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Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields

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ABSTRACT

The United States has made a significant effort and investment in STEM education, yet the size and the composition of the STEM workforce continues to fail to meet demand. It is thus important to understand the barriers and factors that influence individual educational and career choices. In this article, we conduct a literature review of the current knowledge surrounding individual and gender differences in STEM educational and career choices, using expectancy–value theory as a guiding framework. The overarching goal of this paper is to provide both a well-defined theoretical framework and complementary empirical evidence for linking specific sociocultural, contextual, biological, and psychological factors to individual and gender differences in STEM interests and choices. Knowledge gained through this review will eventually guide future research and interventions designed to enhance individual motivation and capacity to pursue STEM careers, particularly for females who are interested in STEM but may be constrained by misinformation or stereotypes.

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Introduction

Despite the United States' significant investment in science, technology, engineering, and mathematics (STEM) education, the size and the composition of the STEM workforce continues to fail to meet demand. In 2012, there were approximately 7.4 million STEM positions in the U.S., and this

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number is expected to grow to 8.65 million by 2018 (My College Options & STEMconnector, 2012). Unfortunately, STEM employers throughout the U.S. report shortages of skilled workers, raising concerns about the quality of the U.S. educational system and its ability to produce a large enough workforce to fill these positions (U.S. Congress Joint Economic Committee, 2012). Moreover, despite the impressive gains girls and women have made in math and science course enrollment and performance in recent years, concerns remain regarding the number of females pursuing degrees and careers in certain STEM fields (National Science Foundation, 2008, 2011). In primary and secondary school, girls and boys take math and science courses in approximately equal numbers (U.S. Department of Education, 2012) and girls outperform boys in math and science courses (Duckworth & Seligman, 2006). However, at the bachelor's level, women earned 27% of degrees awarded in mathematics and computer science, 20% in engineering, and 36% in physical sciences (National Science Foundation, 2011). At the graduate level, females were awarded 30%, 25%, 23%, and 31% of masters and doctorates in mathematics, computer science, engineering, and physical sciences, respectively (National Science Foundation, 2011). Over the past 30 years, researchers have dedicated themselves to studying these differences in career choice. Of these, Eccles' expectancy–value theory provides one of the most comprehensive theoretical frameworks for studying the psychological and contextual factors underlying both individual and gender differences in math and science academic motivation, performance, and career choice (e.g., Eccles, 1994, 2005; Wigfield & Eccles, 2000).

Drawing on work associated with identity formation, achievement theory, and attribution theory, expectancy–value theorists posit that the STEM pathway is composed of a series of choices and achievements that commence in childhood and adolescence. Achievement-related behaviors such as educational and career choice are most directly related to expectations for success and the value attached to the various options perceived as available. These domain-specific competence and task-related beliefs are influenced by cultural norms, behavior genetics, social experiences, aptitudes, and the affective reactions of previous experiences as individuals move through adulthood (Eccles, 1994; Eccles, Wigfield, & Schiefele, 1997). In other words, individual characteristics and experiences associated with STEM-related activities shape the development of self-efficacy, interests, task values, and long-term life goals, which in turn, influence educational and career choices in STEM and non-STEM fields (Eccles et al., 1993; Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005). Therefore, it is likely that male and female differences in STEM field selection are associated with gendered differences in these motivational beliefs (e.g., self-efficacy, interests, and task value).

In this article, we conduct a literature review of the current knowledge surrounding individual and gender differences in STEM educational and career choices, using expectancy–value theory as a guiding framework. The term "STEM" refers to the physical, biological, medical, health, and computer sciences; engineering; and mathematics. We also distinguish gaps in the literature, with the hope that this article will be a useful resource in guiding future empirical research. In the first section, we provide a brief overview of expectancy–value theory and its application to understanding individual and gender differences in educational and career choices. We then examine research demonstrating how both intellectual aptitude and achievement motivation may affect young people's math and science outcomes, focusing specifically on academic performance, aspirations, college majors, and occupational choice. In the third section, we review the influence of school, family, and peer experiences, as well as sociocultural and biological factors, on achievement motivation, engagement, and performance. In the fourth section, we highlight the limitations of the extant literature and provide suggestions for advancing current knowledge through future research.

Our goal is not to review the literature in detail; rather, we suggest how insights gained from previous research can contribute to our understanding of the sociocultural, biological, psychological, and contextual factors associated with individual and gender differences in STEM educational and career choices. A better understanding of individual and gender differences in career pathways will aid in the discovery of potential targets for future intervention. Thus, the overarching goal of this paper is to provide both a well-defined theoretical framework and complementary empirical evidence for linking specific external and internal factors to individual differences in STEM interests and choices. Knowledge gained through this review may eventually guide future research and interventions designed to enhance individual motivation and capacity to pursue STEM careers, particularly for females who are interested in pursuing STEM careers but might be discouraged by misinformation or stereotypes.

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