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# Guest Editorial

# Gendered Motivation and Choice in STEM
# Part 1 - Individual and Contextual Factors

***Guest Editors: Rebecca Lazarides and Angela Ittel***
***Technische Universität Berlin, Germany***

This special issue is the first of two parts which include papers that are based on a selected number of keynotes and research papers presented at the International Gender and STEM Conference (Science, Technology, Engineering, Mathematics), which took place from 3-5 July, 2014 at Technische Universität Berlin, Germany. The conference entitled "Gender and STEM: What schools, families, and workplaces can do?" was organized in close collaboration with Helen M. G. Watt (Monash University, Melbourne, VIC, Australia), and the Network Gender & STEM (www.genderandSTEM.com), the professional network that was founded in 2010 by Helen Watt and the VHTO, the Dutch national expert organisation on girls and women and science and technology. Further details about the Network Gender & STEM, its history and future directions are described in the first paper in this special issue by Helen M. G. Watt, Gertje Joukes and Noortje Jansen.

As readers of this journal will be aware, over the past 30 years a large amount of research spanning many disciplinary fields has been undertaken to investigate the issue of women's underrepresentation in STEM fields. Although many initiatives have been developed to promote gender equality in STEM, the gap between the participation of women and men in STEM fields has only slightly diminished within the last decade (OECD, 2012, 2013). Gender-related differences in labour market outcomes for men and women are wider than gender gaps in educational outcomes (OECD, 2012) and are highly problematic given that professions related to mathematics and science are often associated with higher income (Jones, 2014; OECD, 2014) and higher prestige (Cejka & Eagly, 1999).

The work of the Network Gender and STEM has been strongly influenced by the research undertaken by Jacquelynne Eccles and colleagues, particularly her expectancy-value model of achievement-related choices (Eccles, 2005, 2009; Eccles et al., 1983). This work forms one strand of the extensive psychological literature on women and STEM and consists of a theoretical model that has been intensively empirically validated depicting the underlying psychological processes through which social, cultural and individual influences affect girls' and boys' gendered motivation and career choice behaviours.

This special issue, published in two parts, includes empirical research papers that apply innovative theoretical and methodological research approaches to provide insights on how individual and social factors shape girls' and boys' gendered motivation and career plans. Furthermore, it includes a variety of perspective papers that provide a detailed overview of established theoretical perspectives and empirical research that contribute to the explanation of how social and individual antecedents shape the development of gender stereotypes, motivation and choice in mathematics and science disciplines.

This issue presents research that analyses how different socialization contexts, such as family and peer group affect individuals' gendered domain-specific motivation and choice behaviors. Furthermore, the interplay of gendered motivation in STEM and individual factors such as spatial thinking, anxiety, and career plans is examined. It contains perspective papers, theoretical and empirical papers authored by researchers from Australia, Finland, Germany, and the United States. Part two of the special issue will include perspective papers and empirical studies from Germany, New Zealand, the Netherlands, and the United States.

In this first part of the special issue, the role of parents in adolescents' gendered motivation in STEM is highlighted by Jacquelynne S. Eccles in *Gendered Socialization of STEM Interests in the Family.* This perspective paper focuses on families' influences on STEM-related gender differences using the Eccles et al. model referred to earlier. The model of parental influences on children and adolescents is presented and empirical results from two longitudinal studies are discussed: the Michigan Study of Adolescent Life Transitions (MSALT) and the Childhood and Beyond Study (CAB).

Parental influences are also examined by Jaana Viljaranta and colleagues in their paper *The Role of Parental Beliefs in the Development of Interest and Importance Value of Mathematics and Literacy from Grade 7 to Grade 9.* Here the focus is on mothers' and fathers' child-specific ability beliefs and adolescents' gender for the level and changes in Finnish adolescents' interest and importance values towards mathematics and literacy from grade 7 to grade 9 in comprehensive school.

The role of peers is highlighted by the perspective paper by Campbell Leaper who points out key processes associated with group belonging in *Do I Belong?: Gender, Peer Groups, and STEM Achievement*. The perspective paper focusses on social identities associated with group belonging and outlines how values reinforced in many girls' and women's peer groups may conflict with their perceptions of STEM. Girls and women may experience rejection and hostility from male peers, particularly related to achievement in STEM, and this is shown to be highly influential to continued participation and success. Strategies for reducing peer sexism and fostering STEM belonging are explored and related recommendations for future research are highlighted.

The importance of spatial skills and related interventions is outlined by Lynn Liben who presents arguments for the role of spatial thinking in STEM in *The STEM Gender Gap: The Case for Spatial Interventions*. This perspective paper includes brief reviews of early work establishing spatial intelligence as a distinct human capacity and later work aimed at identifying component spatial skills. The paper examines how spatial thinking in STEM is combined with gender differences in spatial skills, which leads to the argument that spatial interventions may help reduce the STEM gender gap.

Addressing social stereotypes as salient influences on adolescents' motivations and choice behaviours, Ursula Kessels summarizes research on stereotypes about STEM and girls in her theoretical paper *Bridging the Gap by Enhancing the Fit: How Stereotypes about STEM Clash with Stereotypes about Girls*. She demonstrates that STEM subjects are often perceived as unfeminine or as masculine, and those involved in STEM fields are perceived as lacking femininity. Furthermore, the 'Interests as Identity Regulation Model' is presented to contribute to explanations of the psychological consequences resulting from the misfit between stereotypes about STEM and stereotypes of girls. Finally, ways to bridge the gap are discussed within this framework.

Focusing on competence-related stereotypes in their empirical paper *Qualified for Teaching Physics? How Prospective Teachers Perceive Teachers with a Migration Background – and How It's Really About "Him" or "Her",* Lysann Zander and colleagues explore whether one possible reason for the low rates of students' enrolment in physics-based teacher training at German universities may be their competence-related stereotypes. The results of the experimental online study described in their paper indicated that both male and female student teachers perceived immigrant women as less qualified for teaching physics than men, but within this cohort male student teachers specifically perceived Turkish women as less competent and female student teachers perceived German women as less competent than men. Results advise that raising sensitivity towards stereotypic perceptions need to be an essential element of the professional development of teachers.

Several papers examine psychological antecedents of adolescents' gendered motivation or career plans in STEM disciplines. In the empirical paper *Differential Effects of Adolescents' Expectancy and Value Beliefs about Math and English on Math/Science-Related and Human Services-Related Career Plans,* Fani Lauermann and colleagues examined the predictive effects of US adolescents' motivational beliefs across two academic domains, English and Mathematics, on adolescents' math/science-related and human services-related career plans. Compared to boys, girls were less likely to consider math/science-related careers and more likely to consider human services occupations partially because they valued English more than boys. These findings underscore the importance of considering cross-domain influences in analyses of gendered career preferences.

In *Does Anxiety in Science Classrooms Impair Math and Science Motivation? Gender Differences Beyond the Mean Level* Julia Moeller and colleagues investigated gender differences among a sample of US and Finnish lower-and upper-secondary school / high school students when they were in an anxious state. The authors employed the Experience Sampling Method (ESM), a time/diary instrument to assess experiences of anxiety at the moment in which they occur, in different contexts, e.g., in and out of school and in specific science lessons. The findings of their empirical study revealed that when they were in anxious states girls experienced less positive affect and

intrinsic motivation, and more negative affect and withdrawal motivation across all their everyday life experiences.

The contextual influences on gendered motivation and choice are examined by Ingrid Schoon in her perspective paper, *Explaining Persisting Gender Inequalities in Aspirations and Attainment: An Integrative Developmental Approach* using a developmental-contextual model of motivated choice and behaviour. The paper takes a complex systems' view to present the multiple influences that occur over the life course and which contribute to persisting gender inequalities. Latest findings are reported regarding gender differences in aspirations and attainment, using evidence from experiences at different stages of the life course. Findings from previous research are highlighted that contribute to a better understanding of gender differences in aspirations and attainment, with a particular focus on gender differences in STEM educational and career choices.

The intersections of students' nativity and gender are examined in the empirical paper of Amy Roberson Hayes and Rebecca S. Bigler who outline in *Postbaccalaureate STEM Students' Perceptions of their Training: Exploring the Intersection of Gender and Nativity* doctoral and post-doctoral students' satisfaction with their graduate training at a research-focused institution in the US. Results showed that international and US-born women both valued family flexibility more than their male peers. International, but not US-born women, viewed careers in STEM research as affording their values. US women were more likely than international women to perceive their gender as the target of discrimination. Stronger beliefs were that research careers do not afford one's values and greater perceptions of gender discrimination were associated with lower ratings of satisfaction with graduate training among women but not men. The findings suggest the importance of a diverse composition of universities' STEM faculties with respect to gender and nativity. The findings also advise the importance of explicitly addressing potential biases by Faculty.

**REFERENCES**

Australian Council of Learned Academies. (2013). STEM country comparisons. Retrieved April 20, 2015 from: www.acolasecretariat.org.au/ACOLA/PDF/Final%20Report%20STEM%20Country%20Comparisons%20June%202013.pdf.

Cejka, M. A., & Eagly, A. H. (1999). Gender-stereotypic images of occupations correspond to the sex segregation of employment. *Personality and Social Psychology Bulletin, 25*(4), 413-423.

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105-131). New York, London: Guilford.

Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*, 78–89.

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J., & al., e. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). San Francisco, CA: Freeman.

Jones, J. I. (2014). An overview of employment and wages in science, technology, engineering, and math (STEM) groups *Beyond the Numbers: Employment and Unemployment* (Vol. 3). Retrieved April 21, 2015, from

http://www.bls.gov/opub/btn/volume-3/an-overview-of-employment.htm: U.S. Bureau of Labor Statistics.

National Science Foundation. (2015). Women, minorities, and persons with disabilities in science and engineering. Retrieved April 20, 2015 from http://www.nsf.gov/statistics/2015/nsf15311/.

OECD. (2012). Gender Equality in Education, Employment and Entrepreneurship: Final Report to the MCM 2012. Retrieved November 7, 2014 from http://www.oecd.org/social/family/50423364.pdf.

OECD. (2013). *Education at a Glance 2013 OECD indicators*. Retrieved July 17, 2014, from http://dx.doi.org/10.1787/eag-2013-en: OECD Publishing.

OECD. (2014). Enhancing Women's Economic Empowerment through Entrepreneurship and Business Leadership in OECD Countries. Retrieved April 21, 2015 from http://www.oecd.org/gender/Enhancing%20Women%20Economic%20Empowerment_Fin_1_Oct_2014.pdf.