. The C-index is difficult to use as a measure of interest congruence in research because it is complicated and complex to calculate. The researcher wished to examine whether the authors' claims that the gains from accuracy of this method (Brown & Gore, 1994) outweigh the difficulties found in calculations of interest congruence in a large sample. The investigator also hoped to determine whether differences could be found within this sample between interest congruence based on the C-index and a simple "matching method" comparison of the first letter of participants' Holland codes for expressed to the first letter of measured interests Holland code.

*Matching Method.* To examine the match between the participants' expressed and measured interests as a comparison of paired high point codes for measured and expressed interests, the investigator conducted multi-dimensional chi-square tests. This allowed the researcher to determine whether participants' expressed interests in college major choice were differentially distributed among measured career interests. The test also allows for specific examination of this distribution within each career area. For purposes of the "matching method" the distribution of expressed interests in college major is of particular

interest within matching measured interest career areas (e.g. the proportion of individuals with expressed interests in *Realistic* college majors within those participants with measured *Realistic* career interests). The chi-square tests for each cohort showed a significant difference in the distribution of expressed career interests within each measured career area. These tests were significant for all years (1974-1975  $\chi^2 = 2277.15$ ; 1980-1981  $\chi^2=1156.26$ ; 1985-1986  $\chi^2=1993.32$ ; 1990-1991  $\chi^2=1512.47$ ; 1995-1996  $\chi^2=1420.38$ ; 2000-2001  $\chi^2=1304.54$ ; 2004-2005  $\chi^2=1367.64$ ; all years  $df=25$ ,  $p<0.001$ ).

Further measures of association were conducted to reveal more about the nature of the significant chi square tests. The Goodman and Kruskal's tau coefficient was calculated to determine how well expressed interest in college major could be predicted based on measured interest career area. A value of one indicates a perfect ability to predict (knowledge of measured interest career area completely specifies Holland career area for expressed interest in college major), a value of zero means the independent variable is of no help predicting the dependent variable. Results indicate that there is a small reduction in the probability of error for determining expressed interest in college major when measured interest career area is known. It appears that, across time, the strength of this association is small (at it's highest in 1974-1975 approximately 12%) and decreases. All Goodman and Kruskal's  $\tau$  values are significant with small association levels. (1974-1975,  $\tau = .115$ ; 1980-1981,  $\tau = .075$ ; 1985-1986,  $\tau = .111$ ; 1990-1991,  $\tau = .079$ ; 1995-1996,  $\tau = .084$ ; 2000-2001 cohort,  $\tau = .072$ ; 2004-2005,  $\tau = .066$ . All measures are significant at  $p<0.001$ ).

An additional  $\tau$  value was calculated to determine how well participants' expressed interests in college major according to Holland high point code can predict measured interest

in Holland career area. Again, a value of one indicates a perfect ability to predict, a value of zero means the independent variable cannot predict the dependent variable. Results show a similar pattern to those found for the reverse association. There appears to be a small decrease in the probability of error for predicting measured interest when expressed interest in college major Holland career area is known. This association decreased slightly across time (1974-1975,  $\tau = .105$ ; 1980-1981,  $\tau = .064$ ; 1985-1986,  $\tau = .108$ ; 1990-1991,  $\tau = .077$ ; 1995-1996,  $\tau = .072$ ; 2000-2001 cohort,  $\tau = .065$ ; 2004-2005,  $\tau = .067$ . All measures are significant at  $p < 0.001$ ).

These findings indicate a small proportion of predictability in the relation between expressed and measured interests as indicated by high point Holland codes. To examine how this association differs among specific career areas, the investigator focused within each measured career area at the percentage of participants each year who expressed interest in a major in the corresponding career area. These “matching method” results are shown in Table 8 and can be interpreted as follows. Between 2.8% ( $n = 19$ ) in 1974-‘75 and 6.9% ( $n = 31$ ) in 2004-‘05 of participants with a measured interest in the *Realistic* career area also expressed a college major choice in this career area. In the *Investigative* career area, participants with measured interests in this area were likely to express similar interests. From a low 62.6% ( $n = 605$ ; 1990-1991) to a high proportion of 69.5% ( $n = 697$ ; 1995-1996) of participants with measured interests in *Investigative* career areas also expressed interest in this area. Between 22% ( $n = 137$ ; 1980-’81) and 37.2% ( $n = 267$ ; 1974-’75) of individuals with measured *Artistic* interests also expressed interest in *Artistic* majors. For measured interests in the *Social* career area, 43.0% ( $n = 322$ ; 1980-’81) to a high 63.0% ( $n = 439$ ; 1974-’75) also expressed interest in *Social* college majors. Twenty-five point seven ( $n = 190$ ; 1974-’75) to

49.1% (n = 365; 1985-'86) of participants with measured interests in *Enterprising* also had expressed *Enterprising* interests. Lastly, participants with measured interests in the *Conventional* career area chose a matching college major between 9.3% (n = 77; 1995-'96) and 26.1% (n = 182; 1974-'75) of the time.

Table 8.

*Percent of Matching College Major Choice within Measured Career Areas.*

UNIACT %	1974-75	1980-81	1985-86	1990-91	1995-96	2000-01	2004-05
Realistic	2.8	5.1	4.1	5.2	6.6	6.5	6.9
Participants	19	16	6	11	24	21	31
Investigative	62.8	62.9	65.4	62.6	69.5	67.7	64.8
Participants	612	437	478	605	697	681	672
Artistic	37.2	22.3	25.8	22.3	22	24.2	25.4
Participants	267	162	198	137	137	215	215
Social	63	43	44.9	46.4	47.1	41.9	47.1
Participants	463	322	438	444	456	372	384
Enterprising	25.7	42.4	49.1	38.4	37.8	37.6	35.8
Participants	190	244	365	327	224	255	239
Conventional	26.1	12.8	22.3	14.7	9.3	10.4	10.4
Participants	182	133	245	146	77	75	69

When exploring these results, the researcher noticed significant changes in match from the 1974-1975 cohort to the 1980-1981 sample. These changes may be better accounted for by the changes in norming of the UNIACT assessment than by an accurate change in the interests of participants. Thus, as explained in previous results incorporating

the UNIACT assessment, the match from 1980-1981 through 2004-2005 was more closely examined (See Figure 13).

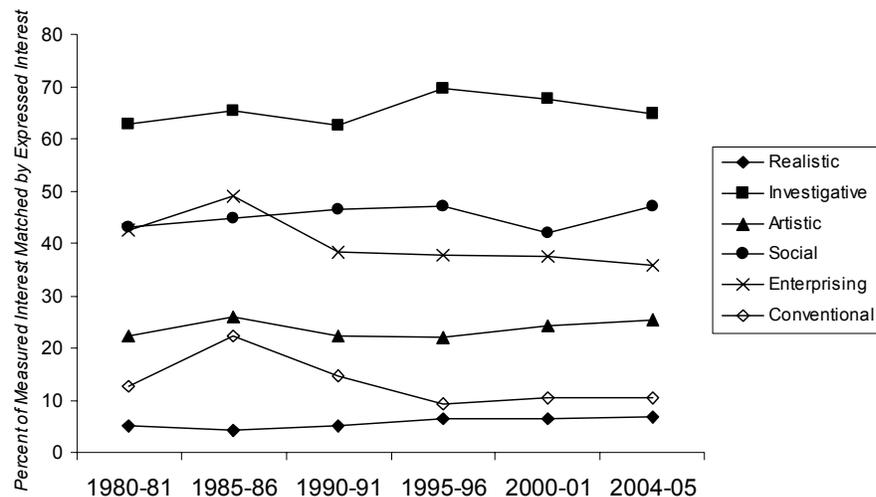


Figure 13. *Percent of Matching College Major Choice within Measured Career Areas.*

These results show that the congruence between measured interests and expressed interests was strongest for participants with measured interest in *Investigative* and *Social* career areas across time. For high *Investigative* measured interests, a mean of 65.48% (total  $n = 4182$ ) of participants also expressed interests in a college major within this career area across time. The mean proportion of matching interests in the *Social* career area was 45.07% (total  $n = 2879$ ) of participants with measured *Social* career interests who also expressed interests in this career area. Following these two career areas, the mean proportion of participants with matching measured and expressed interest ranged for the *Enterprising* career area was 40.18% (total  $n = 1844$ ). The next strongest match between measured high point career area and expressed interest area was in the *Artistic* career area ( $\bar{x} = 23.67$ , total

n = 1331) in 1985-'86), followed by the *Conventional* career area ( $\bar{x} = 13.32\%$ , total n = 927), and the *Realistic* career area ( $\bar{x} = 5.73\%$ , total n = 128). The mean proportion of individuals across time with matching expressed interests for college major within each measured interest area is shown in Figure 14.

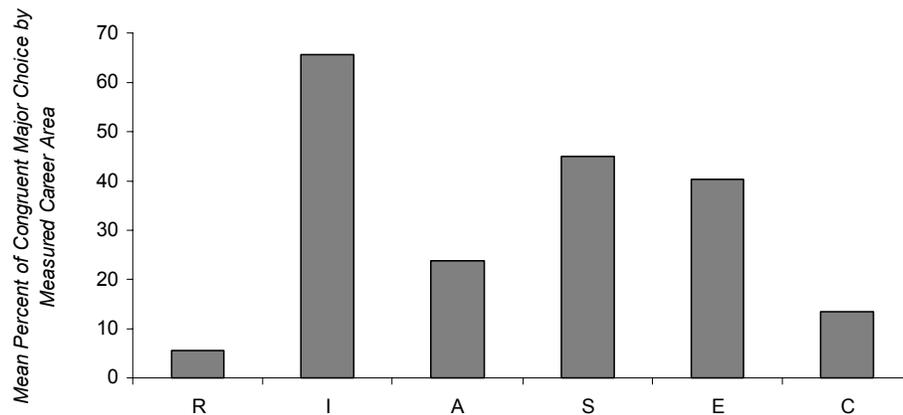


Figure 14. Mean Percent of Congruent Major Choice within Measured Career Area.

*C-Index and Matching Method.* To see how the less complex method of examining interest congruence by exploring the proportion of individuals with expressed interests that match each area of measured interests compares to the Brown and Gore (1994) C-index, the investigator made comparisons of the distributions of congruence within each measured interest career area. Because the methods are described using two different scales (C-index is a scale from zero to eighteen, matching method is a percentage), the mean levels of C-index within each career area were converted to a percentage for easier comparison of the two methods. Mean interest congruence scores were divided by 18 (the highest point on the scale) and multiplied by 100 to determine a mean percent of congruence for C-index

statistics. See Table 9 and Figure 15 for mean interest congruence levels of both methods. Also refer to Figures 3 and 4 and Table 4 compared to Table 8 and Figures 13 and 14 in previous sections of this text.

Table 9.

*Mean Interest Congruence for Two Methods by Measured Career Area.*

	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
C-Index as Percent	44.89	62.72	59.67	61.83	57.06	53.28
Matching Method	5.73	65.48	23.67	45.07	40.18	13.32

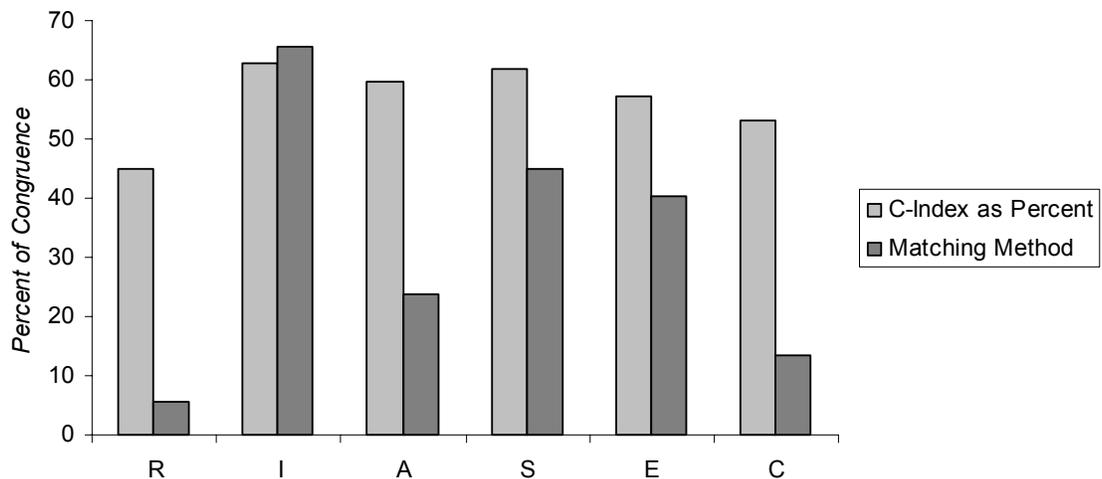


Figure 15. *Mean Interest Congruence for Two Methods by Measured Career Area.*

Some similarities and differences are identified in comparing these two methods. First, it appears that congruence using both methods was found to be relatively stable within measured interest career areas across time. Second, when comparing the mean level of

interest congruence found across time for each measured career area (See Table 9 and Figure 15), it appears that both methods show similar ordering of interest congruence by career area. Using the C-index method, the greatest mean interest congruence was found for *Investigative* measured interests, followed in decreasing order by *Social*, *Enterprising*, *Artistic*, *Conventional* and *Realistic* measured interests. Using the matching method, the rankings are similar, with the greatest mean interest congruence also found within *Investigative* measured interests, followed in decreasing order by *Social*, *Artistic*, *Enterprising*, *Conventional*, and *Realistic* measured interests. The only change in rankings occurred as a switch in the order of mean interest congruence for *Enterprising* and *Artistic* career areas, which are almost equivalent using the C-index. The most apparent difference between the two methods of evaluating interest congruence is evident in the breadth of distribution of mean interest congruence. Using the C-index method, while there are some differences among interest congruence for measured career areas, all career areas show similar levels of interest congruence. The difference in proportion of individuals who have expressed interest within each measured interest career area show much greater disparity in interest congruence among career areas when using the matching congruence method. The meaning of these results will be further explored in the discussion section of this text.

## Discussion

The information gathered in this study is intended to provide descriptive data about the nature of women's career development across time, particularly development within career areas in which women are traditionally underrepresented. An aim of this exploratory endeavor was to present a thirty year, cross-sectional description of trends pertinent to women's career development, as well as to explore the usefulness of statistical methods for understanding interest congruence over time. The results of this study have focused on multiple issues guided by the following goals:

- To assess general trends in college-bound women's expressed vocational interests and measured vocational interests across time.
- To explore the distribution of interest congruence among college-bound women across time using Brown and Gore's (1994) C-index. In addition to exploration of general trends in interest congruence across time, a secondary aim of this study is to examine the distribution of interest congruence based on participants' measured Holland career areas and to examine trends in expressed interest in college major based on level of interest congruence across time.
- To examine trends in expressed interests and interest congruence based on college-bound women's levels of achievement in math.
- To examine the appropriateness of the C-index as a measure of interest congruence in a large-scale vocational interest study.

This discussion will begin by exploring each of these goals separately. Overall results will then be synthesized and examined to make general conclusions based on the findings

within each goal area. Finally strengths, limitations, and implications of the results will be explored.

### *General Trends in Measured and Expressed Interests*

The first goal of this study was to assess general trends in college-bound women's expressed vocational interests and measured vocational interests across time. Results describing college-bound women's expressed interests in a college major indicate that, since 1974-1975, women's interests in various college majors have changed. The most "traditionally female" career area, *Social*, continues to capture a large proportion of women's interests across time. However, women's expressed interest in this area was surpassed by interests in the less traditional, science-based career area of *Investigative* by 1985 and the proportion of women with *Investigative* career interests has continued to increase since that time. Women's interest in the other traditionally female dominated career area, *Conventional*, has shown consistent decreases since the beginning of the time period under study, while interests in another male-dominated career area, *Realistic* have increased across time. The proportion of women with expressed interests in *Realistic* college majors remains small, however.

Two other notable career areas, *Artistic* and *Enterprising*, have also shown some interesting trends in women's expressed interest in college major. The proportion of women with interests in the *Artistic* career area has remained relatively stable across time, indicating that this area consistently captures a small but steady proportion of women's interests. College-bound women's interests in *Enterprising* career area peaked around 1985 when a large proportion of women expressed interest in this area. This proportion has shown steady decline since that time.

These shifts in women's expressed career interests over time indicate that expressed interest in college major is a dynamic, changing construct. Women's expressed interests may reflect societal shifts in norms and expectations, as well as expanding career options for women. However, making causal statements regarding these domains of career opportunities and societal investments is beyond the scope of the present study. The increase across time in interests for traditionally male-dominated career areas suggests that, whatever the reason, college-bound women are expanding the options of career areas they conceptualize as available to them to pursue.

Women's measured interests among career areas have also shown interesting shifts and trends across time. College-bound women's measured interests in both *Investigative* and *Realistic* career areas increased significantly across time, again indicating a shift in women's interests away from traditionally female dominated career areas. Measured interests in the *Investigative* career area surpassed measured interests in the *Social* and *Conventional* career areas by 1995 and this area continued to increase and capture the largest proportion of measured interests across time. Women's measured interests in the traditional *Conventional* career area showed significant decline across the years in this study. This career area shifted from capturing the largest proportion of women's interests in the 1980-1981 testing year to representing almost the smallest proportion of measured interests in 2004-2005, higher only than the *Realistic* career area. The *Social* career area, as expected, captured a significant proportion of women's measured interests across time. However, measured interests in this career area have been decreasing since the 1995-1996 cohort.

Women's measured interests in *Enterprising* and *Artistic* career areas showed some peaks and low points across time, but were generally consistently stable, representing a middle proportion of all women's measured interests across time.

These trends in expressed and measured interests across time indicate that college-bound women's career interests are changing and expanding. The increases for both expressed and measured career interests in non-traditional career areas indicate a continually changing context for women's career development.

#### *Interest Congruence across Time.*

The construct of interest congruence is of significant interest to the current study. Interest congruence is a statistical representation of one of John Holland's core tenets explaining career development; that satisfaction and persistence in career areas can be described by a match between an individual's career "personality" or measured interests and their work "environment" or expressed career intentions. This concept of Person-Environment fit has guided much of the research and theory in vocational development literature, but methods to study it have been varied and have yielded inconsistent results.

For this study, interest congruence was calculated using Brown and Gore's (1994) C-index formula. This method for examining interest congruence was chosen because it accounts for the match between each of the three letters of the Holland code for both measured and expressed interests. It incorporates the principles of Holland's career theory regarding the strength of the relationship between career areas (e.g. adjacent career areas are more congruent than opposite career areas).

The first goal of the present study regarding interest congruence was to explore the distribution of the C-index for all participants across time. Findings indicate that the C-index

as a measure of interest congruence is stable across time for college-bound women. The strength of interest congruence according to calculated C-index for all college-bound women in the present study was consistently found to be between 10.2 and 10.8 (on a zero to 18 point scale). This is slightly larger than the expected interest congruence mean of 9 (Brown & Gore, 1994). This finding indicates congruence between college-bound women's expressed interests in a college major and their measured vocational interests is a relatively stable construct. It appears that the interest congruence of college-bound women in this study is in the high middle range for congruence strength, indicating that college-bound women are likely to have some match between their vocational personality and intended work environment, but the match is not consistently strong.

When the interest congruence of college-bound women in this study was examined based on measured career interest areas, or vocational personality, some interesting trends emerged. First, it was noted that, within *RIASEC* career areas, women's level of interest congruence was relatively stable, providing further support for the stability of this construct. Decreases in interest congruence across time for *Artistic*, and the generally female-dominated *Conventional*, and *Social* measured career areas resulted in moderate effect sizes (ES range from 0.29 for the decrease in the *Artistic* career area across time to 0.36 for the *Conventional* career area). This trend suggests that women with measured interests in these career areas are expressing interests in college major choices that are consistent with their career personality less frequently than they have in previous years. This result may be reflective of shifts or some expansion in the career areas that women are likely to pursue, broadening potential options that are not congruent with measured interests. As indicated, across time

women may have become more likely to resist choosing careers that reflect traditionally held beliefs about women's options.

Women with measured interests in the *Realistic* career area expressed interest in increasingly congruent college majors to pursue across time. The effect size for this increase was small ( $ES = 0.20$ ), but observationally, appears to be a blossoming trend in women's interest congruence. If women with measured interests in *Realistic* career areas are indeed becoming more likely to express interests in these area, it would lend further support to the notion that less traditionally female-dominated career choices are becoming more acceptable for women to pursue.

In addition to examining interest congruence across time within career areas, there were interesting patterns found in mean interest congruence between measured career areas. The results indicate that interest congruence was relatively similar for the *Investigative*, *Artistic*, *Social*, and *Enterprising* career areas across time and the mean level of congruence ranged from 10.3 to 11.3 between these areas. This finding indicates interest congruence by career area is relatively similar but slightly stronger in these career areas than in the general population of college-bound women.

Interest congruence for women with measured interests in the *Conventional* and *Realistic* career areas was consistently lower than interest congruence for the other career areas. The mean interest congruence for the *Realistic* career area across time was found to be 8.08. For the *Conventional* career area, the mean level of interest congruence was 9.59. The strength of interest congruence for both of these career areas falls in the middle range of possible levels of interest congruence. These results indicate that, for these two career areas, women with a measured vocational personality described by each career area are less likely

than other women to choose a college major that is congruent with this area of interest. It is difficult to draw conclusions about the meaning of this result with certainty, however it is worth noting that both of these career areas represent an extreme regarding generally accepted ideas about traditionality of career choices. The *Realistic* career area capturing concrete, hands-on problem solving occupations such as engineering and trades careers and is thought of as the least traditionally accepted career area for women to pursue. The *Conventional* career area, capturing data driven, organization, and clerical skills, is the most traditionally accepted career area for women to pursue and represents careers such as receptionist and secretary. This career area is generally most representative of career interest for women with less educational aspiration than college-bound women. It is interesting that women who have measured interests in these extremely gender valued career areas are not likely to pursue these stereotyped career paths, in either direction.

The final area in this examination of interest congruence patterns across time was a focus on the distribution of expressed interests across expressed college major career areas based on the level of interest congruence as measured by C-index. Previous research has shown mixed results related to level of interest congruence and career choice. Wolfe and Betz (1981) found that women with high levels of interest congruence were less likely than women with low levels of interest congruence to choose “traditional” female careers. However, in a 1999 replication of this study, Betz, Heesacker, and Shuttleworth found that women chose diverse career paths, not just “female” or “male” gender typed careers, and that interest congruence was consistent across gender categorizations.

For the current study, the researcher explored the distribution of expressed interest in college major between high, medium, and low levels of interest congruence. The results are

surprising and lend support to the more recent Betz et al. (1999) study that indicates interest congruence is consistent across choices of major. Results from the present study indicate that for high, middle, and low interest congruence, participants showed relatively similar patterns of expressed interest in college major. Differences did not support the notion that women with high interest congruence would be more likely than women with low interest congruence to express interests in less traditionally “female” career areas. In fact, for the *Investigative* career area, the reverse was true. A larger proportion of college-bound women with low interest congruence levels expressed interests in *Investigative* college majors ( $\bar{x} = 39.4\%$ ), than women with middle ( $\bar{x} = 35.3\%$ ) or high interest congruence ( $\bar{x} = 31.2\%$ ) across time. The same tendency was found for interest in college majors within the traditionally male-dominated *Realistic* career area and the traditionally female career area of *Social*. These trends seem somewhat contrary and suggest that women with low interest congruence, whose measured interests do not match their expressed interests, are likely to choose to major in careers that are either traditionally female or traditionally male dominated (combined  $\bar{x}$  across these three career areas across time is 80.5%).

It is unknown what is different about participants in the low interest congruence group that relates to their choices to express interests in either male or female-dominated careers. By their inclusion in the low interest congruence category, it is clear these participants have selected college majors that are almost opposite of their measured interest career areas. They may have chosen to express these extreme interests based on qualitatively different characteristics than middle or high congruence participants. One possible explanation for this finding is that women with low levels of interest congruence may be those who are influenced more by outside sources than high interest congruence participants.

These women may have chosen such extreme, either traditional or non-traditional, college majors despite their incongruence with individual's measured career personality due to external pressures, obligations, and narrower perceptions of their career options than high interest congruence participants. Conversely, it may be likely that women with high levels of interest congruence may be those who are less easily influenced by external pressures such as social norms and expectations. Instead, these are women who have greater confidence to pursue career directions that fit with their measured interests. By the nature of this exploratory study, the explanations for this trend are only speculative, but it appears to be a finding that is worth noting and exploring further with future research endeavors.

A greater proportion of women with high levels of interest congruence expressed interest in a college major within the *Artistic* and *Conventional* career areas. The proportion of participants captured by expressed interests in *Conventional* careers is small across career areas. However, this pattern in the *Artistic* career area suggests that there may be qualities in career choices depicted by this area that are significantly unique from other career areas. Women who intend to pursue *Artistic* college majors are likely to have a strong fit between their measured vocational personality and the choice that they express. This seems to fit ideas about the nature of *Artistic* careers that attract people who are particularly creative, unique, and expressive.

Finally, it is noteworthy that the high interest congruence group appeared to have more broadly distributed interests in college majors than either the low or middle interest congruence group. This finding provides new meaning to previous studies of interest congruence and traditionality of career choice and suggests that women whose measured interests match their expressed interests may have more varied career interests than women

with less congruence, again supporting the speculation that women with high levels of interest congruence are those who are less easily influenced by outside sources in making career decisions. This pattern indicates that these high interest congruence women are likely to pursue a variety of career paths and the gender typed nature of careers seems unimportant for these women, the same may not be as true for women in low and middle interest congruence groups.

### *Achievement*

Much of the literature on women's career development has focused on examining women's interests in math and science careers and their achievement in these areas. The researcher in the present study wanted to examine trends for college-bound women in expressed interest in college major based on math achievement, as well as trends in interest congruence based on achievement.

Some interesting trends were found for college-bound women's expressed interests in different career areas within different levels of math achievement. Across time, as found in other trends examined in the current study, women with each level of math achievement showed similar patterns of interests among career areas. The distribution of expressed interests was similar within and between areas for all math achievement groups across time. This trend, taken with previous findings, indicates that the distribution of women's expressed interests in college majors is consistent at different points in time regardless of interest congruence or achievement in math.

However, some differences in the values of the proportion of women with expressed interests in different career areas occurred across math achievement levels. Important differences in expressed interests in the traditionally male-dominated *Investigative* career

area, as well as the traditionally female *Social* career area are of particular interest. A large proportion of women across math achievement levels expressed interests in *Investigative* college majors. This expressed interest captured a markedly higher proportion of women in the high math achievement group than in any other achievement level. Across time, 50% of women with high achievement levels in math expressed interest in the science and math related college majors encompassed by the *Investigative* career area. Conversely, the largest proportion of women with low achievement in math consistently expressed interests in college majors described by the more traditional *Social* career area.

These findings relate to much of the previous research investigating women's vocational interests in science, technology, engineering, and math (STEM) related fields. Research based on social learning theory has shown that even high school women who have achieved success in math and science courses are less likely than boys to report feelings of efficacy for math and science, likely influencing their intent to pursue such career areas (VanLeuvan, 2004). However, it has also been shown that women who do plan to pursue career choices in the STEM fields have higher career and educational aspirations than those who plan to enter more female-dominated occupations (Murrel, Frieze, and Frost, 1991). The findings in the current study support the notion that women who have greater achievement in math are more likely than other college-bound women to hold less gender-stereotyped ideas about career choices (Lent, Lopez, and Bieshke, 1993).

The findings from the current study related to level of math achievement and interest congruence indicate that interest congruence is relatively stable across time (as found in previous sections of this research) and there are no meaningful differences in interest congruence based on level of math achievement (all effect sizes for differences are very

small). These results suggest that women at all achievement levels are equally likely to express interests in college majors that match their measured vocational interests.

Taken together, the trends found related to distribution of expressed interests and interest congruence based on math achievement level lead to some interesting conclusions. It appears that women across the three levels of math achievement show differences in their distribution of expressed interests, however, interest congruence is generally stable within these levels. When examining interests in the *Investigative* career area, it appears that women with high levels of math achievement are most likely to express interest in pursuing these careers, however congruence is stable within this area indicating that some of the women with high levels of math achievement who are expressing interests in *Investigative* careers are making incongruent choices, that do not actually fit their measured career interests. It can be postulated that women with high levels of math achievement are likely to express interests in STEM-related career areas partly as a result of their aptitude, which then leads to career interest. It can also then be assumed that a number of the college-bound women who express interests in *Investigative* careers are not expressing a congruent choice and may be less likely to persist in their choice of college major than those women who express interest in a congruent career area choice regardless of aptitude. It seems that, rather than attempting to market STEM-related fields to young women who have high aptitude or achievement in math and science, university advisors and deans would be better served by working to increase the aptitude of women who have a genuine expressed and measured interest in *Investigative* pursuits. This is an approach that could begin early in girls' math and science education and help young women to develop full interests and make congruent choices when they enter college.

*Alternative Methods to Examine Interest Congruence.*

The final goal of the present study was to examine the usefulness of the complex C-index (Brown and Gore, 1994) as a measure of index congruence in a large-scale study of this nature. To accomplish this goal, the researcher attempted to capture interest congruence using a more simple method of examining the proportion of women with expressed interests within each measured career interest area (matching method). It seems appropriate that measured career areas with a higher percentage of individuals who express interests in the same career area would be more congruent than career areas wherein a low percentage of individuals express interests in the matching career area. Results for the distribution of congruence among measured career areas were compared using the calculated C-index of congruence and this matching method.

One trend that has been noted across discussion of results using the C-index of congruence is that there appears to be little variability in the level of interest congruence across time within and between career areas. There have been trends and differences that are worth noting, but the level of congruence has generally been found to be fairly consistent. When comparing results using the two methods of interest congruence it is readily apparent that the matching method shows a great deal more variability in interest congruence between expressed interest career areas. Like the C-index, level of congruence using the matching method is relatively consistent across time within career areas. However when examining differences between career areas, the matching method shows greater differences in congruence.

An additional finding that supports the notion that both methods do measure a similar construct is that the rank order of expressed interests in career areas was found to be similar

for both methods of measuring interest congruence. That is, interest congruence was highest using both methods for participants who expressed interest in the *Investigative* career area followed by the *Social* career area. Participants who expressed interest in the *Conventional* and *Realistic* career areas consistently showed the lowest levels of interest congruence using both methods. .

Previous researchers (Silva, 2001; Camp & Chartrand, 1992; and Brown & Gore, 1994) have suggested that inconsistencies in findings from existing interest congruence literature are due to measurement and construct differences in research methods. These researchers have suggested that a single method for examining interest congruence should be established in order to eliminate these inconsistencies. However, when comparing the two methods of examining interest congruence in the present study, it appears that both are investigating a similar, stable construct. It appears there may be benefits and drawbacks to both methods and the method chosen for research should reflect the question under study.

Brown and Gore (1994) suggested that their C-index would account for challenges to other methods for investigating congruence and establish a consistent and theoretically appropriate index. They proposed that, according to Holland's theory, an adequate measure of interest congruence should be able to discriminate between individuals with identically ordered Holland codes for expressed and measured interests (e.g. SAE expressed and SAE measured) and individuals with similar codes that are ordered in different sequences (e.g. SAE expressed and ASE measured). They also proposed an appropriate index would be based on each of the three letters of the Holland code, not just use first letter or first and second letters. Finally, they suggested an index should incorporate the proximity of hexagonal relations between the Holland career areas within each code (e.g. adjacent career

areas are more strongly congruent than opposite career areas). They developed the C-index based on these principles and it does indeed theoretically reflect a true representation of Holland's (1973; 1997) career development theory. As a result, it seems that this method for understanding interest congruence is very appropriate when researchers wish to examine strengths and limitations of Holland's theory and when the research under question is based directly on his tenets of career development. It seems the C-index is also appropriate to use in research when the investigator aims to make predictions based on level of interest congruence, such as research establishing a link between interest congruence and outcomes like persistence and satisfaction in a career area.

The C-index, while designed to be easily calculated (Brown & Gore, 1994), was found by this investigator to be complex and difficult to calculate for a large sample. The formula is indeed straightforward and follows directly from Holland's theoretical model and Brown and Gore's propositions regarding congruence indices, but necessary transformations of data are not easily computed using basic statistical programs. The consistency of level of interest congruence found between measured and expressed interests in career areas using the C-index makes it difficult to draw conclusions about differences that may be present between these different career areas. It is possible that a less complex method for examining congruence, such as the matching method, may be more appropriate than the C-index when the researcher wishes to compare congruence between measured or expressed interest career areas. The C-index may be the most appropriate method for use in predictive and inferential research. Researchers should be aware that a matching method for assessing congruence does not reflect the core dimensions of Holland's vocational theory as accurately as the C-

index but the comparisons that can be made when examining congruence at this general, more straightforward level, may be useful at times

### *Conclusions.*

The following conclusions can be made based on the findings from the present study. First, it appears that college-bound women's expressed and measured vocational interests in traditionally male-dominated career areas have increased across time. Expressed and measured interests over time are not stable and reflect shifts in societal norms and expectations, as well as expanding career options, for women. Second, the congruence between women's expressed and measured interests appears to be relatively stable across time and within career areas, no matter how it is measured (C-index or matching method). Trends in expressed interests based on level of interest congruence indicate that women with high levels of interest congruence using the C-index as a measure express interests in a variety of career areas. These women appear to have diverse career interests and pursue them, regardless of expectations, gender-norms or other mediating factors. Third, across time, it appears that women with high levels of achievement in math have consistently expressed greater interest than other women in pursuing less traditional *Investigative* college majors. College bound women with low levels of math achievement appear to choose more traditional career areas, such as the *Social* career area, to pursue. Finally, the C-index does appear to measure interest congruence according to Holland's theoretical model and is appropriate for research investigating the construct of interest congruence based on this model. Other methods of examining fit between expressed and measured interests may be appropriate for different research intentions.

### *Strengths and Limitations*

This study is the first research endeavor to examine trends in interests and interest congruence for women across time and, as such, there are several strengths to the conclusions that can be drawn. The study incorporates a large, nationally representative data set and several points of data across time, allowing for the exploration of many issues related to interests and interest congruence at a level that has not previously been studied. Other large-scale or cohort based studies have examined specific issues related to vocational development such as expressed interests, measured interests, or achievement. However, this is the first study of its kind to explore all of these complex issues and their inter-relations and the first study to examine interest congruence within this context. The large-scale nature of this study and the nationally representative sample also allows for confidence in describing temporal trends based on these cross-sectional samples across time. This research will contribute to existing literature encompassing several areas in vocational psychology including women's career development, women's vocational interests in math and science related fields, women's interest congruence, and the potentially moderating variable of women's abilities in math and science. Additionally, it is significant that the current study examines the nature of college-bound women's vocational interests as a distinctive group. Other research has examined trends in interest across time for a less descriptive sample of women but it is established that college-bound women represent a unique segment of the population of all women.

In addition to strengths, there are some limitations to the application of the present study. First, because of the large sample and nature of the data set as intact cohort data, only descriptive statements regarding trends can be made. Conclusions regarding the meaning

behind the observed trends can be only speculative, and do not reflect clear causal research findings. Second, while using college-bound women in this study allows the researcher to make conclusions about a unique population, it would be interesting to investigate interests and interest congruence across time for the larger population of women as well, particularly when looking at interests in traditionally male-dominated careers. Finally, the data for the present study is cross-sectional cohort data rather than a longitudinal analysis of women's career development. The investigator examined women's expressed interests/intentions to pursue a college major. However, the data set does not contain the information necessary to determine whether the women in this study actually entered the major they expressed interest in for ACT's demographic purposes and no data on which to conclude whether women persisted in a college major once they had selected it.

#### *Implications and Directions for Future Research*

The results of the present study have implications across a variety of settings and contexts. These results provide some insight into historical career interest trends for women. While direct conclusions regarding the causes of observed trends cannot be drawn, the trends observed in this study lend support to existing cultural and social theories regarding women's career development. It appears from the results of this trend investigation that interests and interest congruence for women across career areas, particularly in *Investigative*, *Social*, and *Realistic* career areas, have changed over time. It is beyond the scope of this study to speculate about specific societal developments that have contributed to these changes across time; however it appears that the results may contribute to further developments in research. The three-decade time period investigated in the present study is one during which the formal

investigation of women's career development has grown and the changes that are reflected in this study can lend to this literature.

The results of this study allow for further clarification of the role that interest congruence plays in women's career development. It appears that, while debates remain about the predictive capabilities of the construct of interest congruence, this construct is a stable and richly informative aspect of career development. Interest congruence can be incorporated in research to describe a complex relation between expressed and measured interests. The results lend support to a consistent, theoretically driven method for examining interest congruence (C-index) while also acknowledging that variations in this method may be appropriate for research when the question under study references congruence based on variability between career areas (matching method).

The results are qualitatively rich and quite unique because measured interests, expressed interests, interest congruence, and achievement data across time are all incorporated into one study. Findings can be used to inform both future researchers and those interested in vocational trends for other reasons. Thus, the implications of the present study can be applied across a variety of settings. For researchers, results may provide new directions to explore and a basis for further predictions about the role of interest congruence in the career development of women.

For psychologists working as career counselors, this research provides a source of information to help female college-bound or college student clients to investigate different career areas. For example, a counselor who is working with a client that expresses interest in a career area that consistently shows lower levels of interest congruence, such as the *Realistic* career area, may employ tools other than a vocational interest measure to help this client

explore potential careers. A counselor may help a client to explore the meaning of this low interest congruence, as well as the potential outside sources or pressures that are influencing this individual's expressed interests in career choice. If a counselor knows that an individual is expressing interests in a low congruence field, they may further investigate that individual's level of congruence and help them to explore other, potentially more congruent choices. When an individual expresses comfort with their choice in a low congruence field such as *Realistic* the counselor may wish to help that individual explore challenges they may face in pursuing this career direction; such as low participation from other females, lower likelihood of female persistence in a career area (based on interest congruence research) and lack of female role-models. Career counselors may also be able to use information from this research to help female clients expand their vocational choices and make accurate decisions about fields they wish to pursue across levels of interest and congruence. Finally, when working with high math and science achieving women, counselors may wish to investigate congruence levels and help these women sort out their actual interests, vs. those interests that are a reflection of unique aptitude and pressures.

This study also has implications for enrollment officers, academic advisors, and administrators at both university and high school levels. An examination of trends in interest congruence allows universities to make decisions regarding marketing and departmental funding. These trends may help universities to identify areas in which women's interests are growing and more programs for women students need to be developed to encourage persistence and retention. Conversely, the results may help administrators understand a lack of interest in particular career areas from women. The examination may allow those who

work directly with students to identify areas in which women may find role models or support systems already in place.

From a business or marketing perspective, the current research allows more than just an examination of trends and the current status of women's interests. It allows those making marketing decisions to consider what potential predictions regarding interests may mean for the future of a career area. With these predictions, decisions about effective marketing strategies can be made. For example, the chair of a psychology department might consider results from the current study in his/her approach to recruitment of high school students. Following figures 1 and 2, the chair could predict that women's interests in *Investigative*, *Realistic*, and *Artistic* career areas would continue to increase, while interests in *Social* and *Conventional* career areas will remain stable or likely decrease. Based on these predictions the chair of the psychology department may decide to produce materials and develop curricula that emphasize the science, hands-on learning, and creativity that can be involved in the study of psychology, rather than focusing on the social service aspects of this college major. These trends seem to predict college major choices with emphasis on learning to think, and do, rather than study and observe. Effective marketing decisions and curriculum development decisions would reflect utilization of the trend data associated with this study.

The current study also has meaningful results for use by employers and economists who want to better understand a changing workforce. Examining trends in interests and interest congruence for college bound women can help these individuals form expectations about how the workforce is likely to change in the short-term future. By identifying trends in interest congruence, this research allows consumers to make predictions regarding the pattern of interest development for women.

The conclusions from the current study provide a number of avenues for future researchers to explore. Of course, based on history and the nature of conclusions drawn from this study, women's vocational interests and interest congruence in less traditionally female career areas will continue to be a focus of vocational interest research. The findings from this research lend support to further exploration of women's vocational development in *Investigative* and *Realistic* career areas. It is clear from the results herein that the existing focus in literature on these areas is warranted and that there have been meaningful changes in patterns of women's interests in these areas across time.

There are several areas for future research that incorporate the data for the current study. To further explore women's interest and interest congruence across areas, it may be beneficial to examine trends at a more specific level than general career area. Future research could explore trends in women's expressed interests in college major or in occupation based on the specific major a woman identifies as an intended area of study in college. This level of examination would allow researchers to look more closely at characteristics of the work environments that women choose to pursue. For example, psychology and physics are both college majors that would be captured by the *Investigative* career area but may have qualitatively different characteristics that can further describe women's interests.

When examining level of achievement and interest congruence in the current study, some interesting trends have begun to emerge, particularly regarding interest in the *Investigative* career area. These trends could be further explored by incorporating other achievement-related data such as the number of math and science courses participants completed in high school. In addition, investigating characteristic differences and interest

congruence distributions among low and high achieving women who express interest in the *Investigative* career area would contribute further to the literature.

A number of participants were removed from the original sample for the current study due to ties in calculating their interest congruence. A tie was identified when an individual scored identically across two or more of their highest three career areas. It would be interesting to investigate how the interests of these participants differ from those that were not tied. Additionally, all participants who remained in the sample were treated the same regardless of the level of their measured interests. A participant with a measured Holland code of RIA may have normed scores of 97, 80, and 65 for *Realistic*, *Investigative* and *Artistic* career areas respectively. This participant was treated the same in the current sample as one who had a measured Holland code of RIA with normed scores of 40, 20, and 19. It seems likely that there may be differences between individuals with the same measured Holland career area based on both the strength of their interest (as determined by score level) and how close the values of their interests are across the three areas. These qualitative differences may provide interesting data for further investigation.

In addition to the current comparison of C-index and the matching method for judging interest congruence, there appears to be debate in the literature regarding various methods of examining interest congruence. A large-scale study of this nature comparing multiple indices of interest congruence would allow researchers to determine strengths and limitations of various measures of index congruence for different purposes.

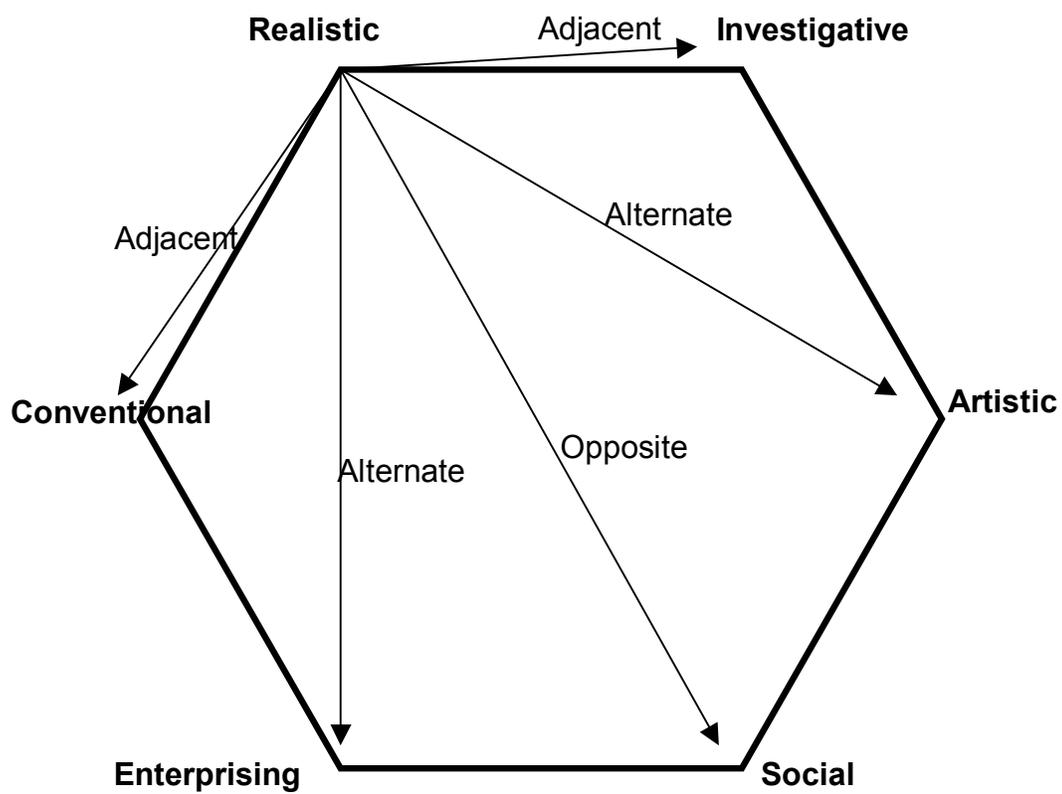
The conclusions drawn from the current study could also be made to be richer in a number of ways. First, it may be interesting for future research to compare trends in women's interest congruence to findings based on the interests of college-bound men. This

would allow researchers to make inferences reflecting any gender differences apparent for interests and interest congruence trends. Second, conclusions could be further strengthened by conducting a similar study using longitudinal, rather than cohort data, that would allow researchers to study the same sample across time. As previously mentioned, future research that incorporates women's expressed and measured interests, as well as measures of career and subject matter self-efficacy, prior to entering college in addition to data reflecting their actual college major and occupational choice following graduation would provide a wealth of information and directions for the literature regarding women's career development. If longitudinal data could not be obtained over an extended period of time, the data in the current study could be supplemented by incorporating additional cohort data regarding enrollment statistics, college major choices for women, and college graduation rates to add qualitative insights to the findings.

Results from the current study are exciting and unique. This cross-sectional large-scale cohort study incorporates several aspects of college-bound women's vocational interests including expressed and measured interests and interest congruence. The present research allows investigators to begin to understand important developments in trends for women's vocational interests across time. Conclusions made from this examination provide meaningful descriptions regarding important aspects of women's career development and advances in vocational psychology of women.

## Appendix A.

## Holland's Career Hexagon



Appendix B.

ACT Research Proposal



Thank you for your recent request to use ACT materials in your upcoming research. Persons wanting to use one or more of ACT's career assessments, programs, or existing data sets in their research must provide the Career Transitions Research Department with a brief (three to five page) proposal outlining the proposed investigation.

The information that you provide in your proposal should address the six major areas:

**1. Objective(s) of the study**

What is the purpose of your proposed study?

What results do you expect to find?

How does your study make a contribution to the field?

**2. Description of sample(s)**

Include information about the source of your sample (i.e., where you will obtain participants?) as well as information about the approximate gender and age of potential participants. Indicate the expected number of participants and their year in school.

**3. Materials to be used in the study**

Clarify the precise ACT career assessments, programs, and/or data sets that you would like to use in your study. Also, provide information about the non-ACT assessments and inventories that you plan to use. Include a description of any counseling technique or intervention that will be part of your study.

**4. Data collection procedures**

If applicable, outline the procedures that will be used to collect data from the participants. If applicable, please provide a copy of documentation indicating Institutional Review Board approval of your study.

**5. Time line**

Provide an overview of the major steps involved in the study, including approximate completion dates for each stage. Be sure to indicate the expected research completion date (i.e., the date by which you expect all data to be collected, analyzed, and reported).

## 6. **Planned data analyses**

Explain the specific statistical analyses you plan to conduct. Make sure that each analysis is linked to the objectives outlined earlier in the proposal.

If you decide to send a formal proposal, please provide the following information in your cover letter:

- \*Your Name
- \*Mailing Address
- \*Phone Number
- \*E-mail Address
- \*Names of Colleagues Involved in the Research

All requests must be accompanied by a copy of the principal investigator's vita.

The information you provide will be promptly reviewed, and we will notify you of its status within two weeks following its submission. If your proposal is approved, a Career Transitions Research Agreement will be emailed to you for your signature, which is then mailed to us. Following the execution of that agreement, the appropriate materials will be mailed to you for use in your study.

### **Objectives of the study:**

The purpose of the proposed study is to examine the interest congruence of college-bound women across time. Interest congruence, the match between expressed and measured interests, has been studied using multiple statistical methods and has been shown to relate strongly to persistence in college major and to career satisfaction. There are multiple objectives for the proposed study, delineated as follows:

- To examine changes in interest congruence for college-bound women with measured interests in each of the six Holland career areas across a 30-year time span.
- To identify differences in interest congruence between Holland career areas over time.
- To compare patterns of interest congruence within each expressed career area for high achieving women and low achieving women as measured by ACT test scores.

The proposed study is an exploratory analysis of women's interest congruence over time. We can make some predictions about expected results based on existing research related to women's interests in "traditional (mostly Social and Conventional)" career areas and research regarding women's intentions to pursue "non-traditional" science, technology, engineering, and math (STEM) careers (mostly Investigative and Realistic career areas).

These possible outcomes include:

- Increases and decreases in interest congruence for college-bound women with expressed interests in each of the six Holland career areas over time. In general, we would expect societal changes in perceptions of women's acceptable career choices to be reflected in their interest congruence over time. If awareness and acceptance of women's contributions to STEM related fields and interventions designed to increase female involvement in these career areas have been effective, we would anticipate an increase in interest congruence for related Holland career areas such as Investigative and Realistic. For career areas that represent more traditionally accepted areas of interest for women (Social and Conventional), we might expect to see either stable levels of interest congruence across time or possibly decreases in congruence as even women who measure with high interest in these career areas are compelled to enter career paths in STEM related fields.
- Some differences in level of congruence between career areas over time. We would expect interest congruence in Social careers to be the strongest across time for women. We would expect the lowest interest congruence for college bound women with measured interests in Realistic career areas because of the historic lack of acceptance and prevalence for females in these careers.
- We would expect to see differences in interest congruence for high achieving and low achieving women across time. It is likely that high achieving women will express interest in STEM-related fields with greater frequency than low-achieving women. As a result, we would expect their interest congruence across time to illustrate the societal changes described above more strongly than low-achieving women.

The outcomes of the proposed study have implications for persistence and career satisfaction for women in different career areas and can be useful for professionals in career counseling, higher education, and employment arenas.

**Description of sample:**

The sample for the proposed study would be obtained from existing ACT data. It would include a national representation of females who have completed the ACT assessment and UNIACT interest measure across time. SDS items regarding expressed major and occupational interest would also need to be completed for participants and we would like to include only those participants who responded to items 13 and 14 (certainty of major and occupational choice) with one or two (excluding students who are “not sure”)

We request a sampling from ACT existing data that includes college-bound females who have complete ACT test scores, UNIACT results, and responses to SDS items regarding expressed interest.

We are requesting data from 5000 females for each of the following years: 2005, 2005, 2000, 1995, 1990, 1985, 1980, and 1975 (N=35,000).

**Materials to be used in the study:**

The proposed research involves a requested data set from ACT that would include 5000 women from each point in time (1975-2005). We propose that participants be randomly selected from all females in each of the target years who completed the ACT and UNIACT assessments and who responded to optional demographic and expressed interest items.

Specifically, these data and SDS items include:

- UNIACT results; raw scores and standard scores
- ACT results; subtests and ACT composites
- SDS Items:
  - F (Racial/Ethnic Background)
  - J (Grade)
  - 11, 12, 13, 14 (Major and occupational choice and certainty)
  - 56 and 59 (SES status)
  - 60 (community of origin)
  - 81 and 82 (high school academic achievement)

**Data Collection Procedures:**

Intact data set with no identifying information obtained from American College Testing.

**Time Line:**

The proposed study is a dissertation developed for partial fulfillment of a doctoral degree in counseling psychology from the APA accredited psychology program at Iowa State University in Ames, Iowa. Upon obtaining data, the proposed study would be reviewed by Iowa State University’s Institutional Review Board. The next major step for this project is the completion and committee defense of a dissertation proposal scheduled for October 21, 2005. Following an approval of the research project, interest congruence measures will be

calculated for the collected data. The data can then be analyzed (Spring 2006) and results written and reported by summer 2006. A projected dissertation defense date would be in the late summer or early fall of 2006.

**Planned Data Analysis:**

- Calculation of interest congruence indices using Brown and Gore Congruence (C) Index
- Analysis of increases and decreases in interest congruence across time for each Holland career area and further quantitative investigation into any significant differences within career areas.
- Comparisons between Holland career areas across time
- Comparison of interest congruence indices between high achieving and low achieving women within each of six career areas.

Appendix C.

ACT Research Agreement

**COPY**

**AGREEMENT FOR THE RELEASE OF ACT DATA  
FOR USE IN CAREER-RELATED RESEARCH**

The purpose of this document is to specify, and confirm agreement to, the terms and conditions under which ACT, Inc. will provide the requested and approved data specified on the Principal Investigator's research request without charge to Brooke Ruxton at Iowa State University.

***Terms and Conditions***

Following is a list of the terms that the Principal Investigator identified above agrees to honor as a condition for receiving ACT data. The signature at the end of this Agreement by the Principal Investigator is a pledge to ACT that these terms have been read, understood, and accepted.

1. The Principal Investigator attests that the data provided by ACT will be used solely for the purposes outlined in the attached research proposal dated October 24, 2005. The expected completion date for this project is August 2006.
2. The Principal Investigator agrees that any reproductions of ACT assessments will include a copyright statement as follows:  
  
Copyright 2005 by ACT, Inc. All rights reserved. Reprinted by permission of ACT.
3. The Principal Investigator agrees to provide ACT with a written report of project results within six months of the expected completion date and a copy of all conference presentations, journal articles, and other publications that result from this research project.
4. The Principal Investigator agrees not to sell, disclose or otherwise make the data or their documentation available to any third party, except as approved by ACT in writing.
5. The agreement period may be extended by mutual agreement of the Principal Investigator and ACT. Such agreement must be confirmed in writing by ACT prior to the expected completion date for the investigation.

Paul A. Gore, Ph.D.  
Career Transitions Research Dept.  
ACT, Inc., 500 ACT Dr., P.O. Box 168  
Iowa City, IA 52243-0168  
319/337-1223  
paul.gore@act.org

Brooke Ruxton  
Graduate Student  
Iowa State University  
5962 Greendale Pl. #201  
Johnston, IA 50131  
515/508-9992  
bhieron@iastate.edu

Appendix D:

IRB Documents

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**IOWA STATE UNIVERSITY**  
OF SCIENCE AND TECHNOLOGY

Institutional Review Board  
Office of Research Assurances  
Vice Provost for Research  
1138 Pearson Hall  
Ames, Iowa 50011-2207  
515 294-4566  
FAX 515 294-4267

Date: February 17, 2006  
To: Brooke Ruxton  
From: Dianne Anderson, IRB Co-Chair, Office of Research Assurances,  
Human Subjects  
Re: IRB ID 06-042

The project "Vocational interest congruence of college-bound females across time: A 30 year investigation with emphasis in math and science interests" does not fit the definition of human subject research according to the federal guidelines, 45 CFR 46. Research is defined in 45 CFR 46 as a systematic investigation, including research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge. Activities, which meet this definition, constitute research for purposes of this policy, whether or not they are conducted or supported under a program, which is considered research for other purposes. For example, some demonstration and service programs may include research activities. Because this project does not need IRB approval, you can proceed with the project. We do, however, urge you to protect the rights of your participants in the same ways that you would if IRB approval were required. This includes providing relevant information about the project to the participants.

Any modification of this project should be communicated to the IRB to determine if the project still meets the Federal definition of not being research. If it is determined that approval is needed, then an IRB proposal will need to be submitted and approved before proceeding with data collection.

C: Psychology Dept.  
Norman Scott

For IRB Use Only	Review Date: _____	IRB ID: _____
	Approval Date: _____	Length of Approval: _____
	Approval Expiration Date: _____	FULL Committee Review: _____
	EXEMPT per 45 CFR 46.101(b): _____ Date: _____	Minimal Risk: _____
	EXPEDITED per 45 CFR 46.110(b) _____	More than Minimal Risk: _____
	Category _____, Letter _____	Project Closed Date: _____

### ISU NEW HUMAN SUBJECTS REVIEW FORM

#### SECTION I: GENERAL INFORMATION

Principal Investigator (PI): Brooke Ruxton	Phone: 294-1314	Fax: _____
Degrees: M.S.	Correspondence Address: 2223 Student Services Building, 3 <sup>rd</sup> Floor	
Department: Psychology	Email Address: bhieron@iastate.edu	
Center/Institute: _____	College: Liberal Arts and Sciences	
PI Level: <input type="checkbox"/> Faculty <input type="checkbox"/> Staff <input type="checkbox"/> Postdoctoral <input checked="" type="checkbox"/> Graduate Student <input type="checkbox"/> Undergraduate Student		

Title of Project: Vocational interest congruence of college-bound females across time: A 30 year investigation with emphasis in maht and science interests
Project Period (Include Start and End Date): [mm/dd/yy][01/25/06] to [mm/yy/dd][01/25/2007]

FOR STUDENT PROJECTS	
Name of Major Professor/Supervising Faculty: Norman A. Scott	Signature of Major Professor/Supervising Faculty: _____
Phone: 294-1509	Campus Address: W112 Lagomarcino Hall
Department: Psychology	Email Address: nascott@iastate.edu
Type of Project: (check all that apply)	
<input type="checkbox"/> Research	<input type="checkbox"/> Thesis
<input type="checkbox"/> Independent Study (490, 590, Honors project)	<input checked="" type="checkbox"/> Dissertation
	<input type="checkbox"/> Other. Please specify: _____
	<input type="checkbox"/> Class project

#### KEY PERSONNEL

List all members and relevant experience of the project personnel. This information is intended to inform the committee of the training and background related to the specific procedures that the each person will perform on the project.

NAME & DEGREE(S)	SPECIFIC DUTIES ON PROJECT	TRAINING & EXPERIENCE RELATED TO PROCEDURES PERFORMED, DATE OF TRAINING

Add New Row

#### FUNDING INFORMATION

Internally funded, please provide account number: N/A
Externally funded, please provide funding source and account number: N/A

Research Assurances 12/01/2005

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Funding is pending please provide OSPA Record ID on GoldSheet:
Title on GoldSheet if Different Than Above:
Other: <i>e.g., funding will be applied for later.</i>

**SCIENTIFIC REVIEW**

Although the assurance committees are not intended to conduct peer review of research proposals, the federal regulations include language such as “consistent with sound research design,” “rationale for involving animals or humans” and “scientifically valuable research,” which requires that the committees consider in their review the general scientific relevance of a research study. Proposals that do not meet these basic tests are not justifiable and cannot be approved. If an assurance review committee(s) has concerns about the scientific merit of a project and the project was not competitively funded by peer review or was funded by corporate sponsors, the project may be referred to a scientific review committee. The scientific review committee will be ad hoc and will consist of your ISU peers and outside experts as needed. If this situation arises, the PI will be contacted and given the option of agreeing that a consultant may be contacted or withdrawing the proposal from consideration.

Yes  No Has or will this project receive peer review?

If the answer is “yes,” please indicate who did or will conduct the review: The Department of Psychology research ethics committee has reviewed this proposal.

If a review was conducted, please indicate the outcome of the review: The signature of the chair or his representative indicates approval of the proposal by this committee.

**NOTE: RESPONSE CELLS WILL EXPAND AS YOU TYPE AND PROVIDE SUFFICIENT SPACE FOR YOUR RESPONSE.**

**COLLECTION OR RECEIPT OF SAMPLES**

Will you be: (Please check all the apply.)

Yes  No Receiving samples from outside of ISU? See examples below.  
 Yes  No Sending samples outside of ISU? See examples below.

Examples include: genetically modified organisms, body fluids, tissue samples, blood samples, pathogens.

If you will be receiving samples from or sending samples outside of ISU, please identify the name of the outside organization(s) and the identity of the samples you will be sending or receiving outside of ISU:

--

**Please note that some samples may require a USDA Animal Plant Health Inspection Service (APHIS) permit, a USPHS Centers for Disease Control and Prevention (CDC) Import Permit for Etiologic Agents, a Registration for Select Agents, High Consequence Livestock Pathogens and Toxins or Listed Plant Pathogens, or a Material Transfer Agreement (MTA) (<http://www.ehs.iastate.edu/bs/shipping.htm>).**

**SECTION II: APPLICATION FOR INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL**

Yes  No Does this project involve human research participants? If the answer “no” is checked, you will automatically moves to a question regarding the involvement of radiation producing devices in your project.

**SECTION III: ENVIRONMENTAL HEALTH AND SAFETY INFORMATION (EH&S)**

- Yes  No Does this project involve laboratory chemicals, human cell lines or tissue culture (primary OR immortalized), or human blood components, body fluid or tissues? If the answer is "no" is checked you will automatically move to a question regarding the involvement of human research participants in your project.

**ASSURANCE**

- I certify that the information provided in this application is complete and accurate and consistent with any proposal(s) submitted to external funding agencies.
- I agree to provide proper surveillance of this project to ensure that the rights and welfare of the human subject or welfare of animal subjects are protected. I will report any problems to the appropriate assurance review committee(s).
- I agree that I will not begin this project until receipt of official approval from all appropriate committee(s).
- I agree that modifications to the originally approved project will not take place without prior review and approval by the appropriate committee(s), and that all activities will be performed in accordance with all applicable federal, state, local and Iowa State University policies.

**CONFLICT OF INTEREST**

A conflict of interest can be defined as a set of conditions in which an investigator's or key personnel's judgment regarding a project (including human or animal subject welfare, integrity of the research) may be influenced by a secondary interest (e.g., the proposed project and/or a relationship with the sponsor). ISU's Conflict of Interest Policy requires that investigators and key personnel disclose any significant financial interests or relationships that may present an actual or potential conflict of interest. By signing this form below, you are certifying that all members of the research team, including yourself, have read and understand ISU's Conflict of Interest policy as addressed by the ISU Faculty Handbook (<http://www.provost.iastate.edu/faculty> .) and have made all required disclosures.

- Yes  No Do you or any member of your research team have an actual or potential conflict of interest?  
 Yes  No If yes, have the appropriate disclosure form(s) been completed?

**SIGNATURES**

Signature of Principal Investigator

Date

1/23/05

Signature of Department Chair

Date

**PLEASE NOTE: Any changes to an approved protocol must be submitted to the appropriate committee(s) before the changes may be implemented.**

**Please proceed to SECTION II.**

**SECTION II: IRB SECTION - STUDY SPECIFIC INFORMATION****STUDY OBJECTIVES**

Briefly explain in **language understandable to a layperson** the specific aim(s) of the study.

**The current study is designed to explore trends across a 30 year time-span (1975-2005) in women's career interests. We will explore how women's expressed interests in a specific career area or major relate to their measured interests using an established vocational interest inventory (UNIACT). This relationship will be examined across time and across career areas. We will also explore differences between high and low achieving women across time as measured by their scores on the American College Testing (ACT) exam.**

**BENEFIT**

Explain in **language understandable to a layperson** how the information gained in this study will benefit participants or the advancement of knowledge, and/or serve the good of society.

Understanding these trends in interest development can be useful for educators at a high school and college level to predict satisfaction and retention for female students in math and science. Results will have meaning for career counselors who address the unique career needs of women. The results can be used to understand and impact women's interests in these traditionally male-dominated career areas.

**PART A: PROJECT INVOLVEMENT**

- 1)  Yes  No Is this project part of a Training, Center, Program Project Grant?  
Director Name: Overall IRB ID:
- 2)  Yes  No Is the purpose of this project to develop survey instruments?
- 3)  Yes  No Does this project involve an investigational new drug (IND)? Number:
- 4)  Yes  No Does this project involve an investigational device exemption (IDE)? Number:
- 5)  Yes  No Does this project involve existing data or records?
- 6)  Yes  No Does this project involve secondary analysis?
- 7)  Yes  No Does this project involve pathology or diagnostic specimens?
- 8)  Yes  No Does this project require approval from another institution? Please attach letters of approval.
- 9)  Yes  No Does this project involve DEXA/CT scans or X-rays?

**PART B: MEDICAL HEALTH INFORMATION OR RECORDS**

- 1)  Yes  No Does your project require the use of a health care provider's records concerning past, present, or future physical, dental, or mental health information about a subject? The Health Insurance Portability and Accountability Act established the conditions under which protected health information may be used or disclosed for research purposes. If your project will involve the use of any past or present clinical information about someone, or if you will add clinical information to someone's treatment record (electronic or paper) during the study you must complete and submit the Application for Use of Protected Health Information.

**PART C: ANTICIPATED ENROLLMENT**

Research Assurances 12/01/2005

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<b>Estimated number of subjects contacted to reach required enrollment: 35,000</b>	
<b>Number of subjects to be enrolled in the study Total: 35,000 Males: 0 Females: 35,000</b>	
Check if any enrolled subjects are:	Check below if this project involves either:
<input checked="" type="checkbox"/> Minors (Under 18)	<input checked="" type="checkbox"/> Adults, non-students
Age Range of Minors: 16-17	<input type="checkbox"/> Minor ISU students
<input type="checkbox"/> Pregnant Women/Fetuses	<input type="checkbox"/> ISU students 18 and older
<input type="checkbox"/> Cognitively Impaired	<input type="checkbox"/> Other (explain)
<input type="checkbox"/> Prisoners	
<b>List estimated percent of the anticipated enrollment that will be minorities if known:</b>	
American Indian:	Alaskan Native:
Asian or Pacific Islander:	Black or African American:
Latino or Hispanic:	

**PART D: SUBJECT SELECTION**

Please use additional space as necessary to adequately answer each question.

11. Explain the procedures for selecting subjects including any inclusion/exclusion criteria (*i.e.*, Where will the names come from? Will a sample be purchased, will ads, fliers, word of mouth, email list, etc. be used?).

Data will be obtained via an archival de-individuated intact data set from American College Testing. All data is gathered nationally from high school juniors and seniors who provide information regarding career choice and background when registering for the ACT assessment. A routine part of educational assessment procedures for college-bound high school students includes the ACT assessment and corresponding UNIACT interest inventory used in this study.

12. Attach a copy of any recruitment telephone scripts or materials such as ad, fliers, e-mail messages, etc. Recruitment material must include a statement of the voluntary and confidential nature of the research. Do not include the amount of compensation, (e.g., compensation available).

**Note:** Please answer each question. If the question does not pertain to this study, please type not applicable (N/A).

**PART E: RESEARCH PLAN**

Include sufficient detail for IRB review of this project independent of the grant, protocol, or other documents.

13. Describe the flow of events used in this research protocol. Include information from the first contact with the volunteers to the end of the study. Use a diagram or flow chart if appropriate. Also, include a description of the study procedures or tasks that participants will be exposed to or asked to complete. This information is intended to inform the committee of the procedures used in the study and their potential risk. Please do not respond with "see attached" or "not applicable."

This project will be carried out via a secondary data analysis (including correlational matrices of Holland career type and congruence indices reflecting relations between measured and expressed interests for each Holland career area) on an existing archival data set. There are no personal identifiers associated with the data set. The de-individuated data set has been provided with written permission from American College Testing in Iowa City, Iowa. See attached letter

14. For studies involving pathology/diagnostic specimens, indicate whether specimens will be collected prospectively and/or already exist "on the shelf" at the time of submission of this review form. If prospective, describe specimen

procurement procedures; indicate whether any additional medical information about the subject is being gathered, and whether specimens are linked at any time by code number to the subject's identity. If this question is not applicable, please type N/A in the response cell.

N/A

15. For studies involving deception, please justify the deception and indicate the debriefing procedure, including the timing and information to be presented to subjects. If this question is not applicable, please type N/A in the response cell.

N/A

#### PART F: CONSENT PROCESS

16. Describe the consent process for participants who are age 18 and older. *If the consent process does not include documented consent, a waiver of documentation of consent must be requested.*

It is unknown at this point, but possible that some participants were 18 years old at the time they completed the UNIACT and ACT assessment. These data would be part of an intact archival de-individuated data set obtained from American College Testing. No additional consent will be solicited.

17. If your study involves minors, please explain how parental consent will be obtained prior to enrollment of the minor(s).

The data are part of an intact archival de-individuated data set obtained from American College Testing. No additional consent will be solicited.

18. Please explain how assent will be obtained from minors (younger than 18 years of age), prior to their enrollment. Also, please explain if the assent process will be documented (*e.g., a simplified version of the consent form, combined with the parental informed consent document*). According to the federal regulations assent "...means a child's affirmative agreement to participate in research. Mere failure to object should not, absent affirmative agreement, be construed as assent."

The data are part of an intact archival de-individuated data set obtained from American College Testing. No additional assent will be solicited.

#### PART G: DATA ANALYSIS

19. Describe how the data will be analyzed (*e.g. statistical methodology, statistical evaluation, statistical measures used to evaluate results*)

Congruence between expressed and measured interests will be calculated using a congruence index. Data will be statistically analyzed for diversity

20. If applicable, please indicate the anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

\_\_\_\_\_ Month/Day/Year

#### PART H: BENEFITS

21. Describe the benefit to the volunteer from participating in this study, *if any*, and the benefit to society that will be gained from the study. Please note that monetary compensation is not considered a benefit.

There is no direct benefit to participants for inclusion in this sample. However, the results of this study may provide benefit to career counselors and educators at a high school and university level. These results will impact understanding of women's career development and career interests across areas.

#### PART I: RISKS

The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological, emotional, legal, social or financial risk.

22.  Yes  No Is the **probability** of the harm or discomfort anticipated in the proposed research greater than that encountered ordinarily in daily life or during the performance of routine physical or psychological examinations or tests?
23.  Yes  No Is the **magnitude** of the harm or discomfort greater than that encountered ordinarily in daily life, or during the performance of routine physical or psychological examinations or tests?
24. Describe any risks or discomforts to the subjects and how they will be minimized and precautions taken. Do **not** respond with N/A. If you believe that there will not be risk or discomfort to subjects you must explain why.

The data is an intact data set obtained through regular educational testing. Names and identifying information have been removed from the data set for secondary analysis. There will not be any risk or discomfort to subjects who completed this testing from 1 to 30 years ago.

25. If this study involves vulnerable populations, including minors, pregnant women, prisoners, educationally or economically disadvantaged, what additional protections will be provided to minimize risks?

The participants who completed the ACT assessment and UNIACT inventory were high school students, likely minors, and completed these assessments as part of usual educational experiences. The archival data are anonymous and were conveyed as an intact, de-individualized data set. No other protections are necessary to minimize risks to participants.

#### PART J: COMPENSATION

26.  Yes  No Will subjects receive compensation for their participation? If yes, please explain.

Do not make the payment an inducement, only a compensation for expenses and inconvenience. If a person is to receive money or another token of appreciation for their participation, explain when it will be given and any conditions of full or partial payment. (E.g., volunteers will receive \$5.00 for each of the five visits in the study or a total of \$25.00 if he/she completes the study. If a participant withdraws from participation, they will receive \$5.00 for each of the visits completed.) It is considered undue influence to make completion of the study the basis for compensation.

N/A

**PART K: CONFIDENTIALITY**

27. Describe below the methods that will be used to ensure the confidentiality of data obtained. For example, who has access to the data, where the data will be stored, security measures for web-based surveys and computer storage, how long data (specimens) will be retained, etc.)

The electronic data set will be stored on a password protected computer located in the principal investigator's locked staff office in the Student Counseling Service. Access to the data will be restricted via password procedures and will be limited to the principal investigator and project supervisor.

**PART L: REGISTRY PROJECTS**

To be considered a registry: (1) the individuals must have a common condition or demonstrate common responses to questions; (2) the individuals in the registry might be contacted in the future; and (3) the names/data of the individuals in the registry might be used by investigators other than the one maintaining the registry.

Yes  No Does this project establish a registry?

If "yes," please provide the registry name below.

**Checklist for Attachments**

The following are attached (please check ones that are applicable):

- A copy of the informed consent document **OR**  Letter of introduction to subjects containing the elements of consent  
 A copy of the assent form if minors will be enrolled  
 Letter of approval from cooperating organizations or institutions allowing you to conduct research at their facility  
 Data-gathering instruments (including surveys)  
 Recruitment fliers, phone scripts, or any other documents or materials the subjects will see

Two sets of materials should be submitted for each project – the original signed copy of the application form and one copy and two sets of accompanying materials. **Federal regulations require that one copy of the grant application or proposal be submitted for comparison with the application for approval.**

**FOR IRB USE ONLY:**

Initial action by the Institutional Review Board (IRB):

- Project approved. Date: \_\_\_\_\_  
 Pending further review. Date: \_\_\_\_\_  
 Project not approved. Date: \_\_\_\_\_

Follow-up action by the IRB:

\_\_\_\_\_  
 IRB Approval Signature

\_\_\_\_\_  
 Date

**SECTION III: ENVIRONMENTAL HEALTH AND SAFETY INFORMATION**

- Yes  No Does this project involve human cell or tissue cultures (primary OR immortalized), or human blood components, body fluids or tissues? If the answer is "no", please proceed to SECTION III: APPLICATION FOR IRB APPROVAL. If the answer is "yes," please proceed to Part A: Human Cell Lines.

**PART A: HUMAN CELL LINES**

- Yes  No Does this project involve human cell or tissue cultures (primary OR immortalized cell lines/strains) that have been documented to be free of bloodborne pathogens? If the answer is "yes," please attach copies of the documentation. If the answer is "no," please answer question 1 below.

- 1) Please list the specific cell lines/strains to be used, their source and description of use.

CELL LINE	SOURCE	DESCRIPTION OF USE

Add New Row

- 2) Please refer to the ISU "Bloodborne Pathogens Manual," which contains the requirements of the OSHA Bloodborne Pathogens Standard. Please list the specific precautions to be followed for this project below (e.g., retractable needles used for blood draws):

--

**Anyone working with human cell lines/strains that have not been documented to be free of bloodborne pathogens is required to have Bloodborne Pathogen Training annually. Current Bloodborne Pathogen Training dates must be listed in Section I for all Key Personnel. Please contact Environmental Health and Safety (294-5359) if you need to sign up for training and/or to get a copy of the Bloodborne Pathogens Manual (<http://www.ehs.iastate.edu/bs/bbp.htm>).**

**PART B: HUMAN BLOOD COMPONENTS, BODY FLUIDS OR TISSUES**

- Yes  No Does this project involve human blood components, body fluids or tissues? If "yes", please answer all of the questions in the "Human Blood Components, Body Fluids or Tissues" section.

- 1) Please list the specific human substances used, their source, amount and description of use.

SUBSTANCE	SOURCE	AMOUNT	DESCRIPTION OF USE
<i>E.g., Blood</i>	<i>Normal healthy volunteers</i>	<i>2 ml</i>	<i>Approximate quantity, assays to be done.</i>

Add New Row

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- 2) Please refer to the ISU "Bloodborne Pathogens Manual," which contains the requirements of the OSHA Bloodborne Pathogens Standard. Specific sections to be followed for this project are:

**Anyone working with human blood components, body fluids or tissues is required to have Bloodborne Pathogen Training annually. Current Bloodborne Pathogen Training dates must be listed in Section I for all Key Personnel. Please contact Environmental Health and Safety (294-5359) if you need to sign up for training and/or to get a copy of the Bloodborne Pathogens Manual (<http://www.ehs.iastate.edu/bs/bbp.htm>).**

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FOR ENVIRONMENTAL HEALTH AND SAFETY USE ONLY

\_\_\_\_\_  
Signature of Biological Safety Officer

\_\_\_\_\_  
Date

## Appendix E.

## Demographic items on ACT Registration

Item	Question	Possible Responses
F	Which phrase best describes your racial/ethnic background? <i>Colleges may provide special educational opportunities for students from particular racial or ethnic backgrounds. This item provides a means for you to identify yourself so that colleges may communicate with you about these opportunities. This information is released only to institutions that request it in accordance with federal guidelines.</i>	African-American/Black(non-Hispanic) American Indian/Alaskan Native Caucasian-American/White (non-Hispanic) Mexican American/Chicano/Latino Asian-American/Pacific Islander Puerto Rican/Cuban/Other Hispanic Multiracial Other I prefer not to respond
56.	I expect to apply for financial aid to help meet college expenses.	Yes, applies to me No, does not apply to me
59.	Please estimate the approximate total combined income of your parents before taxes last year	Less than 18,000 About \$18,000 to \$24,000 About \$24,000 to \$30,000 About \$30,000 to \$36,000 About \$36,000 to \$ 42,000 About \$42,000 to \$50,000 About \$50,000 to \$60,000 About \$60,000 to \$80,000 About \$80,000 to \$100,000 More than \$100,000

## Appendix F.

## UNIACT Interest Inventory

**Directions:** Indicate how much you would like doing each of the activities listed below. Mark a response to an activity even if you are uncertain how you feel about it. Consider whether you would *like* or *dislike* an activity rather than whether you have the ability to do it.

For EACH question, choose one of the answers from the scale below and mark the corresponding letter on page 2 of your registration folder. Try to answer *like* or *dislike* to as many questions as possible.

I would *dislike* doing this activity.....D

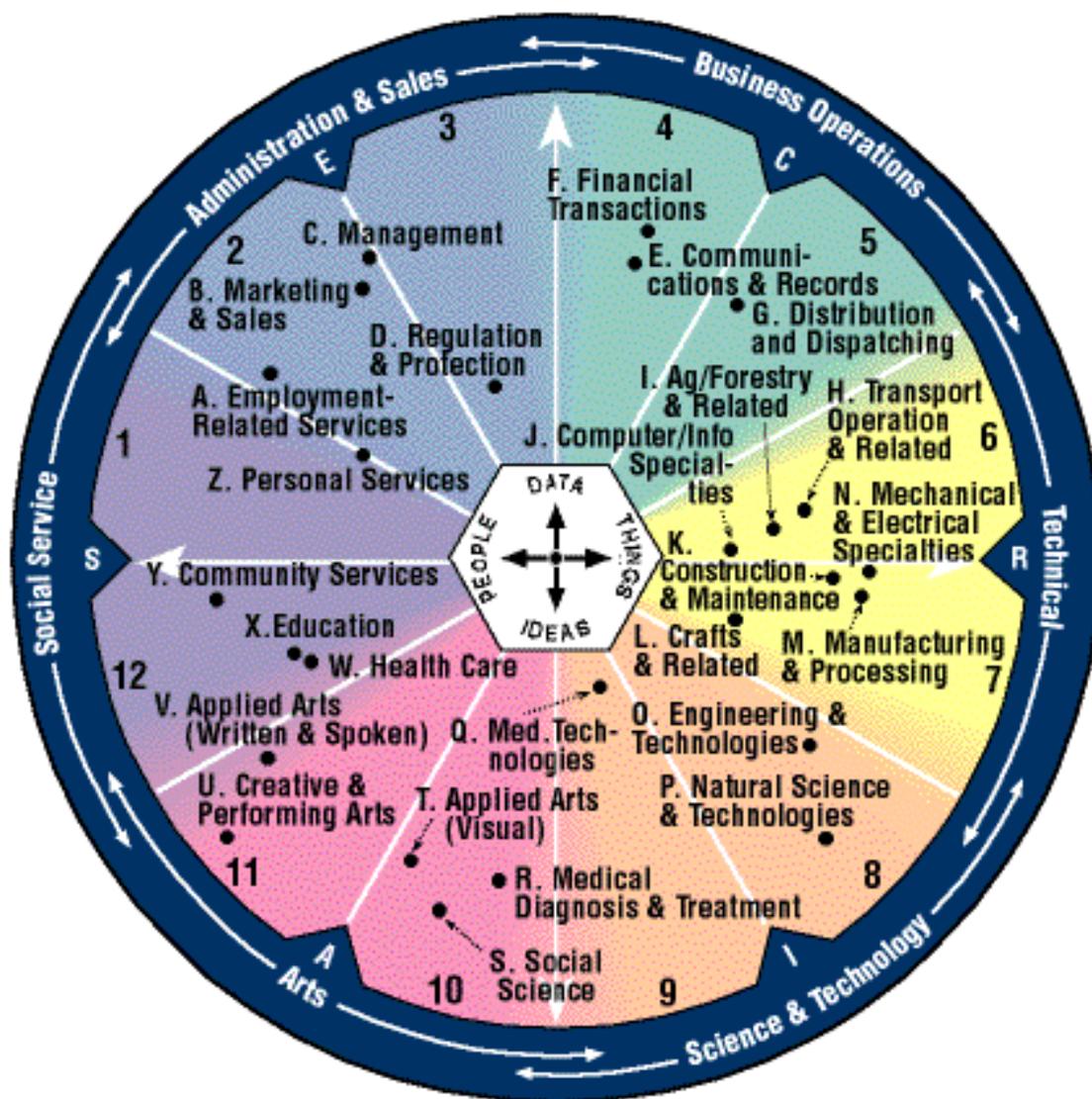
I am *indifferent* (don't care one way or the other).....I

I would *like* doing this activity.....L

- 
- |   |   |  |
|---|---|--|
| 1. Learn about star formations                            | 31. Measure chemicals in a test tube                      | 61. Use a microscope or other lab equipment            |
| 2. Sketch and draw pictures                               | 32. Prepare drawings to illustrate a magazine story       | 62. Design a metal sculpture                           |
| 3. Help someone make an important decision                | 33. Take part in a small group discussion                 | 63. Help friends with their problems                   |
| 4. Conduct a meeting                                      | 34. Plan work for other people                            | 64. Conduct business by phone                          |
| 5. Count and sort money                                   | 35. Balance a checkbook                                   | 65. Make charts or graphs                              |
| 6. Build a picture frame                                  | 36. Learn to cut and polish gemstones                     | 66. Pack things into boxes                             |
| 7. Learn how the brain works                              | 37. Read about a new surgical procedure                   | 67. Read about the origin of the earth, sun, and stars |
| 8. compose or arrange music                               | 38. Write a movie script                                  | 68. Play in a band                                     |
| 9. Give first aid to an injured person                    | 39. Find out how others believe a problem can be solved   | 69. Teach people a new hobby                           |
| 10. Develop new rules or policies                         | 40. Explain legal rights to people                        | 70. Interview workers about company complaints         |
| 11. Take inventory in a store                             | 41. Sort, count, and store supplies                       | 71. Calculate the interest on a loan                   |
| 12. Fix a toy   | 42. Repair damage to a tree after a storm                 | 72. Watch a technician repair a television             |
| 13. Explore a science museum                              | 43. Study plant diseases                                  | 73. Observe and classify butterflies                   |
| 14. Make creative photographs                             | 44. Select music to play for a local radio station        | 74. Write reviews of Broadway plays                    |
| 15. Show children how to play a game or sport             | 45. help rescue someone in danger                         | 75. Help people during emergencies                     |
| 16. Work in a political campaign                          | 46. Demonstrate a new product                             | 76. Hire a person for a job                            |
| 17. Write payroll checks                                  | 47. Plan a monthly budget                                 | 77. Keep expense account records                       |
| 18. Run a lawn mower                                      | 48. Design a bird feeder                                  | 78. Prune plants and shrubs                            |
| 19. Attend the lecture of a well-known scientist          | 49. Read books or magazines about new scientific findings | 79. Study the effects of vitamins on animals           |
| 20. Writs short stories                                   | 50. Play jazz in a combo                                  | 80. Design a poster for an event                       |
| 21. Work on a community improvement project               | 51. Help settle an argument between friends               | 81. Entertain others by telling jokes or stories       |
| 22. Present information before a group                    | 52. Campaign for a political office                       | 82. manage a small business                            |
| 23. Set up a bookkeeping system                           | 53. Find errors in a financial account                    | 83. Look for errors in the draft of a report           |
| 24. Watch for forest fires                                | 54. Engrave lettering or designs on a trophy or plaque    | 84. Shelve books in a library                          |
| 25. Study biology   | 55. Study chemistry                                       | 85. Learn how birds migrate                            |
| 26. Read about the writing style of modern authors        | 56. Draw cartoons   | 86. Play a musical instrument                          |
| 27. help a newcomer meet people                           | 57. Give directions to visitors                           | 87. Give a tour of an exhibit                          |
| 28. Discuss a misleading advertisement with a salesperson | 58. Publicize a show or athletic event                    | 88. Conduct a door-to-door opinion poll                |
| 29. Prepare a budget for a club or group                  | 59. Figure shipping costs for catalog orders              | 89. Operate office machines                            |
| 30. Build furniture                                       | 60. Assemble a cabinet from written instructions          | 90. Inspect products for defects                       |

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Appendix G.  
World of Work Map



Appendix H.  
ACT List of College Majors and Occupational Choices

400	Undecided	585	Pre-elementary (early child) Education	758	Pharmacy (pre-pharmacy)
<b>410</b>	<b>AG SCI &amp; TECH, General</b>	586	Secondary Education	759	Physical Assisting
411	Agricultural Business	587	Student counseling/Service	760	Physical Therapy/Assisting
412	Agricultural Economics	588	Teacher Aide	761	Radiology/Radiological Technology
413	Agricultural Mechanics			762	Recreational/Art/Music therapy
414	Agricultural Production/Technology	590	<b>TEACHER EDUCATION, General</b>	763	Respiratory Therapy/Technology
415	Agronomy (e.g. field crop management, soils)	591	Agricultural Education	764	Speech Pathology/Audiology
416	Animal Sciences (e.g. animal breeding, dairy, poultry)	592	Art Education	765	Veterinarian Assisting
417	Farm and Ranch Management	593	Business Education	766	Veterinary Medicine (pre-veterinary)
418	Fish, Game, and Wildlife Management	594	English Education		
419	Food Sciences/Engineering	595	Foreign Languages Education	780	<b>HUMAN, FAMILY, &amp; CONSUMER SCI, General</b>
420	Forestry (pre) & Related Science	596	Health Education	781	Child Dev., Care, and Guidance
421	Horticulture/ Ornamental Horticulture	597	Human Family and Consumer Science Education	782	Child Care Aide/Assisting
422	Natural Resources Management	598	Industrial Arts Education	783	Culinary Arts/ Chef Training
		599	Mathematics Education	784	Family/Consumer Resource Management
<b>430</b>	<b>ARCHITECT &amp; ENVIRONMENT DESIGN, General</b>	600	Music Education	785	Fashion Design and Illustration
431	Architectural Drafting/CADD	601	Physical Education	786	Food Production, Manager, & Services
432	Architecture (pre-architecture)	602	Science Education	787	Food Sciences & Nutrition/Dietetics
433	Building Construction/ Construction Science	603	Social Studies/ Sciences Education	788	Human Environment and Housing
434	City, Community, & Regional Planning	604	Speech Education	789	Individual and Family Development
435	Environmental Design	605	Speech Correction Education	790	Textiles and Clothing
436	Interior Design	606	Teaching English as Second Language		
437	Landscape Architecture	607	Technical/Trade and Industrial Ed	800	<b>LETTERS, General</b>
		608	Education, Other Subject Areas	801	Classics
<b>450</b>	<b>BUS. &amp; MANAGEMENT, General</b>			802	Comparative Literature
451	Accounting	<b>620</b>	<b>ENGINEERING (PRE-), General</b>	803	Creative Writing
452	Banking and Finance	621	Aerospace Engineering	804	English, General
453	Business Administration & Management	622	Agricultural Engineering	805	Linguistics
454	Business Economics	623	Architecture & Biosystems Engineer	806	Literature, English/American
455	Contract Management & Procurement/Purchasing	624	Bio and Biomedical Engineering	807	Speech and Rhetorical Studies
456	Hotel/Motel/ Restaurant Management	625	Ceramic engineering		
457	Human Resources Deve./Training	626	Chemical Engineering	810	<b>MATEMATICS, General</b>
458	Institutional management	627	Civil Engineering	811	Actuarial Sciences
459	Insurance and Risk management	628	Computer Engineering	812	Applied Mathematics
460	International Business Management	629	Construction Engineering	813	Statistics
461	Labor/Industrial Relations	630	Electric, Electronic & Communication		
462	Management Information Systems	631	Engineering Management	820	<b>PHILOSOPHY, RELIGION, General</b>
463	Management Sciences	632	Engineering Physics	821	Bible Studies
464	Marketing Management and Research	633	Engineering Science	822	Philosophy
465	Organizational Behavior	634	Environmental health Engineering	823	Religion
466	Personnel/Human Resource Manage	635	Geological Engineering	824	Religious Education
467	Real Estate	636	Industrial Engineering/Technology	825	Religious Music
468	Small Business/ Entrepreneurial Studies	637	Materials Engineering	826	Theology/Theological Studies
469	Trade & Industry Sup & Management	638	Mechanical Engineering		
470	Transportation Management	639	Metallurgical Engineering	830	<b>SCI (BIO &amp; PHYSICAL). General</b>
		640	Mining and Mineral Engineering	831	Astronomy
<b>480</b>	<b>BUSINESS &amp; OFFICE, General</b>	641	Naval Architecture & Engineering	832	Atmospheric Science/Meteorology
481	Bookkeeping/Accounting Technology	642	Nuclear Engineering	833	Biochemistry and Biophysics
482	Business Data Processing/ Computer	643	Ocean Engineering	834	Biology
483	Court Reporting	644	Petroleum Engineering	835	Botany
484	Office Supervision and Management	645	Systems Engineering	836	Chemistry
485	Secretarial (executive, legal, medical)			837	Earth Science

486	Typing and General Office	660	<b>ENGINEERING-RELATED TECH,</b> General	838	Ecology/Environmental Studies
487	Word Processing	661	Aeronautical technology	839	Geology
		662	Air, Heat, & Refrigeration Tech.	840	Microbiology
<b>510</b>	<b>MARKETING &amp; DISTRIB.,</b> General	663	Architectural Design/Technology	841	Oceanography
511	Fashion Merchandising	664	Biomedical Equipment Technology	842	Physics
512	Retailing and Sales	665	Civil Engineering Tech.	843	Zoology
513	Travel Services and Tourism	666	Computer Engineering Tech.		
		667	Construction/Building Tech.	850	<b>SOCIAL SCIENCES,</b> General
<b>520</b>	<b>COMMUNIC. &amp; TECH.,</b> General	668	Drafting and Design Tech./CADD	851	Anthropology
521	Advertising	669	Electrical Engineering Tech	852	Economics
522	Graphic/Commercial Art & Illustration	670	Electronic Engineering Tech.	853	Geography
523	Graphic and Printing Communications/Technologies	671	Electromechanical Instrumentation	854	History
524	Journalism	672	Environmental Control Tech.	855	International Relations
525	Photography/Film/Video Technology	673	Industrial Production Technologies	856	Law (pre-law)
526	Public Relations	674	Laser/Fiber Optic Technology	857	Legal Assisting/Paralegal
527	Radio/Television Broadcasting	675	Manufacturing Technology	858	Political Science/Government
528	Radio/TV Production and Technology	676	Mechanical Engineering Technology	859	Psychology
		677	Mining and Petroleum Technology	860	Sociology
<b>540</b>	<b>COMMUNITY &amp; PERSONAL SERVICES,</b> General	678	Occupational Safety & Health Technology	861	Urban Studies
541	Corrections	679	Surveying and mapping Technology		
542	Cosmetology/Hairstyling	680	Engineering Related Tech, other	870	<b>TRADE &amp; INDUSTRY,</b> General
543	Criminal Justice/Criminology			871	Aircraft Technician
544	Fire Protection/ Control & Safety Tech	720	<b>FOREIGN LANGUAGES,</b> General	872	Airplane Piloting
545	Funeral Services	721	Asiatic Languages	873	Automotive Body Repair
546	Law Enforcement and Administration	722	Classical Languages	874	Automotive Technology
547	Library Science/Library Assisting	723	French	875	Aviation Management
548	Military Science/Technology	724	German	876	Computer Electronics/repair
549	Parks and Recreation	725	Italian	877	Construction Trades and Carpentry
550	Public Administration	726	Middle Eastern languages	878	Diesel Engine Mechanics
551	Public Affairs	727	Russian	879	Drafting/CAD
552	Social Work	728	Spanish	880	Electrical Equipment Repair
		729	Foreign Languages, Other	881	Heating/Air /Refrigeration Repair
<b>560</b>	<b>COMPUTER &amp; INFO SCI,</b> General			882	Machine Technology
561	Comp. Program/Software Engineering	<b>740</b>	<b>HEALTH SCI &amp; FIELDS,</b> General	883	Mechanical Drafting/CAD
562	Computer Science	741	Chiropractic (pre-chiropractic)	884	Welding and Welding Technology
563	Data Processing	742	Dental Assisting		
564	Information Science and Systems	743	Dental Hygiene	920	<b>VISUAL &amp; PERF. ARTS,</b> General
565	Math/Computer Science	744	Dental laboratory/Technology	921	Applied Design/Crafts
		745	Dentistry (pre-dentistry)	922	Art (e.g., painting, drawing, sculpture)
<b>570</b>	<b>CROSS-DISCIPLINE,</b> General	746	WMT-Ambulance/Paramedic	923	Art History and Appreciation
571	Area and Ethnic Studies	747	Health Care Administration	924	Cinematography/FilmVideo
572	Liberal Arts/General Studies	748	Medical/Surgical Assisting	925	Dance
573	Multi/Interdisciplinary Studies (e.g., peace studies, women's studies)	749	Medical Laboratory/Technology	926	Design, General
		750	Medical Records Admin./Tech	927	Drama/Theater Arts
<b>580</b>	<b>EDUCATION, General</b>	751	Medicine (pre-medicine)	928	Fine Arts, General
581	Adult and Continuing Education	752	Mental Health & Human Services/Technology	929	Graphic Arts Technology
582	Education Administration	753	Nuclear Medicine Technology	930	Graphic Design
583	Elementary Education	754	Nursing (practical nursing)	931	Music (liberal arts)
584	Junior High/Middle School Education	755	Nursing (registered/BSN)	932	Music Performance
		756	Occupational Therapy/Assisting	933	Music Theory and composition
		757	Optometry (pre-optometry)	934	Photography

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