

Within the pipeline: Self-regulated learning, self-efficacy, and socialization among college students in science courses

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ABSTRACT

The present study examined associations between changes in students' science self-efficacy and self-regulated learning strategies and their relation to science achievement. Influences of gender, ethnicity, and childhood and adolescent socialization experiences were also examined. The variables were consistent with Bandura's social cognitive theory, which predicts a triadic model of determinants of behavior. Participants were one hundred thirteen undergraduates enrolled in science courses in large public college in New York. Students were administered two surveys, at the beginning and end of the semester. Results showed that self-efficacy beliefs changed over the course of the semester and that these changes positively predicted final course grades after controlling for gender, mother's educational level, and ethnicity. Males' childhood and adolescent science experiences were correlated with delay of gratification while for females these experiences correlated with final term grades.

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The National Science Foundation (2011) reports that while more women than men graduate with baccalaureate degrees, proportionately fewer women earn degrees in science and engineering. The report indicates that the science and engineering workforce consists of primarily white males. Educators have used the analogy of a *pipeline* to create an image of students moving through a funnel, which ends in STEM (science, technology, engineering, and mathematics) careers (Hanson, 1996). Young students are required to take science in early school years, but as they progress through the educational system they are often provided with the choice of whether or not to take science courses. This is especially evident in high school where many students begin to leak out of the pipeline.

Researchers have looked into possible explanations for why some students, particularly women, leak out of the pipeline and have examined variables such as gender roles, early exposure to STEM careers, parental attitudes, students' beliefs and values, self-efficacy, outcome expectations and self-regulated learning strategies (Bleeker & Jacobs, 2004; DiBenedetto & Zimmerman, 2010; Jacobs & Eccles, 1992; Tennenbaum & Leaper, 2003). While there have been longitudinal studies on this matter (Eccles & Wigfield, 1995), little is known about how science related-experiences during childhood are associated with

academic performance, self-regulation of learning, delay of gratification, and self-efficacy during a college science course. This study examined these variables and changes that took place over the duration of a college level science course within the framework of Bandura's social cognitive theory.

1. Theoretical framework

Bandura (1997) suggests that cognition and behavior are functions of human agency and context. This fall within Bandura's triadic model of reciprocity as: *personal* (i.e., feelings and cognition), *behavioral* (i.e., learning strategies or test performance), and *environmental dimensions* (i.e., classrooms or family units). The three dimensions are not unidirectional (see Fig. 1). Personal dimensions affect one's behavior and one's behavior affects one's personal feelings and thoughts. Learning takes place through *social modeling*—observing patterns of behavior of another in the environment. Through vicarious and direct observations provided during childhood, children learn about what is considered appropriate behavior for their gender. This ultimately affects their personal motivation for the occupations they may (or not) embrace as adults; thus the triadic components affect each other in a reciprocal manner.

The *personal dimension* includes motivation such as self-efficacy and outcome expectancies. *Self-efficacy* refers to individuals' beliefs in their capability to accomplish a specific task (Bandura, 1986). Self-efficacy is related to one's choice of activities, persistence, effort, and

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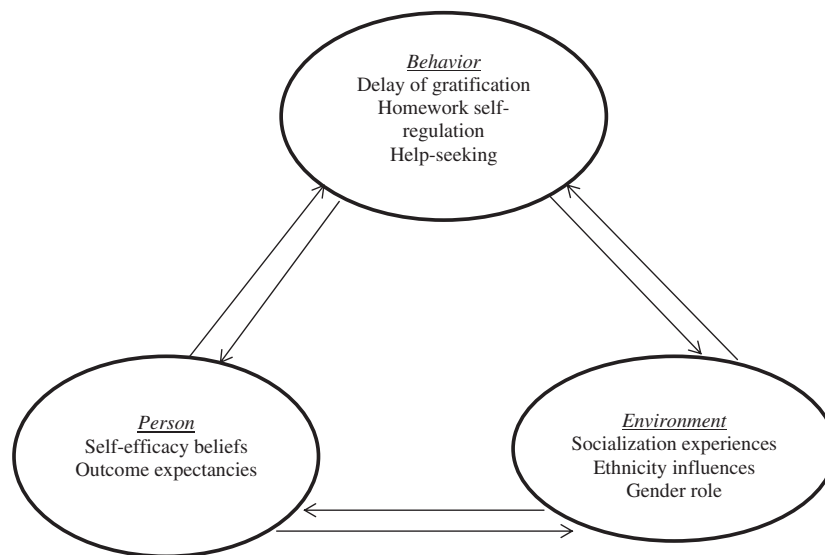


Fig. 1. Personal, behavioral, and environmental factors consistent with Bandura's triadic reciprocity.

academic achievement (Bandura, 1997). Hackett and Betz (1992) have explored the role of self-efficacy in the career development of women in underrepresented occupations. They posit that early learning experiences, in particular sex-role socialization experiences, influence girls' perceptions about careers, which subsequently affects their career choices. Zeldin, Britner, and Pajares (2006) analyzed self-efficacy beliefs of ten men and women working in STEM professions and found gender differences. Women reported beliefs as stemming from vicarious experiences such as observing other women in science related professions, and from verbal persuasions by significant others. These persuasions were considered to be critical to their own beliefs about their capabilities. This is consistent with social cognitive theory which postulates that two important sources of self-efficacy are vicarious observation of social models and verbal persuasion (Bandura, 1997).

Bandura also highlights the importance of *outcome expectancies*, beliefs about the anticipated results of behavior (Bandura, 1997). He suggests a conditional relationship between these two in that self-efficacy is the motivational variable between the person and behavior, and outcome expectancies are the beliefs about the consequences obtained from engaging in the behavior. For example, a student's self-efficacy about succeeding (outcome) in a biology class will determine whether she enrolls in the class (behavior). Research shows that although boys and girls often perform equally on standardized tests, girls report less confidence in their ability to perform well in science and enroll in fewer science courses in high school and college (Meece & Jones, 1996).

The *behavioral dimension* involves self-regulated learning (SRL), defined as "a self-directive process where learners transform their mental abilities into academic skills" (Zimmerman, 2002, p. 65). Three SRL strategies have been examined in the current investigation. First, *academic delay of gratification* (ADOG), the intentional postponement of a pleasurable activity for a more distant academic reward (Bembenuddy & Karabenick, 2004). Bandura and Mischel (1965) found that fourth and fifth graders who observed models delaying gratification also did so at a later time. Bembenuddy and Karabenick (1998) found that college students who delay gratification are more likely to use study management techniques resulting in higher achievement in a college course. Second, *homework self-regulation*, which refers to setting goals, using study strategies, and self-monitoring to complete tasks outside the classroom, is linked to academic achievement (Bembenuddy & White, 2012; Zimmerman & Kitsantas, 2005). Third, *help-seeking* is a self-regulatory strategy by which learners seek help from others to facilitate learning when faced with obstacles (Karabenick & Newman, 2006; White, 2010). Bandura's theory postulates that individuals are

in control of their learning by monitoring and managing their learning (1997). Self-efficacy, outcome expectancies, and ADOG are positively related to help-seeking (Bembenuddy, 2011). Evidence shows that high achieving students faced with academic challenges will seek help (Karabenick, 2011). Gender, self-efficacy, and help-seeking are also related (Williams & Takaku, 2011).

In the *environmental dimension*, Bandura (1997) discusses the effects of *socialization experiences*, *ethnic influences*, and *sex-roles*. Childhood science socialization experiences include exposure to social modeling, parental expectations and stereotypes, fieldtrips to science museums, science books, chemistry sets, computer games, science clubs, and working or volunteering in science related locations such as museums and laboratories. Socialization experiences affect students' self-efficacy, outcome expectancies, and self-regulatory behavior; and findings show that differences among cultures may result in biases between boys and girls (Eccles & Wang, 2012; Meece & Courtney, 1992).

Social and ethnic variables are linked to the personal and behavioral dimensions of the triadic model. Schunk and Meece (2006) found that when effective interactions with the environment are fostered by families, students have enhanced self-efficacy and competency beliefs, which can ultimately affect their choice of courses to enroll in (Eccles, 1987). ADOG has differed among psychology students from different ethnic groups and genders (Bembenuddy, 2007). An investigation on homework practices and parental involvement showed differences for adolescents with parents being more involved in girls' homework (Carter & Wojtkiewicz, 2000). Newman (2000) explored the development of help-seeking by examining social influences from parents, teachers, and peers indicating that from early experiences of help-seeking, children develop the ability to selectively judge when, the type needed, and the source of help. Senler and Sungur (2009) found that parents' educational level affected elementary and middle school students' science achievement. However, little is known about how motivational variables and SRL approaches are related or change during a college science course. The current study aimed to fill this gap.

The study addressed the following research questions: First, do students' motivational beliefs and self-regulatory learning strategies change over one science course? Secondly, do students' childhood and adolescent science experiences relate to motivation and use of self-regulation strategies in a science course? Thirdly, are changes in motivational beliefs, use of self-regulatory learning strategies, and final course grades correlated? Lastly, are final course grades associated with changes in motivation and use of self-regulatory strategies over time even after controlling for demographic factors?

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