GENDER PARADIGMS

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Abstract

There are gender gaps in mathematics achievement in several of the TIMSS countries. The authors examined these gender differences among Asian countries, European countries, and America and analyzed these disparities in terms of the accepted gender paradigms developed to explain the variations. To date theoretical frameworks detailing gender inequity in the hard sciences have essentially been divided between biological factors, socialization factors, and/or a combination of the nature vrs. nurture theory. Keeves (1972, 1973) examined gender differences in the early IEA studies and concluded (Keeves, 1986) that gender acts as an antecedent for motivation. Sex differences in participation in math and science courses are due to expectancy roles in society to the attitudes inculcated at home and in peer group environments. Other non-TIMSS studies have uncovered large gender gaps especially between high achieving math and science students (Benbow & Stanley, 1983a, 1983b; Page, 1976; Campbell, 2002). These gaps persist despite efforts to eliminate them in Europe and America. Nations are especially concerned about this issue as the development of technical talent is fundamental to both economic and military concerns.

INTRODUCTION

This paper summarizes the paradigms that have been developed to explain gender inequities in mathematics achievement. Nations are especially concerned about the development of technical talent because it is fundamental to both economic and military concerns. In the United State such talent is carefully monitored by the National Science Foundation because the nation needs a steady supply of scientists and mathematicians in the Science and Engineering (S & E) pipeline for continued economic growth.

Through analysis of mathematical achievement scores from various large-scale empirical studies, theoretical gender paradigms are presented to explain achievement differences by gender. In this way an international audience will be able to gain insight into a serious worldwide equity problem that can affect our global community.

REVIEW OF LITERATURE

Some researchers attribute the gender differences to overall male/female differences (Benbow & Lubinski, 1997; Benbow & Stanley, 1983a, 1983b; Page, 1976). Feingold (1992) attributes the gaps to more variability among males. Other researchers (Campbell & Beaudry, 1998; Eccles, 1982, Eccles, Kaczala, & Meece, 1982; Chipman & Thomas, 1987; Chipman & Wilson, 1985; Fennema, 1983, Linn, 1986) believe that differential socialization factors are responsible. Plomin (1997) argues for analyzing the interactions between nature (genes) (44%) and nurture (46%) when analyzing such complex questions.

Through analysis of mathematical achievement scores from large empirical studies, various theoretical frameworks are categorized into the following divisions:

Explanations Depending Largely on the Biological Differences Between Males and Females

Deficit Theory Including Genetic & Hormonal Differences: In 1971 the Study of Mathematically Precocious Youth (SMPY) uncovered large gender gaps (Benbow & Stanley 1980, 1982, 1983a; 1983b, 1983c; Lubinski, Benbow, & Morelock, 2000). The following gender gaps were found: SAT-M 500+2:1 (2 boys: 1 girl); SAT-M 600+ 4:1(4 boys: 1 girl); SAT-M 700+ 13:1 (13 boys: 1 girl). Page (1976) believes that these data "brilliantly satisfies [sic] all requirements" for a sex-linked recessive model of inheritance where genes on the X and Y chromosomes were responsible for some of the important traits involved with exceptional math achievement.

Explanations Involving some Balance Between Physical Gender Differences and Socialization Forces

Combination of Nature & Nurture: According to this paradigm (Plomin, 1990, 1997), genes account for no more than 50% of variance for most traits. For example, for IQ, 44% of the variance is due to genes (nature), 23% can be attributed to common family factors (environment – nurture), and 23% can be traced to environmental factors outside the family (nurture).

Males Exhibit Greater Variability: Feingold (1992) and Hedges and Nowell, (1995) attribute gender gaps to the fact that males exhibit more variability than females; more males are found at the extreme ends of the normal curve on many traits. For example, there are more feeble-minded males at one extreme and more genius males at the other extreme.

Explanations Depending Largely on Socialization Factors

Interaction of Numerous Factors Effecting Choice: The Eccles paradigm (Eccles, 1982, 1983, 1984; Eccles, Adler & Meece, 1984; Eccles, Barber, Updegraff & O'Brien, 1995; Eccles & Jacobs, 1986) is the most comprehensive theoretical model yet to be developed. It represents a synthesis of other promising theories and frameworks. Much of this model is based on the perceptions of students as they make important decisions. Each specific decision is not dependent on any one variable but is the result of numerous interactions, and gender stereotypes and gender typing occurs over time.

Females Camouflage Talent: Kerr (2000) believes that during preschool and primary school years gifted females are encouraged to develop their talents. However, during early adolescence and adulthood many gifted females learn to camouflage their talents in an effort to gain acceptance by other females and by males for dating and marriage. Furthermore, the families in many cultures encourage gifted girls to comply with traditions, and by doing so limit their career development.

Balance between Development & Nurturing Job Environment: According to this theoretical prospective (Theory of Work Adjustment – TWA) (Lubinski, Benbow & Morelock, 2000), there is a correspondence between each individual's abilities and the abilities inherent in the job (satisfactoriness). The correspondence between each individual's interests and preferences must be matched with the degree to which the job permits the nurturing of these personal qualities (satisfaction). Many gifted females have more balanced goals than gifted males -- wanting to divide their time more equitably among marriage, family, and their career. This orientation undercuts their job satisfaction and limits their career growth.

Micro-Inequities/Macro-Inequities: Campbell and Beaudry (1998) break down gender differences into micro-inequities and macro-inequities. This approach emphasizes that there are hundreds or even thousands of socio-psychological variables where gender inequities occur. Many different social agents reinforce these inequities over time. A good many of these micro-inequities arise when parents emphasize "masculine" behavior for their sons and "feminine" behavior for their daughters. They want their sons to exhibit masculine ways of acting and their daughters to be "lady-like." This emphasis is responsible for starting boys and girls down very divergent roads. Eventually these subtle micro-inequities accumulate over time to produce observable gender gaps and gender stereotypes.

DATA SOURCE

The following research studies were analyzed in terms of the aforementioned gender paradigms: The Third International Mathematics and Science Study-Repeat (NCES, 1999), conducted by the International Association for the Evaluation of Educational Achievement (IEA), supplied the eighth-grade data for this study; the John Hopkins Research Studies on Mathematically Precocious Youth (1983), Plomin's Familial Studies (1990), Hedges and Nowell (1995) meta analysis on sex related difference in mathematics (1995), Eccles (1979) longitudinal study on student academic beliefs, the Work Adjustment Studies (Lubinski et al., 2000) and Cho's (2001) and Campbell's (2002) research on International Math Olympians. See Table 1.

Table 1

Gender Gaps For Academic Olympians	
Country	*Ratio (Males: Females)*
Finland	
Math	10:1
USA	
Math	44:1
Physics	4:1
Chemistry	6:1
Germany	
Math	35:1
Physics	95:0
Chemistry	10:1
Taiwan	
Math	17:1
Physics/Chemistry	11:1
China	
Math	17:1
Korea	
Math	15:1

CONCLUSIONS

Although most researchers agree that gender inequities in mathematics are more a result of socialization factors than biological predilections, gender variations still exist and remain static despite innumerable efforts to ameliorate them. Researchers must therefore find an international platform where this growing concern can be addressed before the scarcity of female mathematicians and scientists become an irreparable reality.

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