Handbook of Gender Research in Psychology

Joan C. Chrisler · Donald R. McCreary
Editors

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Chapter 16
Gender and Occupational Choice

Helen M.G. Watt

Men and women tend to end up in different kinds of occupations. This phenomenon is extraordinarily robust across different settings (see Watt & Eccles, 2008), although there is certainly also cultural variation; good illustrations are women's higher representation in the sciences in India and the former Soviet Socialist Republics than in other countries. Children's literature, role models, vocational high school, and career counseling are some of the ways people get ideas about which careers are appropriate for them. College majors are gender imbalanced, which also sends signals to women who like chemistry and men who like languages that those are not the right places for them. Concerns regarding gendered occupational participation have often focused on women's underrepresentation in STEM (Science, Technology, Engineering, Mathematics) domains based on arguments related to gender equity. Ever since Lucy Sells (1980) identified mathematics as the "critical filter" that limits access to many high-status, high-income careers, others have also argued that many women prematurely restrict their educational and career options by discontinuing their mathematical training in high school or soon after (Bridgeman & Wendler, 1991; Heller & Parsons, 1981; Lips, 1992; Meece, Wigfield, & Eccles, 1990). Women are both less likely to choose careers in STEM fields and more likely to leave those careers if they do enter them (American Association of University Women, 1993, 1998; National Center for Education Statistics [NCES], 1997; National Science Foundation, 1999). In the United States, Australia, and elsewhere, there has been a concentration of research efforts and policy interventions designed to promote girls' and women's participation in mathematics and the sciences over the past 25 years.

The concentration of boys in masculine-typed careers has caused less consternation, probably because female-dominated careers tend to be lower in status and to pay lower salaries. Whether boys pursue their interests and develop their skills in nontraditional domains has been less often a topic of research concern or public interest. However, it is also important to discover the factors that affect boys' and men's educational and occupational choices, and whether they are being pushed into gender-stereotypic careers in the same ways that girls and women are, which could have significant implications for men's career satisfaction and personal well-being. Over the last decade there has been an increasing trend in educational research, policy initiatives, and the media to target boys' educational needs. Such discussions have invariably focused on boys' academic achievement and boys' disaffection with schooling, together with a call for positive male role models among teachers to bring out the best in boys (e.g., House of Representatives Standing Committee on Education and Training, 2002; Lingard, Martino, Mills, & Bahr, 2002; Martin, 2002). In Australia, there has been insistent and vocal concern regarding boys' education and participation in domains gender-typed as

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feminine and a call for more efforts to encourage boys' involvement in those domains. An example of this is the ongoing *Inquiry into the Education of Boys* (by the Standing Committee on Employment, Education, and Workplace Relations; Parliament of Australia, House of Representatives, commissioned on 21 March 2000 by the Minister for Education, Training and Youth Affairs; O'Doherty, 1994). I argue from both social justice and human resource perspectives that we should be concerned with the educational opportunities and outcomes of both boys and girls.

Although women have been making gains in entering traditionally male-dominated professions, gender differences persist. Why does a gender imbalance remain, and does it matter? Both genders in male-dominated, masculine-typed occupations report higher levels of job satisfaction than both genders in female-dominated, feminine-typed occupations (Harlan & Jansen, 1987; Jacobs, Chhin, & Bleeker, 2006; Moore, 1985). A possible explanation is that male-dominated occupations generally provide higher levels of income, freedom, and challenge than female-dominated occupations do (Moore, 1985). Yet, the numbers of women in nontraditional occupations continue to be low. As guidance counselors, teachers, and parents help young women to make choices about what fields to pursue, it is important that they encourage girls and women to consider nontraditional fields of interest that are likely to lead to high levels of job satisfaction.

Despite equivalent levels of academic achievement, girls choose fewer advanced STEM courses in senior high school than boys do, and they are less likely to aspire to high-status STEM-related careers than boys are, although they are more likely to be concentrated in lower status STEM professions (e.g., nursing) and other non-STEM caring professions (e.g., teaching). This pattern has been repeatedly identified and is of concern in Australia, the United States, and other countries. Two perspectives inform concerns regarding women's lower participation in STEM fields: (i) an adequate supply of high-quality human capital in the STEM fields is fundamental to any nation's capacity to create and absorb scientific knowledge and to undertake innovative activities, and women represent an underutilized pool that could supplement the critical shortage of people who elect STEM careers and (ii) at an individual level, STEM skills play an important role in expanding or limiting career options (Betz & Hackett, 1983; Lent et al., 2005); mathematics in particular has been identified as the critical filter to many prestigious careers (Sells, 1980), such that women do not share equally in the advantages of the mathematically well prepared.

The first argument is concerned with economic advantage: Participation in advanced science and mathematics education has continually declined in the United States over the last two decades, to the point where there is grave concern about the country's viability to sustain economic growth (see Jacobs, 2005; National Science Board, 2003; National Science Foundation, 2002). Similar concern exists in Australia (Dow, 2003a, 2003b; National Committee for the Mathematical Sciences of the Australian Academy of Science, 2006) and other Western nations. For example, a recent examination showed that only 32% of bachelor's degrees in the United States were in science or engineering (National Science Foundation, 2004) and that there were declines in undergraduate mathematics, engineering, and physical science enrollments through the 1990s of 19, 21, and 13%, respectively (National Science Foundation, 2000). In Australia in 2006, the Department of Education, Science, and Training (DEST) commissioned the Science, Engineering, and Technology (SET) Skills Audit to examine trends in SET demand, supply, and influential factors; the study showed that participation across all education and training sectors was static or declining (DEST, 2006). Global human capital supply issues in STEM are predicted to continue to loom large (Organisation for Economic Co-operation and Development [OECD], 2006) and may impact negatively on countries' economic and social well-being.

The second argument is concerned with social equity and individual well-being. Gender differences in earning potential are important because women are more likely than men to be single, widowed, or single heads of households; therefore, those women are likely to need to support themselves and their dependents financially (see Meece, 2006). Also, both women and men need to develop and deploy their talents and abilities in their work outside the home, as developing and using one's abilities in the workplace substantially impacts general life satisfaction and psychological well-being (Eccles, 1987; Meece, 2006).

The potential talent pool for STEM careers has often been regarded as a "pipeline" that starts in secondary school, flows through university, and empties into the workforce. A pipeline metaphor of supply captures the cumulative nature of STEM education, where early choices to opt out can foreclose or constrain subsequent opportunities. Major transition and decision points provide opportunities for leakage in the STEM pipeline, including the transition between elementary/primary and secondary school, lower and upper secondary school, secondary school and university, undergraduate and graduate education, and throughout employment. These are time points when people may opt out of STEM careers more easily. Figure 16.1 represents this diagrammatically including influential factors at each of the transition points based on an extensive review of the literature. Consideration of gender differences and gendered influences at each critical point in the pipeline is key to interventions designed to promote women's participation.

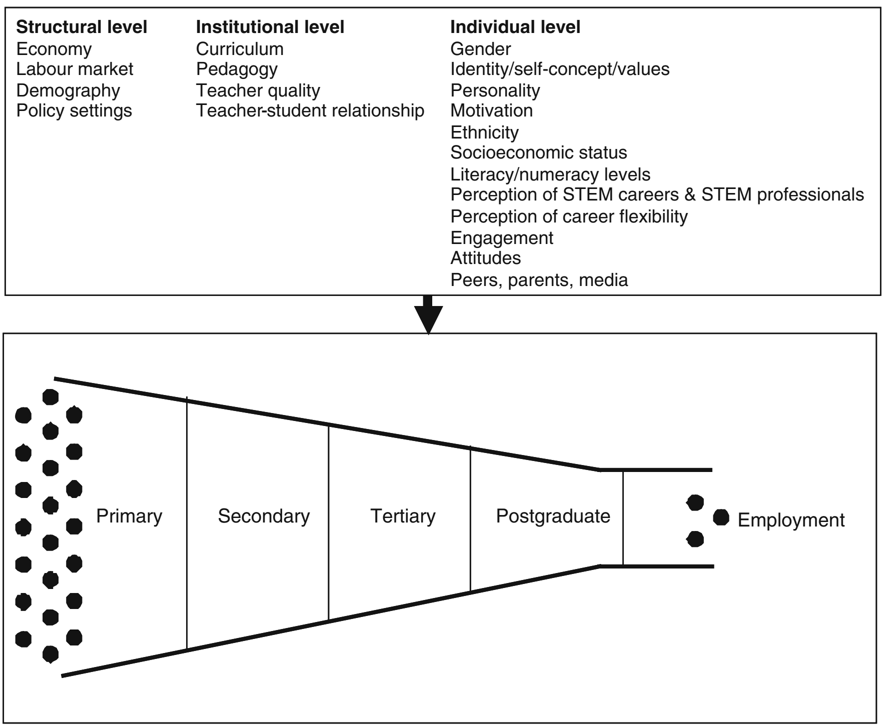

Fig. 16.1 Factors that influence educational and occupational choices at different stages of the STEM pipeline. *Note*: Commonwealth of Australia 2007. This figure is copyright. Apart from any use permitted under the *Copyright Act 1968*, no part may be reproduced by any process without the written permission of the Commonwealth of Australia acting through the Department of Education, Employment and Workplace Relations. The views expressed herein do not necessarily represent the views of the Commonwealth Department of Education, Employment and Workplace Relations

The literature indicates that pathways to STEM careers are defined by a complex and diverse array of factors and that the pipeline is more complex than a sequential funneling effect, whereby structural factors successively filter out girls and women (Watt, Eccles, & Durik, 2006). Such an interpretation does not take into account girls' and women's positive and informed choices as a result of contextual issues such as employability, work-life balance, gender equality, and occupational status (Siann & Callaghan, 2001). Girls and young women may be more likely to consider career options that provide successful role models, rather than those that suggest a "glass ceiling," and to consider their occupational choices in light of family planning. For example, young women's desire for a family-flexible career has been found to predict the decision to opt out of earlier aspirations for a STEM-related career (Frome, Alfeld, Eccles, & Barber, 2008). Because there are fewer women in STEM careers, these careers tend to reflect the values of the men, which, in turn reinforces perceptions that girls and women hold about STEM culture. This is especially the case with the ways in which STEM careers do (or do not) accommodate women's frequent family obligations. Such workplace cultures can affect women's initial aspirations for these careers, impede their progression if they do enter, and deter them from persisting along their career path.

At the far end of the "pipeline," there have also been interventions designed and implemented to meet professional women's needs within STEM careers. It is not clear at the present time how such reforms will change young women's motivation, performance, development, or persistence. Despite a plethora of intervention efforts, particularly targeting the secondary school years, most of these programs have not been formally evaluated. There has also been a lack of longitudinal as opposed to "one-shot" examinations, a lack of large-scale and representative samples rather than small and convenience samples, a lack of representation across diverse samples and sociocultural settings, and a lack of representation and integration across theoretical perspectives. In short, much work is needed in this area. A taxonomy of barriers and supports for girls/women who participate in STEM courses and careers is under development by Fouad, Hackett, and their colleagues (see http://vcc.asu.edu/taxonomy_v1/index.shtml), with the goal of directly translating identified barriers and supports into interventions to promote, sustain, and support girls' and women's participation in STEM pathways. Their developing taxonomy identifies both core obstructive and enabling agents such as parents and family, school, guidance counselors, and other social and individual sources. This taxonomy emphasis reflects the contemporary view that barriers to women's participation in nontraditional careers exist in social structures, rather than in the form of formal barriers as in the past. The cultural context provides norms such as gender-role stereotypes, which impact the formation of individuals' perceptions and motivations, both directly and indirectly, via socializers' beliefs and behaviors (e.g., Fredricks & Eccles, 2002; Frome & Eccles, 1998), such as verbal information, behavioral modeling (Pekrun, 2000), and individuals' own internal schema.

Of course, STEM careers are only one area of work where there are gender differences. Considerably fewer men than women are represented in the arts, humanities, education, and helping professions, such as nursing and social work (e.g., Carrington, 2002; Richardson & Watt, 2006). Although less concern has been expressed in the literature about the underrepresentation of men in these domains, there may well be ramifications for boys' and men's satisfaction and well-being if they do not pursue their interests and abilities in female-dominated careers. It is important that young men feel able to pursue careers outside of STEM fields if this is where their interests and abilities lie. In this chapter I consider influences on occupational choices within STEM and humanities fields, as domains that are respectively male- and female-dominated.

Explanations

Career "choice" presupposes the availability of alternatives as well as the individual freedom to choose from among them. Such an assumption in relation to occupational choice has been regarded as rare, naïve, or even misguided by Özbilgin and his colleagues (Özbilgin, Küskü, & Erdoğmuş, 2005), who reference labor market rigidities of supply and demand, persistent structural and institutionalized forms of discrimination and segregation, and path dependence by prior education and experience in many career fields. Explanations, and therefore interventions, must accommodate both individual and contextual factors at different stages along the "pipeline" (see also Mignot, 2000).

Barriers and Supports

Barriers and supports have been posited to affect career choices indirectly via their impact on individual self-efficacies and interests, however, evidence for both their direct and indirect effects has been identified (e.g., Lent et al., 2005). This indicates that structural and institutional conditions manifest as discrimination and disadvantage both objectively and as internal conditions in conception and imagination (Özbilgin et al., 2005) as individuals filter their experience through a net of expectations and attributions, such that similar phenomena are experienced differently by different people (Sameroff & Feil, 1985). Objective conditions may be more likely to be perceived or experienced as barriers or supports for different subgroups in society. For example, a longitudinal study of men's and women's persistence in science and technology studies at the university level showed that support from parents and teachers contributed weakly to whether women continued their science and technology studies, but strongly to whether men did (Larose et al., 2008). Such results show the critical importance of examining the moderating effects of gender in the links between barriers and supports and individuals' educational and occupational choices. Similarly, others have found ethnicity/race to be important in the development of occupational aspirations (Mau, 1995; Mau & Bikos, 2000; McWhirter, Larson, & Daniels, 1996; Wilson & Wilson, 1992). A recent meta-analysis yielded few differences in occupational aspirations, but significant differences in perceptions of barriers (Fouad & Byars-Winston, 2005), which, in turn, appear differentially to prompt racial/ethnic minority students to foreclose prematurely on career options or to experience greater career indecision (Fouad, 2007).

Gender Stereotypes

Proposed sources of gender stereotypes are many and varied; they include exposure to role models (e.g., Monaco & Gaier, 1992), reinforcement experienced for "gender-appropriate" and "gender-inappropriate" behaviors (e.g., Lamb, Easterbrooks, & Holden, 1980), differential teacher and classroom experiences (e.g., Spender & Sarah, 1992), and the important role played by the media in shaping ideas and attitudes (e.g., Leder, 1992). Key socializers, such as parents and teachers, impact students' outcomes by acting as "interpretors of reality" (Eccles, Arbreton, et al., 1993, p. 154) and through the experiences they provide.

Parents

The importance of parents' beliefs in shaping students' achievement-related attitudes, performance, and career decisions has been established by a large body of literature (see Jacobs, Finken, Griffin, & Wright, 1998), and, over the past 20 years, research based on the Eccles et al. (Parsons, Adler, & Kaczala, 1982) parent socialization model has highlighted the important role parents play (see Jacobs & Eccles, 2000). According to this model, characteristics of the parents, family, and neighborhood, along with characteristics of the child, influence parents' behaviors, general beliefs, and child-specific beliefs, which, in turn, affect parents' behaviors and expectations and, thereby, children's outcomes including their educational and occupational choices. Parents' roles shift from sharing their perspectives and providing exposure, opportunities, and role modeling at early ages to providing encouragement and guidance for activities that are supportive of the child's developing interests in certain occupations (e.g., Eccles, 1994; Jacobs & Eccles, 1992). When parents show enthusiasm they provide a support system to bolster the child's own value for a domain (Gonzalez-DeHass, Willems, & Holbein, 2005). Parents model involvement in valued activities (Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005; Jacobs & Eccles, 2000; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001), and, because parents are powerful role models, students come to value what their parents do (Parsons, Adler, & Kaczala, 1982; Eccles, Arbreton, et al., 1993; Whitbeck & Gecas, 1988).

Parents generally have been found to endorse the cultural stereotype of mathematics achievement as more natural for boys (Eccles, Freedman-Doan, Frome, Jacobs, & Yoon, 2000), and verbal or expressive skills as more natural for girls, and to hold gender-differentiated views of their children's academic abilities from a very early age (Eccles, Arbreton et al., 1993). Parents of boys have been reported to stress the importance of productive technical careers for their sons, whereas parents of girls stress the importance of being happy and well adjusted (Willis, 1989). Parents communicate their perceptions to boys through the use of strategies such as withdrawal of privileges for poor work, offering rewards for good performance, discussing the future usefulness of mathematics, and ensuring that homework is done. In addition, parents of boys, particularly fathers, are more likely to tell their sons that they should be ashamed of poor achievement. Such strategies are rarely implemented by parents of daughters (Yee, Jacobs, & Goldsmith, 1986). Parents relay how talented they believe their children to be, and they also can serve as "limit-setters" by communicating their beliefs about their daughters' potentials and abilities (Dickens & Cornell, 1990, p. 9).

Parents' educational expectations for their children during adolescence relate to their adult children's actual educational attainment (Chhin, Jacobs, Bleeker, Vernon, & Tanner, 2005), and parents' earlier gender-typed occupational expectations significantly relate to children's own expectations and actual career choices even 11 years following high school (Jacobs et al., 2006). Although many studies have shown that parents are powerful agents in influencing the goals, choices, and behaviors of their children (Farmer, 1985; Schulenberg, Vondracek, & Crouter, 1984; Trusty, 1998), most have not examined long-term relations between parents' earlier expectations and their children's later career choices because the studies were cross-sectional or spanned only a small number of years. Without additional long-term longitudinal data such as those of Eccles, Jacobs, and colleagues (e.g., Jacobs & Eccles, 1992; Jacobs et al., 2006), it is not possible to study adequately parents' role in constructing and sustaining gendered environments in which adolescents consider future occupations and how adolescents' early speculations translate into actual occupational choices in adulthood.

Peers

Individuation and autonomy development in adolescence is characterized by more time spent with peers and less with parents (Larson & Richards, 1991), and parents' influences may be expanded and challenged by children's peers (Brown, 1990; Kindermann, 1993). Within the domain of mathematics, for example, the class' average value for mathematics has been demonstrated to relate to individual students' values (Frenzel, Pekrun, & Goetz, 2007). Cross-gendered behaviors are more likely than "gender-appropriate" behaviors to cease when criticized by peers. Similarly, "gender-appropriate" behaviors are more likely than "gender-inappropriate" behaviors to be strengthened when praised by peers (Lamb et al., 1980). Because mathematics and English are frequently gender-typed domains, we expect these dynamics to apply. Indeed, boys make a clear gain in status by electing to study advanced mathematics courses, whereas girls who do so gain nothing in the way of status (Cohen & Kosler, 1991).

Teachers

Teachers' own attitudes are related to students' motivations in particular academic domains (Eccles, Arbreton, et al., 1993; Kunter et al., 2008), as are teachers' direct and indirect messages about the value of learning (Brigham, Scruggs, & Mastropieri, 1992; McKinney, Robertson, Gilmore, Ford, & Larkins, 1984; Patrick, Hisley, Kempler, & College, 2000). Classroom practices that have been found to undermine interest and motivation include public competition, frequent drill and practice, and teachers' insincere praise and criticism (e.g., Flink, Boggiano, & Barrett, 1990; Turner et al., 2002). Teachers' preferential treatment of boys in class has been well-established (see Spender, 1982; Spender & Sarah, 1992). Regardless of the gender of the teacher, boys receive more criticism, praise for correct responses, monitoring of work, and general contact with the teacher (Becker, 1981; Brophy & Good, 1974; Hart, 1989; Koehler, 1990; Leder, 1987). Perhaps most disturbing, girls for whom teachers hold high success expectancies have been found to receive the least amount of praise from teachers (Parsons, Kaczala, & Meece, 1982). Spender (1982) found that teachers spent about two-thirds of their classroom interaction time with boys, and boys made about two-thirds of students' comments. She attributed these behaviors to the cultural system in which teachers are embedded, which perceives preferential treatment of boys as the norm and, therefore, fair (Spender, 1981). Over the past 15 years, there have been significant reforms in elementary/primary and secondary school mathematics and science curricula and teaching practices to incorporate more collaborative, problem-focused, and authentic instruction (Meece & Scantlebury, 2006). This happened in response to research that showed that girls take a more active role and respond more favorably in individualized and cooperative learning environments (Kahle & Meece, 1994; Parsons, Kaczala, & Meece, 1982) and that the decontextualized content of the transmissive pedagogies, which have characterized school science and mathematics for generations, do not engage students' interest or commitment (Lyons, 2006).

Media

The male and female role models that children encounter, as well as the role models portrayed in the media, are important broader socialization agents in the development of children's beliefs and values (Signorella, Bigler, & Liben, 1993). Media accounts frequently report difficulties encountered by successful women professionals in balancing job demands with interpersonal needs (Leder, 1992). Such accounts, as well as stereotyped portrayals in films and on television, reinforce the notion that women achieve success at a personal price and that they need to work harder than men do to attain success (Leder, 1992). Clearly, passive nondiscrimination is not an adequate intervention strategy (Eccles & Jacobs, 1986). To counter these gender stereotypes, educators could provide explicit nontraditional role models for children and adolescents.

Ability

Another explanation that has been put forth to explain gender differences in occupational choices relates to different innate abilities for women and men. It is difficult to find a more controversial topic than that of gender differences in mathematical abilities in recent educational research. There is no dispute that, in samples from the general population, women's and men's global mathematical performance is similar (e.g., Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Kimball, 1989; Rosenthal & Rubin, 1982; Tartre & Fennema, 1995). Two comprehensive meta-analyses of approximately 100 research articles each (Friedman, 1989; Hyde, Fennema, & Lamon, 1990) showed that, in samples from the general population, boys' and girls' secondary school mathematical performance is similar. Since then, Hyde and her colleagues have analyzed mathematics achievement data from seven million students in U.S. statewide assessments (Hyde, Lindberg, Linn, Ellis, & Williams, 2008), and they identified uniformly trivial gender differences: 21 indicated better performance by boys, 36 indicated better performance by girls, and 9 showed no difference. The weighted mean effect size was 0.0065, which is consistent with no gender difference. The authors further found that effect sizes for gender differences were similarly small across all ethnic groups. Boys showed slightly more variability in scores, although this could not account for gender differences in participation in STEM fields.

Other researchers have focused on gender differences in spatial skills (Linn & Petersen, 1985) and gender differences among very high achieving students (e.g., the Study of Mathematically Precocious Youth; Lubinski, Benbow, & Sanders, 1993). An influential U.S. study showed that the ratio of men's to women's variability in "space relations" scores on the Differential Aptitude Test generally decreased from 1947 to 1980 (Feingold, 1992), although an interaction effect between year and grade showed that this variance ratio decreased from Grades 8 to 12 in 1947, in 1962 and 1972 it was constant across grades, and in 1980 it increased over grades. Such findings imply that it is necessary to seek explanations beyond biology because these changes are occurring "rather faster than the gene can travel" (Rosenthal & Rubin, 1982, p. 711). Gender differences in mathematical performance have been identified among moderately selective and precocious samples, although Hyde, Fennema, and Lamon (1990) cautioned against the validity of such comparisons because of the different variability within the gender groups being compared (see also Feingold, 1992, 1993). Men and boys are, in fact, overrepresented at both the high *and the low* extremes of mathematical performance (e.g., Lubinski et al., 1993), which some argue means that boys are more often selected for remedial help as well as for gifted programs in mathematics (Willis, 1989).

On the other hand, gender differences in verbal ability are regarded by many as one of the well-established findings in psychology (e.g., Halpern, 1992); most introductory textbooks have presented this as a recognized "fact" (e.g., Atkinson, Atkinson, & Hilgard, 1983; Gleitman, 1981; Hetherington & Parke, 1986; Mussen, Conger, Kagan, & Huston, 1984). A meta-analysis by Hyde and Linn (1988) provided estimates of effect size for gender differences across a range of dimensions of language achievement, including vocabulary, analogies, reading comprehension, speech production, essay writing, anagrams, and general verbal ability. Except for modest effect sizes where girls and women scored higher on measures of general verbal ability, anagrams, and speech production, all other effect sizes were negligible (Hyde & Linn, 1988). A comparison of effect sizes by year of publication (earlier than 1974 versus 1974 and later) was statistically significant, which led the authors to conclude that the gender gap had reduced over time in measured language abilities. The authors concluded that "the magnitude of the gender difference in verbal ability is currently so small that it can effectively be considered to be zero . . . the one possible exception is measures of speech production" (Hyde & Linn, 1988, p. 64).

Although recent evidence suggests that biology affects psychological characteristics related to occupational preferences (Berenbaum & Bryk, 2008), recent researchers have emphasized that biology is not destiny, and there are additional effects of social and cultural influences (e.g., Ruble, Martin, & Berenbaum, 2006; Steele, 1997; Wood & Eagly, 2002). It is clear that continued research beyond biology is needed into the antecedents of, and influences on, gendered occupational choices.

Perceived Abilities and Motivations

The expectancy-value model proposed by Eccles and her colleagues (Eccles, 2005; Eccles et al., 1983) sets out the importance of individuals' perceived abilities, motivational values, and background socialization influences in shaping their educational and occupational choices, over and above their demonstrated skills and abilities. This prominent, productive, and highly influential theoretical framework was developed to explain gender differences in mathematics participation and has subsequently been applied to language/literature participation and to different kinds of careers. More recently, the social cognitive career theory of Lent and his colleagues (SCCT; Lent, Brown, & Hackett, 1994, 2000) similarly has emphasized the related constructs of self-efficacy and interest as major influences on career choice.

Part of the explanation for the gender difference in STEM participation lies in the fact that girls have less confidence in their mathematical abilities than boys do, despite similar measured mathematical achievement. Does this mean that girls underestimate their mathematical abilities? In fact, a stronger relationship has been identified between girls' mathematical ability beliefs and achievement than between boys', which suggests that girls may actually be more realistic about their abilities, whereas boys overestimate theirs (Crandall, 1969; Watt, 2005). Boys' higher confidence translates into a spiral of benefits, including enrollment choices that produce advanced mathematical preparation. In contrast, the greater "realism" on the part of girls translates into levels of mathematics participation more commensurate with their abilities, which results in a situation where boys *over-participate,* rather than girls *under-participate,* in advanced mathematics. Given the current critical shortage of people entering mathematics-related careers, it would be silly to suggest that educators discourage boys' participation in order to equalize gender representation. Rather, we should aim to promote greater participation for everyone, but especially girls.

A particularly effective lever for change may be to target girls' lower interest and liking for mathematics, which has strong flow-on effects to their level of mathematics participation in high school and later mathematics-related career choices (Watt, 2006, 2008). Because we know that girls are more likely to be engaged by activities that they see as socially meaningful and important (e.g., Farmer, Rotella, Anderson, & Wardrop, 1998), it is essential that educators make explicit connections between STEM and its social uses and purposes. Adolescents also often have quite inaccurate ideas of which careers involve developed STEM skills (Fouad, 2007), which implies a need to provide more detailed information about STEM skills' relevance for a range of varied careers.

Comparative United States and Australian data have been analyzed to show how gendered choices play out regarding the amount of mathematics students undertake in the U.S. setting, and the difficulty level undertaken in the Australian setting, with prior mathematical achievement controlled (see Watt et al., 2006). No gender difference in the number of senior high school mathematics courses was evident among the U.S. sample, although there were clear gender differences in the Australian sample in which fewer girls both planned to undertake and subsequently actually undertook the higher levels of mathematics. Because Grade 11 in Australia is the first point where students are able to choose their mathematics courses, this means that girls began to opt out of the "pipeline" at their first opportunity. In the U.S. sample, where college-bound youth from this sample's upper-middle class demographic may have thought that they had little choice in how much mathematics to take, most boys and girls similarly undertook the maximum of four courses. The mathematics pipeline, therefore, appears to "leak" later in the U.S. setting, when fewer women elect to study post-secondary mathematics (Bridgeman & Wendler, 1991; Lips, 1992) and when equally prepared women defect from undergraduate mathematics studies at a higher rate (Oakes, 1990). It seems that many women opt out of mathematics when they are given a real choice to do so.

Perceived abilities and intrinsic values are emphasized in the Eccles (Parsons) et al. (1983) expectancy-value model as the most proximal influences on educational and occupational choices (e.g., Eccles, 1984, 1985; Eccles et al., 1983; Eccles, Adler, & Meece, 1984; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Meece et al., 1990; Watt, 2005; Wigfield, 1994; Wigfield & Eccles, 1992). Intrinsic value is similar to intrinsic motivation as defined by Deci and colleagues (Deci & Ryan, 1985; Deci, Vallerand, Pelletier, & Ryan, 1991) and by Harter (1981); it refers to engaging in a task out of interest or enjoyment.

The influences of perceived abilities and intrinsic values on senior high school mathematics enrollments have been found to exceed the influence of prior mathematical achievement for girls. For boys, perceived abilities and intrinsic values also exert significant, although weaker, influences of similar strength to the impact of their prior mathematical achievement (Watt et al., 2006). In contrast, mathematics-related career aspirations have been found to be directly impacted only by level of senior high school course enrollments (see Watt, 2008), which clearly demonstrates the importance of retaining girls in the mathematics "pipeline" through senior high school as a critical leakage point away from mathematics-related occupations.

English enrollments during senior high school are also substantially predicted by intrinsic values, over and above prior English achievement (Durik, Vida, & Eccles, 2006; Watt 2002, 2008). English-related career plans were predicted equally by ability-related perceptions and utility (or importance) values, whereby boys and girls who believed themselves to be more able in English, and perceived English to be more useful, aspired to careers involving higher English-related skills (Durik et al., 2006; Watt, 2002, 2008). Unlike mathematics, senior high school English enrollments did not mediate the relations between adolescents' English-related motivations and their career plans. It is interesting that these findings suggest that the pipeline argument is less relevant for explaining a continued pattern of lower English participation rates for boys than for girls.

Given the importance of perceived abilities and intrinsic values in determining educational and occupational decisions, it is important to understand their development over time. Identification of points where changes occur can suggest potential causes as well as fruitful points for intervention: Points of gender difference and gender divergence could be particularly helpful in locating gendered barriers and designing interventions. Perceived mathematical abilities have been found to decline fairly linearly through adolescence (Nagy et al., in press; Watt, 2004), as do perceived English abilities (Watt, 2004). Declines in intrinsic values for mathematics and language/literature, however, coincide with changes in curricular structures (Fredricks & Eccles, 2002; Frenzel, Goetz, Pekrun, & Watt, in press; Watt, 2004). These longitudinal studies provide evidence for continued declines after the transition to secondary school that have been well documented in shorter term or cross-sectional research (e.g., Anderman & Midgley, 1997; Midgley, Feldlaufer, & Eccles, 1989a, 1989b; Seidman, Allen, Aber, Mitchell, & Feinman, 1994; Watt, 2000; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991; Yates, 1999). Such declines may be reality based and inevitable due to social comparative processes in which individuals increasingly engage through adolescence (e.g., Nicholls, 1978), but declines also are promoted by the secondary school context through practices such as normative assessment.

Some theorists have suggested that negative changes on transition to junior high school (e.g., Anderman & Midgley, 1997; Midgley et al., 1989a, 1989b; Seidman et al., 1994; Wigfield et al., 1991) are a consequence of concurrent physiological and psychological pubertal changes (e.g., Blyth, Simmons, & Carlton-Ford, 1983; Hill & Lynch, 1983; Rosenberg, 1986; Simmons, Blyth, Van Cleave, & Bush, 1979). This view has been challenged by research that shows how differences in the pre- and post-transition classroom and school environments relate to declining motivations (Eccles & Midgley, 1989, 1990) and, instead, suggests a model of "person-environment fit" whereby the needs of young adolescents are not met by the new junior high school environment. This model is supported by the findings of nonlinear declines in intrinsic values, although perceived abilities appear not to be tied to grade-related changes in the same way.

Gender differences in perceived abilities and intrinsic values in mathematics and language/literature occur in line with gender stereotypes (e.g., Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004). Boys have higher perceived abilities and intrinsic values for mathematics than girls do, whereas girls have higher intrinsic values for language/literature than boys do. There are mixed findings regarding gender differences in perceived English abilities: The U.S. longitudinal study showed that girls had higher ability perceptions than boys did (Jacobs et al., 2002), whereas the Australian longitudinal study indicated no evidence of gender differences in ability-related perceptions, despite higher English achievement levels for girls (Watt, 2004, 2008). No evidence was found in either study for a gender intensification hypothesis (e.g., Eccles, 1987; Hill & Lynch, 1983; Maccoby, 1966); initial gender differences continued to be fairly stable through adolescence (Frenzel et al., in press; Nagy et al., in press; Watt, 2004), which could imply that girls' and boys' perceptions diverge at an earlier age, prior to commencement of secondary school. Because gender differences in perceived abilities and intrinsic values have been identified in early school years (e.g., Eccles, Wigfield, Harold, & Blumenfeld, 1993; Marsh, 1989; Wigfield et al., 1997), it seems that boys and girls begin school already having those gendered perceptions, which have been attributed to socialization experiences in the home and the wider society, such as portrayals of women and men in the media (e.g., Jacobs et al., 2002).

Summary and Directions for Future Research

The occupational landscape is not equal for both genders, nor for minority racial/ethnic groups (Fouad, 2007). In this chapter I have discussed influences on the persistent and enduring problem of women's lower participation in STEM fields, which is important to economic advantage, social equity, and individual well-being, and men's lower representation in female-dominated fields such as language/literature-related careers. The pipeline metaphor was introduced and elaborated to emphasize the need to focus on both individuals' perceptions and motivations and societal barriers and supports. Recommendations that derive from this review to enhance girls' and women's STEM progression and retention include promoting their perceived abilities and intrinsic values, providing them with STEM-related career information and role models, acting to overcome gender-typed messages concerning abilities and opportunities, and attending to gender inequities in barriers and supports at both ends of the pipeline. Recommendations to increase boys' and men's participation in language-related careers are to enhance their interest and liking for language and literary studies and to elaborate its utility value. Of course, this is no simple task.

Advanced mathematical preparation provides a substantial skills and status advantage for further educational and occupational opportunities, yet girls and women appear to opt out of the pipeline once they are given a chance to do so. Results from a German study (Nagy et al., 2008) suggest that forced early specialization may amplify gender differences in students' course selections. Successful participation in post-secondary STEM education has been shown to be associated with less specialization at earlier stages of schooling, which allows fewer points of leakage from the pipeline (Van Langen & Dekkers, 2005). Does this mean that we should more tightly constrain students' mathematics course taking to enhance girls' retention in mathematics through secondary school completion? Should we develop policies to keep girls in the mathematics pipeline for as long as we can? But how long *can* we constrain girls to keep taking mathematics?

Because mathematics-related intrinsic values and perceived abilities are important influences on the extent of girls' and boys' educational and occupational choices, girls' lower intrinsic values and perceived abilities are of particular concern. Such differences are evident even in very young girls and boys. The fact that these gender differences emerge early (as early as Grade 2; Jacobs et al., 2002) implies that they need to be addressed from early childhood, but this does not mean that we should not also address them during secondary school, where there may be much educators can do to increase girls' interest. What we need to be asking is whether factors such as personal relevance, familiarity, novelty, activity level, and comprehensibility, which promote task interest (Hidi & Baird, 1986), are equally addressed for both boys and girls in mathematics classrooms. Eccles and her colleagues have demonstrated that girls are engaged by activities that they perceive to be socially meaningful and important (e.g., Eccles & Vida, 2003), whereas mathematics (and science; DeHart, 1998) is often taught in skills-based, abstract, and decontextualized ways. Making explicit connections between STEM and its social uses and purposes may help to heighten girls' interest. Adolescents also often have quite inaccurate ideas of which careers involve developed scientific and mathematical skills due to negative stereotypes of scientists and mathematicians (e.g., Furlong & Biggart, 1999). Detailed information about the STEM education and skills required for a range of careers would be likely to promote girls' interest when their preferred careers require mathematics or science skills.

A qualitative study of seven women who had "opted out" following completion of an undergraduate mathematics major (Stage & Maple, 1996) showed that interest in mathematics and beliefs about mathematical aptitude *since early childhood* had been the main determinants of the women's decision to complete a mathematics major. Socialization experiences in the home strongly influence children's beliefs and values (Lytton & Romney, 1991), and parents report spending almost no time on mathematics activities with their children (Eccles et al., 2000; Freedman-Doan et al., 2000). This finding is in stark contrast to the emphasis on early reading in the literacy domain; perhaps what is needed is a systematic campaign about the importance of early numeracy experiences. Given the centrality of mathematics interest to choices about mathematics participation and given girls' lower interest in mathematics than boys', it might be worth encouraging parents to focus on engaging in mathematics-related activities such as mathematical puzzles and problem-solving particularly with their young daughters as a possible way to enhance their interest and liking for mathematics. Such recommendations become problematic in cases where parents may not have mathematical skills or interests themselves, although research suggests the need to educate parents about the important roles their opinions and parenting play in their children's later career decisions. Teachers have been able to convince parents that their daughters are talented at mathematics, and then have enlisted the parents' help in encouraging young women to consider advanced mathematics courses and occupations in mathematics-related fields (Eccles, Arbreton, et al., 1993). We need to understand better why it is that girls perceive themselves as having less mathematical talent or ability than boys do, even though they perform similarly. Although girls' perceptions may be more realistic than boys', they nonetheless fail to share as much in the advantages of the mathematically well prepared. Therefore, we need to think very carefully about messages conveyed to girls about their abilities by their teachers, peers, and the media.

It is a fair assumption that the relative absence of women at the end of the STEM pipeline might be an important factor in the choices being made by girls and younger women to move away from those careers. Consequently, there is a need to target both ends of the "pipeline" at once: working to attract individuals to opt in and enforcing explicit policies to change the often unfriendly and unsupportive workplace cultures that might, for example, conflict with women's family responsibilities. STEM careers appear to have remained insufficiently flexible with regard to women's family responsibilities in practice, even if not in policy. There is a need for an explicit policy reform agenda and multi-pronged initiatives aimed at accommodating women's outside-work responsibilities and changing the values of the workplace culture. Until this can be achieved, it may be small wonder that girls and young women elect to specialize in non-STEM occupations as they think ahead about the situation at the end of the "pipeline."

The beginning of the pipeline is an eminently sensible focal point for interventions, before students have implicitly (e.g., affective disengagement, low effort) or explicitly (i.e., enrollment choices) opted out of STEM participation. It may be most sensible to implement preventative measures at this point rather than to focus intervention efforts on attempts to ameliorate substantially reduced participation at later points. Continued investigations into the origins and sources of gender differences in mathematics intrinsic values and self-perceptions promise to shed further light on the reasons for persistent "leaks" from the STEM pipeline for girls. There is also scope for mentorship because women may choose to opt out of STEM courses due to the lack of role models and female networks (Siann & Callaghan, 2001; Van Leuvan, 2004). At the same time, we need to be focused on workplace reforms, which provide family-friendly policies and practices, if we wish to attract girls and women to STEM careers in the long term. Factors that influence individuals' choices at different points in the pipeline are complex and interdependent and require an holistic approach to examining "leaks." This interdependence implies that tackling any one aspect in isolation is unlikely to deliver strong improvements. Although gendered outcomes appear at the level of the individual, a complex set of factors, including the historical legacy of gender differences in STEM domains and interpersonal relations, is involved. Multi-pronged interventions are required to enhance women's participation in STEM, including legal and ideological support at the policy and regulation level, institutional commitment to understand and tackle gendered prejudice and interpersonal measures, such as building networks between female students and providing mentors, and promoting a strong personal awareness that can equip female students with the resolve and vision to counteract the entrenched forms of gendered prejudice that they experience (Küskü, Özbilgin, & Özkale, 2007).

Intrinsic values emerge as a key predictor of choices for language/literature participation in senior high school. Unlike mathematics, English-related ability perceptions do not directly predict English enrollments in senior high school, and gender continues to predict English enrollments significantly even when motivation variables are included in the models (Watt, 2008). Thus, motivations and prior achievement do not fully explain the gender difference by which girls elect to participate more and boys less in language and literary studies; other factors must also be at play. English-related career plans were impacted equally by English ability-related perceptions and utility values. Students who believed themselves to be more able and likely to succeed in English, and students who regarded English as more useful, were those who aspired to highly English-related careers (Watt, 2008).

As with mathematics, and as predicted by expectancy-value theory, ability-related perceptions and values were most important in explaining adolescents' gendered English participation. Different *types* of values were important for different types of choices: As for mathematics, English-related intrinsic values predicted senior high school English course enrollments, whereas utility values influenced English-related career plans. Unlike mathematics, English ability-related perceptions did not impact senior high school course selections but did contribute to career plans. English ability-related perceptions and utility values impacted directly on career plans that would involve language or literary skills; their influence did not operate through senior high school English participation.

In order to encourage boys and young men to aspire to participate in language/literature-related careers, it appears to be most important to target their ability-related beliefs directly, as well as their conceptions regarding the utility of language skills. I believe that it is a dangerous aim to enhance boys' ability beliefs at the expense of girls', and instead recommend targeting boys' lower language/literature *values*, particularly their utility values. It may be less important to worry about boys' lower participation in senior high school English courses, as this does not subsequently determine the language-relatedness of their aspired careers (Watt, 2008). Should we wish to do so, however, it is boys' lower liking for and interest in language/literature that would be most useful to address. Findings imply a focus on boys' lower utility values regarding language/literature through secondary school will be likely to promote boys' and men's participation in language-related careers. That said, I reiterate that other factors are also at play in explaining boys' lower senior high school language/literature course enrollments, such as family influences, lifestyle goals, and social contexts.

Future Directions

I conclude by elaborating three major trends to advance future research in the field. These relate to changes in the world of work, how to contextualize the study of gendered occupational choices, and increased movement toward longitudinal designs, which allow for the study of developmental influences.

The Changing World of Work

The world of work has been impacted by demographic changes within the workforce, emerging technologies, an increasingly globalized economy, and decreased employment security (Fouad, 2007). Rapid changes in the economy and labor force have created a world of work that is now a "moving target" and resulted in the shifting of established notions of careers as resulting from choices made early on toward a view of a series of choices over individuals' working lives (Fouad, 2007, p. 544). Which abilities and values will be the most valuable for individuals to function effectively will be important concerns in this changing environment (Fouad, 2007). Western European beliefs have dominated the career literature until recently, but they may no longer be tenable (Flores & Heppner, 2002). These entail beliefs in individualism and autonomy, affluence, an open opportunity structure, the centrality of work in individuals' lives, and linear and rational processes of career development (see Gysbers, Heppner, & Johnston, 1998). Within the field of gender and occupational choice, there is a strong tradition of theory-based research, which to date has focused on "choice" outcomes, although many individuals either do not have the luxury to choose or do not make their "choices" with awareness, cognition, or volition. Further theoretical developments will need to take into account the degrees of freedom and awareness within which different individuals from different contexts operate. We also need to consider the nature of, and influences on, choices to opt *out* of gender-typed occupational fields, which may involve a different set of processes than simply the reverse of those that explain the choice to opt in.

Contextualization

Consistently strong research evidence for relationships among motivational and achievement-related constructs has accumulated at the level of the individual, whereas contextual effects (e.g., classroom, teachers' influence) have typically been comparatively weaker. Psychologists have worked to conceptualize and measure important individual-level predictors. Similarly sensitive, sound, and robust theories and measurements are needed at the level of context constructs to determine which contextual factors affect psychological beliefs. Integral to this endeavor are decisions concerning the appropriate "grain size." For example, in research concerning gendered educational choices during secondary schooling, is the right grain size the school, the class, friendship networks, the family, or some combination? The important question is which context and level of intensity will provide for better explanation. To complicate matters further, the critical grain size may vary at different developmental points or stages through the pipeline and for different kinds of individuals. Different moderators will need to be examined to determine how processes differ for different groups, as well as continued attention to the psychological mediators via which socio-environmental barriers and supports are construed.

In addition to extra-personal contexts, it will be important to consider intrapersonal contexts and to broaden our theories and measurements to incorporate multiple domains (e.g., career, family) and dimensions (e.g., STEM, humanities, helping professions) of relevance in individuals' lives. Informal barriers may lie in patterns of participation and choice that are functionally related to other patterns of participation and choice (Maines, 1985). This is all the more important in the study of gendered occupational choices because women tend to base their life decisions on a broader set of criteria than men do; women tend to anticipate "contingent futures" in which family plays an important role and where occupational pursuits may be compromised by other commitments (Maines, 1985).

There is a continuing need for psychologists to expand their view of the spectrum of psychological processes, on the one hand, and the array of societal supports and barriers, on the other (Roeser, 2006), and how these interact for different kinds of individuals, at different stages of development, in different contexts. At the macro-contextual level, we need more research that includes diverse samples. Much of the work in this field has been conducted with Western participants, and future researchers could fruitfully sample different racial/ethnic and socioeconomic groups in different countries, for whom there may be quite different patterns of gender influence. Comparative studies from a range of cultures are needed to assess which trajectories may be tied to particular schooling and societal systems. Cross-cultural comparisons provide wonderful *natural experiments* to enable investigations of how different structural features might shape different occupational outcomes for women and men and how trajectories for girls and boys may vary within and across cultures.

Longitudinal Designs

Without longitudinal data, it is not really possible to test the impacts of earlier influences or how processes unfold over time to produce outcomes of interest. We need more long-term longitudinal studies that allow for investigations into the origins of gender differences in occupational choice. At the same time, we also need studies that contain many occasions of measurement to be able to detect the nuances of development and associated influences. These studies will need to be large-scale to permit the kinds of analyses that are now available to researchers as a result of advances in statistical methods, which allow for increasingly sophisticated designs. Rich qualitative data are required within the context of these extensive designs to shed further light on processes and individual particularities, and advances in qualitative software now permit analyses across large numbers of responses.

Greater attention to between-individual variability in trajectories may yield new directions through a closer examination of individuals who demonstrate *positive* development, which may assist in identifying personal factors and social ecologies that promote resilience and well-being. For example, the study of parents who are especially effective in nurturing awareness of nontraditional occupational pathways for their children, schools that promote exemplary mathematics participation among young women or arts and humanities participation among young men, universities that have higher than expected numbers of female STEM or male nursing students, or workplaces that are particularly conducive to work-family balance (Roeser, 2006). To conduct research in this vein implies the need for large-scale, longitudinal, international, interdisciplinary, and collaborative programs of research that involve teams of experts from across different specializations. Although such designs are costly both in terms of time and money, the social and economic costs of *not* bringing our collective resources and expertise to bear on the persistent problem of gendered occupational choices is a greater cost yet.

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