VIRGINIA COMMONWEALTH UNIVERSITY

Longitudinal Relations Between High School Science Motivation and Performance

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Abstract

Prior work has established the importance of motivational beliefs in explaining performance in and pursuit of STEM, yet critical questions remain unanswered. There has been a disproportionate focus on samples that primarily consist of European-American, middle-class students, for example. Moreover, few studies have considered the combined experiences of gender and racial identities. Drawing from expectancy-value theory, the current research addresses these gaps by using the nationally representative *High School Longitudinal Study* dataset. Structural equation modeling results revealed patterns of direct and indirect pathways that were consistent with hypotheses: 9th grade expectancies for success and values in science positively predicted 9th and 11th grade achievement. A direct relation between 9th grade motivational beliefs and achievement also emerged, as did indirect relations through 9th grade achievement and 11th grade motivational beliefs. Implications and next steps are discussed.

Introduction

- There is a pressing need to cultivate skills, interest, and persistence in science, technology, engineering, and mathematics (STEM).
- Many students– especially women and people of color – who initially aspire to pursue STEM opt out of doing so (NSF, 2019).
- Academic motivation plays a central role in predicting STEM achievement and retention (e.g., Rosenzweig & Wigfield, 2016).
- Much of this work is guided by expectancy-value theory (EVT; Eccles et al., 1983). According to EVT, students who (a) expect to do well in a given domain (i.e., have high *expectancy for success*) and (b) *value* it will perform better in the domain and persist.
- Many previous EVT STEM studies have (1) used samples that consist primarily of White students (e.g., Lauermann et al., 2017; Watt et al., 2012); and (2) not explored the combined experience of gender and race/ethnicity.
- Drawing from EVT, the current study attempted to address the aforementioned two gaps.

Research Questions

1. Do 9th grade science expectancies and values predict 11th grade achievement?
2. Are these associations mediated by 9th grade achievement and 11th grade science expectancies and values?
3. Do the means and magnitudes of the aforementioned relations depend on unique combinations of race and gender?

Conceptual Model

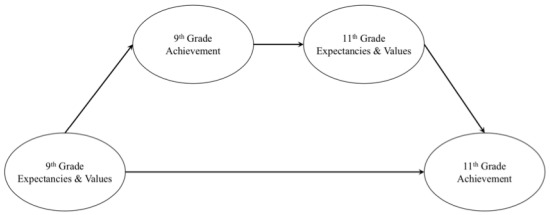

Figure 1. Conceptual model guiding the current study. Expectancies and values = expectancies and values in science. Final analyses will investigate whether the conceptual model above varies as a function of unique combinations of gender and race: male URM, female URM, male non-URM, female non-URM.

Method

- **Participants.** A subsample of students (n = 17,666) from the High School Longitudinal Study (HSLS; Ingels et al., 2011).
- **Procedure and Measures.** Data were collected at two waves in Fall 2009 and Spring 2012 when students were in 9th and 11th grade.
- *Expectancies and values* in science were measured by survey items (see Table 1). *Achievement* was measured by a standardized test of algebraic reasoning administered in Fall 2009 and Spring 2012.
- Final results will include (1) *science course performance,* measured with 9th and 11th grade transcripts, and (2) *gender* and *race,* reported by students.

Table 1: Summary of Measures

Construct	*n* items	Sample Item
Expectancy for Success	4	You are certain that you can understand the most difficult material presented in the textbook used in this course.
Intrinsic Value	3	You are enjoying this class very much.
Utility Value	3	Science is useful for everyday life.
Attainment Value	2	You see yourself as a science person.

Note. All items are measured on a four-point Likert scale with "Strongly Disagree" and "Strongly Agree" as anchors. Items closely resemble widely-used measures of these and related constructs in the extant literature (e.g., see Eccles & Wigfield, 1995; Midgley et al., 2000)

Results, Implications, & Next Steps

Results:

- Structural equation modeling results displayed excellent fit (RMSEA = .058 90% CI = (.056, .06), CFI = .96, TLI = .94, SRMR = .04).
- Patterns of indirect and direct effects were consistent with hypotheses:
  - 9th grade expectancies for success and values in science positively predicted 9th and 11th grade achievement.
  - 9th grade motivational beliefs directly predicted 11th grade achievement and did so indirectly through 9th grade achievement and 11th grade motivational beliefs.

Implications and Next Steps:

- Results suggest that science expectancies for success and values predict achievement within a nationally representative sample.
- These findings reinforce the critical importance of creating a classroom context that promotes these beliefs among all students.
- An essential next step: explore whether and how these relations differ according to unique combinations of gender and race.

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