AWE Assessing Women and Men in Engineering
In Partnership with the Society of Women Engineers

Overview: Career Development Theory for Women in Engineering

Career counseling and career theory provide insight into the reasons and ways people choose their careers with a focus on assisting people in finding satisfaction in their work lives. While most WIE directors are not formally educated in career development theory and practice, or even explicitly expected to provide career counseling, they will inevitably be in a position to provide support and guidance to women who have chosen (or have yet to choose) a unique and perhaps difficult career path.

When choosing from theoretical perspectives, a counselor of women in non-traditional paths must choose wisely from the literature on career theory, which ranges from the traditional to the currently alternative. While traditional models have been criticized for their focus on middle-class males, newer, more diverse models have yet to be tested. Crozier (1999) and Cook, Heppner & O'Brien (2002) provide the following assumptions at the core of traditional theories that are problematic for women:

- Work is central to people's lives.
- Work is the primary role for developing identity.
- Work is the primary means of meeting one's needs.
- The paid work role can and should be isolated from other major life roles such as family roles.
- Career counseling should be separated from personal or lifestyle counseling.
- Career achievement is accomplished independently; achievement is completely in the control of the individual and is based solely on ability and initiative.
- The structure of opportunity characterizes occupational choices as made freely without barriers, limitations, or stereotypes.
- Career development is progressive, rational and linear.

Newer models seek to address the concern that women's career development is often non-linear, both complemented and frustrated by multiple-role fulfillment, and shaped by the structure of opportunity. Such models often take into consideration the larger social context in which people function, opening a broader range of opportunities for intervention.

Career Development Theory for Women in Engineering Sections

Career Development Theory

Career counseling and career theory provide insight into the reasons and ways people choose their careers with a focus on assisting people in finding satisfaction in their work lives. While most WIE directors are not formally educated or even expected to provide career counseling, they will inevitably be in a position to provide support and guidance to women who have chosen a unique and perhaps difficult career path. In addition, they have frequent opportunities to encourage young women to expand their career options in non-traditional directions. The material presented here introduces the major theories of career development as well as some contemporary alternatives specifically designed with women in mind, and also discusses some of the unique aspects of the careers and choices of women and engineering. Finally, AWE offers suggestions for improving recruitment and retention of women in engineering based on the information gleaned from career theories and research.

Three theories stand out in the career development literature. These are: Super's Developmental Stage Theory (1957; 1991) Holland's Person-Environment Fit Theory (1997), and Social Learning Theory, emphasizing self-efficacy derived from the work of Bandura (1977) and furthered in application to careers by Lent, Brown and Larkin (1984) and Betz and Hackett (1981). Each of these theories offers a different perspective on career development and has different strengths and weaknesses for explaining and aiding in women's success in engineering. None propose to explain the entirety of career choice and satisfaction, but each seeks to address what their authors see as the most salient factors. A brief introduction to these three enduring classics follows below, including descriptions of contemporary and innovative alternatives. The latter seek to explain career development from women's perspectives and to place career development in a broader social or psychological context.

Super (1957; 1991) proposed a life-span developmental model of career development which centered on self-concept rather than traits (e.g. Holland, see below). Originally conceptualized as linear, Super came to consider the stages of career development to be potentially cyclical. One of the more holistic models of career development, Super's model takes into consideration the role of the environment in shaping individual self-concepts. Yet the complexity of his understanding also makes conducting research based on his model more difficult and does not offer the kind of predictive promises many clients seek during times of career transitions (Vondracek & Porfeli, 2002). The vocational development tasks and stages are listed below in Tables 1 and 2.

Table 1. Super's Vocational Development Tasks

Vocational Development Task	Ages	General Characteristics
Crystallization	14-18	Developing and planning a tentative vocational goal
Specification	18-21	Firming the vocational goal
Implementation	21-24	Training for and obtaining employment
Stabilization	24-35	Working and confirming career choice
Consolidation	35+	Advancement in career

Source: http://susanroudebush.home.mindspring.com/courses/lesson4.html

Table 2. Super's Vocational Development Stages

Stage	Age	Characteristics
Growth	Birth – 14 or 15	Form self-concept; develop capacity, attitudes, interests, and needs, and form a general understanding of the world of work.
Exploratory	15-24	"Try out" through classes, work experience, hobbies. Collect relevant information. Tentative choice and related skill development.
Establishment	25-44	Entry skill building and stabilization through work experience.
Maintenance	45-64	Continual adjustment process to improve position.
Decline	65+	Reduced output, prepare for retirement.

Source: http://susanroudebush.home.mindspring.com/courses/lesson4.html

These stages and tasks are used to help clients understand their current situation and to develop appropriate interventions.

In contrast to Super's Developmental approach, Holland's (1997) theory offers a typology of personality traits that classifies both people and their work environments as: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. These types are presented in a hexagonal model, with the types opposite each other the least congruent and those next to each other most congruent (see below). The extent to which an individual's personality type matches the work environment predicts outcomes including vocational choice, vocational stability and achievement, educational choice and achievement, personal competence, social behavior and susceptibility to influence.

Figure 1. Holland's Hexagonal Model of Personality Types
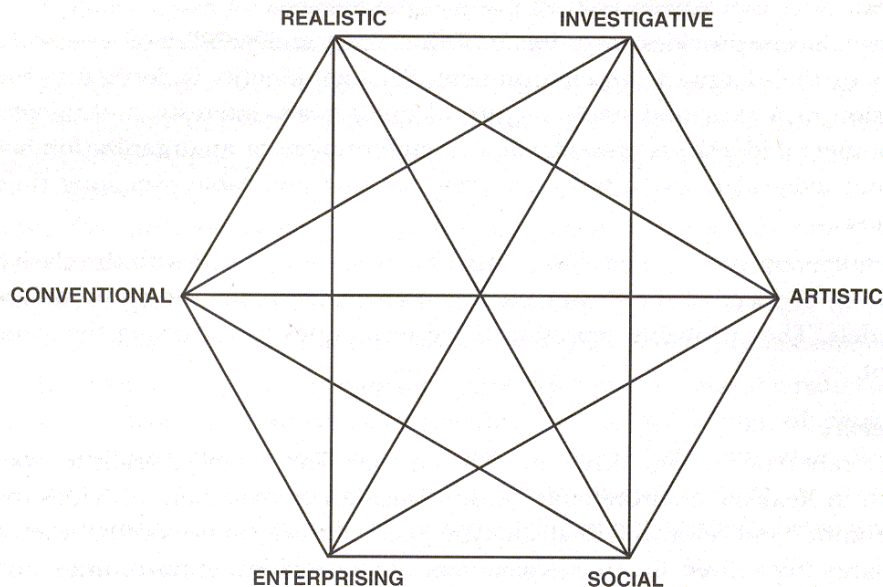
Source: Holland, J. L. (1997). *Making vocational choices: a theory of vocational personalities and work environments*. Odessa: FL: Psychological Assessment Resources.

Holland considers these personality traits to be stable over time and, although he mentions the contribution of gender in constraining choices (1997, p. 14), he is not particularly concerned with how personalities are formed or in changing our social environment to offer more and better opportunities. It is not surprising to find that researchers concerned with women's career development find these aspects of Holland's theory problematic. If women's options are restricted early in life by gender socialization and are unchangeable, and if there is no emphasis on removing systematic institutional barriers, then there is little room for expanding women's options outside of their traditional gender roles. In fact, empirical research on Holland's theory finds that women are disproportionately represented in the "social" category whereas men obtain significantly higher scores in the "realistic" category. Given that, Holland's model may appear to be useful only in identifying the few women who would score high for engineering while the rest would continue onward into their gender prescribed careers. Yet Holland does shed some light on how women cluster into particular occupations that may not actually represent their personalities. These are offered under the heading of "maladaptive career development" and occur when (p. 196-7):

1. A person has insufficient experience to acquire well-defined interests, competencies, and self-perceptions.
2. A person has had insufficient experience to learn about the major kinds of occupational environments.
3. A person has had ambiguous, conflicting, inaccurate, or negative experience concerning his or her interests, competencies, or personal characteristics.
4. A person has acquired ambiguous, conflicting, inaccurate or negative information about the major work environments.
5. These deficiencies lead to beliefs about the self and the occupational world that make it difficult for the person to translate his or her personal characteristics into occupational opportunities.
6. Some persons lack the personal, educational, or financial resources to carry out their plans.
7. Some persons with consistent differential profiles and a clear sense of identity are unable to find congruent work because of economic or social barriers.

For those accustomed to thinking about women's career development and are familiar with literature on gender socialization and discrimination, the above may sound more like the norm than the exception. Gender socialization acts to constrict the experiences of men and women and provides reinforcement for gender appropriate behaviors and interests, regardless of a person's original desires (Valian, 1998), and overt and subtle discrimination will cause the final two forms of "maladaptive career development" to appear more often in the lives of all but the most advantaged.

Holland's theory is a purposefully straightforward attempt to simplify a very complex phenomenon. For that reason, it is tempting for people exploring careers to limit their use of Holland's theory to determining their personality type and picking from the list of matching jobs. That strategy, however, is a misuse of the tools which are meant to be used as part of an investigative process that may include exploration of the issues such as those listed above.

The third of these theories, Social Learning Theory, offers more flexibility for human growth and development over the lifespan, and is therefore more widely used by gender equity theorists. Farmer (1997) explains the theoretical orientations of social learning theory within the career development theory of two prominent researchers – Krumboltz (1996) and Lent, Brown, and Larkin. (1996) who both base their work on Bandura's social learning theory. Krumboltz outlined a series of concepts related to learning: associational learning, instrumental learning, the influence of genetics on learning, and self-observation learning. Krumboltz also developed the Career Beliefs Inventory (1991) to assess self-beliefs that influence the career development process. Lent et al. (1996) have focused on self-efficacy, outcome expectations, and goals. A substantial volume of research has been conducted from the latter theoretical perspective, verifying self-efficacy's centrality to academic choices, achievement, and persistence.

In recent years, career theories have been criticized for not addressing those issues specific to women's lives and for resting upon problematic assumptions. Cook, Heppner, and O'Brian (2002) note, "career counseling, as widely practiced today, evolved at a time when the typical career client was young, male, white, able-bodied, publicly heterosexual, and ethnically

homogenous" (p. 291). Crozier (1999) and Cook et al. (2002) provide the following assumptions at the core of traditional theories that are problematic for women:

- Work is central to people's lives.
- Work is the primary role for developing identity.
- Work is the primary means of meeting one's needs.
- The paid work role can and should be isolated from other major life roles such as family roles.
- Career counseling should be separated from personal or lifestyle counseling.
- Career achievement is accomplished independently; achievement is completely in the control of the individual and is based solely on ability and initiative.
- The structure of opportunity characterizes occupational choices as made freely without barriers, limitations, or stereotypes.
- Career development is progressive, rational and linear.

In contrast, women's career development is often non-linear, both complemented and frustrated by multiple-role fulfillment, and shaped by the structure of opportunity. After reviewing a decade of research on women's career development, Phillips & Imhoff (1997) conclude that recent research has better reflected the complexity of women's lives. The "increase in the sophistication of questions that are asked, the development of integrative models, and the capability of researchers to embed their studies and findings in larger individual and environmental contexts are all significant accomplishments" (p. 49). Such research also serves as "a note of caution to those who are tempted to focus on singe-factor explanations, to ask fragmentary questions, or to decontextualize a problem…such approaches are severely limited" (p. 49). This "word of caution" is duly noted in both revisions of older theories and in the development of new theories specific to women's career development.

In some cases, existing theories have been adapted and several new theories have been offered specifically for understanding women's career development. Pajares (e.g. 2004), Betz and Hackett (1981, 1983) have made major contributions to understanding self-efficacy in terms of women's career development. Since this material is covered elsewhere, the reader is referred to "Self-Efficacy" for a more thorough review of that literature as it relates to women in engineering.

Relational theory. This perspective offered by Crozier (1999) is a work in progress based on Gilligan's (1982) theory of women's identity development and Belenky, Clinchy, Goldberger & Tarule's (1996) theory of women's "ways of knowing." In line with their theoretical work, Crozier offers a postulated theory based on her own "constructed knowing" that is a combination of research and theory from the literature and her own experience as a practicing career counselor. This theory has not yet been empirically tested. Although there are some problems with this early formulation, it is in some ways a unique new approach to understanding women's career development.

Crozier (1999) applies Gilligan's three stages of moral development to women's careers. According to Gilligan, women's lives begin with an orientation to survival and self-interest, the first stage of their development begins with recognizing this as self-centered and selfish. The

second stage emphasizes connection and interdependence with others and values self-sacrifice. In the third stage, women seek balance between the two. The implications for women's career development lie in the need to seek and balance nurturing experiences with those that are self-serving. Components of women's relational sense of identity are such desires as helping others, working with people, making a meaningful contribution, etc. The accompanying skills include human relations skills, communications skills and interests that are socially related. Women may seek occupations in which they serve others while using their existing skill sets. They may also desire positions in which they may apply "intuitive and subjective" forms of knowledge, as prescribed by Belenky, et. al. (1986). Crozier relies on support from research on the Holland themes that does indeed show more women drawn to social and artistic occupations (Chusmir, 1990, cited in Crozier). Crozier points out that women are neither suited *only* to these roles, nor should they be denigrated for participating in them. Women may, however, be encouraged to venture into new territories such as engineering by being made of aware of how they may satisfy their relational needs and apply their skills of intuition and nurturing in these fields.

The relational model of women's career development offers a new way of thinking about women's careers. Some cautions are in order, however. The first, already mentioned, should be reiterated. There is no known empirical research conducted specifically to support the model. Further, it rests almost exclusively on two pieces of research from the mid-1980's. This foundation can only be as strong as that original research and possibly that which has supported it to the present day. This brings us to the more complex problems of the theory and its research foundations. The theory and research are not able to say how many and what kinds of women are "relational," either morally or cognitively, nor under what contexts and in what proportions compared to men[1]. Nor does relational model address the ways in which such identity and cognitive styles may develop. Given the possibility that these are socially structured, along with the potential negative consequences for 1) characterizing women as essentially different from men at their intellectual and moral core and 2) women's and society's acceptance of the generalization of this characterization, great caution should be exercised in tailoring interventions based on relational theory.

Another aspect of this theory that warrants more attention is the idea of stages. The authors do not state when these stages occur,, nor whether they are sequential, simultaneous or cyclical. The only indication as to a woman's age during these stages occurs as a discussion of women's "mid-life career crisis" and of a transitional period "at about age thirty" when women are presumed to seek balance from their previously nurturing roles. If the theory is to address the career paths of women who attend college, then the theory must delve into the complexities and contradictions of young women's romantic lives, peer relationships, professional and academic aspirations, plans for childrearing, and the relative freedom of self-centered fulfillment available during undergraduate education. The freedom of self-fulfillment of the early college years contrasts sharply with self-sacrificing years of dual careers and child rearing that come next in the lives of college graduates who may have postponed childbearing into their thirties.

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[1] Cook, Heppner & O'Brienh (2002) explain that the use of "many" or "some" rather than total generalizations or attempts to further categorize arise out of the need to develop a new model that embraces diversity. "Little justice," they say "would be done on behalf of marginalized individuals if a new singular mold was simply substituted for previous models of career development" (p. 292).

For some, the early parenting years are followed in short order by caring for elderly parents. In that case, balance may be even further in the future. In short, women's life cycles frequently vacillate in emphasis between times of caring for the self and/or others. The theory makes room for this on the one hand by acknowledging women's multiple roles and career patterns but, on the other, limits its applicability by using the term "stage" and suggesting timelines for those stages. For this theory to have meaning for career development, especially at the initial point of choosing an undergraduate major, these issues need further investigation.

Ecological Model. Developed in response to the limits of traditional career counseling, the ecological model is under development as a tool to "stimulate new thinking." At its core is the idea that "human behavior results from the ongoing, dynamic interaction between the person and the environment." The environment in this case is defined by Bronfenbrenner's ecological model (1979) as microsystems (interpersonal interactions), mesosystems (relationships between two microsystems), exosystems (linkages between subsystems, such as neighborhoods or media that indirectly influence individuals) and macrosystems (ideological components of a society). The goal of ecological counseling is to shape the optimal person-environment fit. Ecological interventions span these environmental levels and may include: clarifying and affirming women's life options, managing multiple roles, obtaining quality childcare, creating healthy working environments, improving access to role models and mentors, and equalizing salaries (Cook, et al, 2002). Regarding the ecological model, Betz (2002) cautions that not all women are relationally oriented, willing to compromise their careers for family reasons, or consider their relationships when making career decisions. Further, Betz (2002) is concerned that the ecological model increases the complexity of assessment and "makes research difficult." Here a caution on the caution is warranted. In the *Handbook of Vocational Psychology* (Walsh & Osipow, 1995), other theories have been rejected for a lack of "heuristic value." Note that this has nothing to do with its value to counseling or to its potential relationship with truth, but rather the ease with which the theory may advance a particular research agenda.

Possible Selves. Possible Selves (Markus & Nurius, 1986) is a psychological theory in which people hold images of what they hope, expect, or fear becoming in the future. In this theory, behavior is motivated by avoiding feared images and pursuing hoped-for images. Packard and Nguyen (2003) examined the career interests of girls who participated in an intensive summer camp for high school girls interested in science. Of the 41 participants, only 6 of the 30 participants who expressed an initial career interest in a science related field maintained that interest into college. The intention of the research was not to gauge the effectiveness of the intervention, but rather to examine the ways in which "possible selves" shape career paths. The idea that girls hold at the outset a collection of "possible selves" is compelling. More information is needed to explain how initial ideas are developed and about how the process of adding to and subtracting from that collection unfolds.

The theories detailed above offer a number of ways to understand women's career development. Since it does not appear that any one of these theories fully explains career development for all women, perhaps most useful at this point in time is the variety of theories from which to draw upon. Thirty years ago women's careers would have been compared only to standards, developed for men, which assumed women value their work lives above all of life's other priorities. New theories take into consideration the multiple roles both men and women are

expected to value and fulfill as well as the myriad, ever-changing social circumstances in which we operate.

Factors Affecting Non-Traditional Career Choice for Women
        The definition of "non-traditional career path" is influenced by several factors: variation by researcher, point in time, age of participants, data collection methods, and data reporting practices. While different researchers have defined "non-traditional careers for women" in different ways, one of the most prevalent is that of Betz & Hackett, who based their definitions on the percentage of women employed in an occupation. Traditional careers were defined as those with 70% women and non-traditional careers as those occupied by women at 30% or less (Betz & Hackett, 1981). Included in this definition are positions that do not require academic training, those that require two-year degrees and those that require four years or more of higher education. For our purposes here, the discussion will be confined to academic and professional pursuits that require a four-year degree in science, mathematics, engineering and/or technology. Occasionally, however, the original research discussed has not clearly defined "non-traditional" or "SMET." In this document the researchers' definitions have been given with as much clarity as possible.
        Just as researchers define "non-traditional" differently among themselves, the idea of what is "traditional" employment for women is also changing in the broader context. Over the course of the past three decades, we have seen dramatic changes in women's workforce and educational participation in the United States. Women are now attending college in higher percentages than men and have increased their proportion of enrollment in every discipline. For some disciplines women have moved from minority to more-than-equal status, such as in agriculture and biological sciences. Even in math, where some would argue there is (or at least has been) a strong stereotype against women's achievement, women have made great strides, to move from receiving 33.3% of the degrees to 46.8%. Since math is considered a "gateway" subject in which achievement is necessary for advanced SMET options, this increase is promising for subsequent increases in engineering and technology. Yet in other fields, where progress has also been substantial, great gender disparity still exists. For example, women received than 1% of engineering degrees in 1966; in 1998, they received over 18% of engineering degrees.. This increase is substantial and marks considerable progress, yet is not enough to transform engineering into a "traditional" field for women.
        The dynamic nature of gender composition in the workforce means that the age of participants may affect their perception of jobs that are appropriate for men, for women, or both. Young participants may sense that it is not socially acceptable to suggest that jobs are or should be gender-segregated. Conversely, some may not have the introspective skills to determine the level to which they conform to stereotypes even when their actual interests may be different. Researchers are not immune to gender socialization, either, and have been known to consciously or unconsciously design gender discrimination into their measurement instruments (see discussion of Holland Code above) or fail to inquire about the changing world of contemporary generations in comparison to their own. The final issue is the age of those studied in WIE literature and for whom interventions are designed. Because the participants in AWE are situated in college and university settings, this review will focus on undergraduate women in engineering. This is not meant to minimize the importance of efforts by AWE directors and others that focus on earlier stages of education or support female graduate students and

faculty in SMET fields. Efforts directed at the improvement of opportunity for women off all ages are valuable in their own right and may well have positive impacts for women in other segments of society.

Data collection and reporting must disaggregate data to provide the greatest level of detail about entry and persistence in engineering. Women are not underrepresented in all SMET fields. When statistics include fields such as social and behavioral sciences or biology, the percentage of women completing SMET degrees appears much higher. In 1998, for example, women represented 72 percent of those entering psychology (National Science Board, 2002). When psychology and other social sciences are excluded, the percentage of women completing Bachelor's degrees in SMET ranges from a low of 18.6 in engineering to a high of 52.7 in agricultural and biological sciences. Within engineering, women remain segregated by subfield, with 32.7 percent in chemical engineering and only 12.2 in mechanical engineering (*Women, Minorities, and Persons with Disabilities in Science and Engineering*, 2002). Data collecting and reporting practices must take these differences into consideration.

Researchers, acknowledging both the progress and the continued disparities in gender composition within most SMET degree fields, have focused energies on multiple aspects of the problem. These range from individual level description of the characteristics of women who enter and persist in engineering to institutional and societal level perspectives. In some respects, these have mirrored the framework Rosser (1997) developed to explain the progression of feminist activism. In phase models, it is first noted that women are absent from a particular setting; analysis then ensues along ever-progressing lines of complexity and sophistication, ending at a final stage of integration and transformation that is free of sexism, racism, classism, and heterosexism. Since 1997, when Rosser developed her model, many WIE programs have continued to focus on individual level interventions. For that reason, and the fact that most literature on career development continues to focus on individual rather than systems-level interventions, this piece tends toward an individual focus.

Gender Socialization in Entry and Persistence in Engineering

Children are socialized to conform to their feminine or masculine roles from birth. This process constrains the behaviors that are acceptable for boys and girls, shaping their experiences and subsequently forming their self-perceived competencies, values, and aspirations (Eccles, 1986). For women this means coming to value their expected roles a caregivers and cultivating the interpersonal skills that promote nurturing (Metzler-Brennan, Lewis & Gerrard 1985). These skills and values are acquired early in life and are then translated into career choices offering congruence between work and all that is required by femininity (Phillips & Imhoff, 1997)[2]. In general, characteristics associated with femininity cluster work choices around those that offer intrinsic rewards in a relational context and are seen as helping people (Whiston & Brecheisen, 2002).

Considerable evidence suggests that SMET careers are not perceived to as consistent with feminine identity. Lee (1998) points to research from the early 1980's showing that women with more feminine gender identities (Baker, 1987; Boswell, 1985; Handley & Morse, 1984; Hollinger, 1983) and those with perceptions of greater gender barriers to studying science (Barnett, 1975) are less likely to pursue SMET fields. Women may leave SMET may do so in order to pursue careers with greater evidence of making social contributions (Sax, 1994). Conversely, a scientific self-concept is related to success in SMET classes and to positive attitudes toward science and technology. This is most directly evident in women's differential performance on an engineering skills test in which women performed worse than men when the stereotype threat was high and equally well when no stereotype threat was present (Bell, Spenser, Iserman and Logel, 2003). Additionally, those with more instrumental and expressive traits as well as more egalitarian attitudes about women's roles are more likely to pursue non-traditional careers (Phillips & Imhoff, 1996). Therefore, the less a woman conforms to traditional notions of femininity, the more likely she is to pursue a career in engineering. The opposite is also true. Nosek, Banaji, and Greenwald (2002) explain how subtly gender socialization creates the illusion that women are not actively prevented from pursuing math-related careers. Their research on women's identity development led them to conclude that social learning, constrained by social group identity and stereotypes, affects interests and choices. These findings are similar to those of Lee (1998), who found that female students aligned masculine identities with those of scientists while identifying for themselves traditional occupational choices. Thus, it may appear that women do not enter into SMET fields simply because they are not interested, but interest is actually determined by complex and gendered social interactions.

Although women who enter engineering resist gender stereotypes, they continue to express a struggle with their gender role identity throughout their education. A number of studies investigate the ways in which women negotiate femininity in engineering (Seymour & Hewitt, 1997; Walker, 2001; Henwood, 1996; 1998). One approach is to assume characteristics of masculine identity. This tactic may be especially appealing to women attracted to engineering because of the status and rewards offered by a masculine profession (Henwood, 1996). Walker explains that a portion of the participants in her study considered themselves to be different from their female peers in other fields, claiming to be "more like the boys" (p. 81). Women also consistently report the need to excel when it is acceptable for their male peers to show average

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[2] For a full and detailed explanation of this process, along with supporting empirical research see Valian (1999).

performance (Henwood, 1996; Eden, 1992). In so doing women have something to support their confidence and achieve respect from their professors (McIlwee & Robinson, 1992). Yet in identifying with masculinity and holding themselves to exceptional standards, the women faced several problems. They did not change an environment hostile to women but rather conformed to it; they did not redefine femininity in terms of scientific competency; and they remained, despite their best efforts, women in a man's world. This strategy is also difficult both for the women who assume it and for the women who strive to maintain their femininity (Seymour & Hewitt, 1997); it does not call for transformation of the culture of engineering, but rather maintains impossible double standards for women.

A final aspect of femininity in relation to women in engineering involves perceptions and expectations of balancing work and family roles. Hawks & Spade (1998) found that women were more likely than their male peers to anticipate work and family conflicts, had low confidence in their abilities to deal with these conflicts and also perceived work/family conflicts to be barriers to success in their careers. Consistent with the explanations of how women negotiate femininity in a masculine workplace, evidence suggests that women in engineering who do have children do so without workplace flexibility and support, instead devising individual solutions that do not disturb the status quo (Evetts, 1994). These issues are certainly not confined to engineering careers. It is possible, however, that women perceive the potential for conflict as heightened in engineering as opposed to career fields dominated by women, because of these work-related expectations: women's perceptions that they must perform exceptionally well to secure their positions next to lower-achieving male peers, and to stay current with ever-changing technical knowledge (Eden, 1992).

A consideration of all of the issues affecting women's entry and persistence in engineering points to the incompatibility between women's traditional gender roles and the opportunities offered in engineering. However, this incompatibility does not arise out of a mismatch between women's skill sets and the requirements of successful engineers. On the contrary, women are well equipped academically and socially for the job. Girls are now taking mathematics in comparable levels with their male peers (Braswell et al., 2001). Further, recent conceptualizations of engineering as collaborative and team-oriented require precisely the kinds of interpersonal skills women are said to possess (Belenky et al., 1996). Problems arise when the reality of engineering practice does not meet this ideal, but rather continues to preserve an exclusionary culture that is counter to the advancement both of women in engineering and to the profession itself.

Conclusions and Recommendations

      It is clear from the career theorists that the processes affording greater options begin early in life and are affected by several environmental factors, many beyond the control of colleges and universities, which often do not seek to recruit women into their programs until high school or even the first year of college. Intervention strategies are available, although they have generally been implemented on a case-by-case or model basis rather than as a unitary collaboration across campuses.

What WIE Directors Can Do:

- Understand the interconnected and reciprocally influencing nature of women's personal, academic, and career needs.
- Provide to students informal career counseling and referral informed by a better understanding of the literature.
- Educate career counselors about your programs and the relevant gender issues.
- Collaborate with other equity-oriented groups on campus to create a tight network of support for you, your students, and your institution.
- Work with all levels of the institution to address faculty and administrative support issues. All the work in the world with individual students will only prepare them, one at a time, to deal with a flawed system. While this may seem like a more accessible accomplishment in the short-term, it is not a long-term solution.
- Understand and cultivate your role as a campus leader and an agent of change.

What Faculty Can Do:

- Be accessible. Face-to-face positive interaction with faculty is important to female students, and perhaps to all students entering non-traditional territory.
- Provide research opportunities, scholarships, internships and co-ops. These are not only opportunities to enhance skill levels and resumes, but also to develop a sense of belonging and make personal connections.
- Develop pedagogical skills appropriate to the material and to the diversity of student needs. There is much talk of women's "connected ways of knowing" accompanied by the suggestion for truly cooperative and experiential learning as well as more holistic, immediately relevant content and delivery. The fact that ABET has incorporated these suggestions into their standards indicates their predicted effectiveness for all students.
- Be a steward of the climate and culture of the classroom as well as the image of engineering in general. It is widely acknowledged that four-year education is more than instilling substantive knowledge into the minds of young people. It is also professional socialization. If engineering maintains – at the extreme - an image of a socially incompetent white male and allows an exclusionary masculinist culture in the academy, many potential students will not become engineers. Further, those who do will be acculturated in a way that does not provide the interpersonal skills needed in the world of work.
- Make gender equity in education a priority. Even though adding one more responsibility to burdened faculty may seem an impossible task, the value in doing

so is great. There are many reasons for involvement in the academic community: Gender equity in education is an ethical and social justice issue, the attainment of which is deeply rewarding.
- Reward gender equity initiatives and achievement. Faculty with competing demands prioritize their efforts by what is required of them by their institutions. The National Science Foundation Broader Impact requirement is a good example.
- Encourage collaborative projects with elementary, middle, and high school students as well as their families. Women do not suddenly decide against engineering at the point of choosing a major in college, but rather collect information about external expectations and rewards from an early age.

What Administrators Can Do:
- Make childcare available and affordable on campus.
- Schedule classes so that they are available during the day and evening.
- Allow part-time study.
- Facilitate "re-entry" for students who have been absent from academia or are changing careers.
- Ensure adequate financial assistance to students from diverse family backgrounds, those raising families, and those in 5 year 4 year engineering programs.
- Provide accurate and realistic information about how long degree completion normally takes for financial and personal planning.

Assessment Instruments

A variety of measurement instruments are available, but it is important to note that these instruments should be done in combination with counseling. In other words, the results of an inventory are only meant to be used as another kind of information for use in decision making and are *not* meant to be prescriptive or to make decisions for people.

Following is a short list of the more prominent assessment instruments available for assistance in career decision making. Some may also be used for research purposes. Before choosing any of these, further research is encouraged. Some instruments are only supposed to be used by practitioners with specific qualifications. Many are not publicly available, and some must be purchased before viewing. The links provided give a starting point for researching a particular instrument.

Career Beliefs Inventory: This instrument is designed to assess career beliefs of people in eighth grade through retirement. Results may be used to address inaccurate beliefs about careers that cause career problems. It is available through CPP at www.cpp.com .

Career Decision Scale (CDS): This scale is used for assessing high school and college students' status in the career decision making process. It can be used to determine the outcome of an intervention process. Normative data are available for several populations. For more information, search the ETS test collection database at: http://www.ets.org/testcoll/index.html or try www.parinc.com for more details (including purchasing) from the test's publisher.

Myers-Briggs Type Indicator (MBTI): This is a personality inventory that can be used to determine a person's ideal career situation. There are many versions of the instrument, available through CCP, Inc. at www.cpp.com. See the Myers Briggs foundation for extensive information: http://www.myersbriggs.org/ . ETS provides some information as well at: http://www.ets.org/testcoll/index.html .

Self-Directed Search (SDS): This inventory, based on Holland Code, helps individuals in High School through adulthood to explore their career interests. The SDS has been in use for over thirty years and has been the subject of intensive research. Several variations of the instrument are available. For a listing see the distributor's website at: www.parinc.com, the website devoted to the instrument: www.self-directed-search.com or the educational testing service at http://www.ets.org/testcoll/index.html . For research studies using the instrument, try searching PsychInfo (this yields hundreds of results) or similar academic databases.

Strong Interest Inventory: This inventory assesses interests in occupations, work activities, leisure activities and academic subjects. It is available through CCP, Inc. at www.cpp.com .

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