

What Factors Promote High School Students' Development of **Science Identity** and **STEM Major Aspiration**? An Analysis of HSLs:09 Data

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Research Background

- **Current Disparity in STEM Workforce**
 - 75% of STEM workforce are White & Asian workers
 - Only 24% underrepresented groups (Hispanic, Black, American Indian/Alaska Native) (NCSES, 2023)
- **Importance of Science Identity**
 - Strong, stable science identity → Higher STEM persistence (Estrada et al., 2018; Robinson et al., 2019)
- **Research Gap**
 - Fewer studies have explored how high school students develop science identity and what role, if any, science identity plays in students' educational aspirations.
- Leveraging the High School Longitudinal Study of 2009 (HSLs:09), This study aims to understand the factors promoting high school students' science identity and STEM major aspirations, and the influence of parental involvement, through the lens of Social Cognitive Career Theory (SCCT).



Research Questions

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1. Controlling for demographic characteristics and academic achievement, what factors contribute to college-bound high school seniors' development of science identity while in high school?
2. Controlling for demographic characteristics and academic performance, to what extent does science identity predict college-bound high school seniors' aspirations to major in STEM?

Literature Review

- 3 • **Background Characteristics Informing Science Identity and STEM Major Aspirations:**
 - URG students face more challenges in developing strong science identities due to systemic barriers, affecting their STEM persistence and performance (Murphy & Kelp, 2023).
 - Parental involvement in school education, such as discussing school courses and being present at school events
 - High school students demonstrate higher levels of self-esteem and career flexibility when their parents invest more time, energy, and interest in their school activities (Amarnani et al., 2018).
- **Development in Science Identity**
 - Participation in extracurricular science activities, such as joining science clubs, engaging in science camps, and visiting science museums, has positive effects on high school students' science identity (Cohen et al., 2021).
 - Dou et al. (2019) found that discussions about science with family members had lasting effects on the development of their science identity.
- **Key Factors in Shaping STEM Aspirations**
 - Students' interest and confidence in math and science, parental occupation and socioeconomic status, and students' participation in extracurricular science activities
 - Science self-efficacy and science identity



Conceptual Framework

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Social cognitive career theory (SCCT), which provides a powerful lens to understand the processes and outcomes shaping academic and career choices (Byars-Winston & Rogers, 2019). SCCT, rooted in the broader social cognitive theory, posits that career and academic interests, choices, and performance are the product of complex interplays between personal attributes, cognitive influences, and proximal environmental factors (Lent et al., 1994). The central tenet of SCCT is that individuals' academic and career-related pursuits and decisions are influenced by self-efficacy and outcome expectations.

- **HSLs:09 (NCES):**
 - High School students' school experiences, parental involvement, STEM self-efficacy, college majors, and career aspirations.
 - Base Year in 2009 (HS freshman year)
 - First follow-up in 2012 (HS senior year)
 - Second follow-up in 2016 (3 years after high school).
 - Final sample of 14,260 observations.
- **Key Outcome Variables of Interest:**
 - This study has two key outcomes: a composite scale measuring high school seniors' science identity and a binary indicator of whether respondents intend to pursue a STEM major in college. The composite science identity scale includes agreement items related to statements about seeing themselves and being seen by others as a "science person," with higher values indicating stronger science identity



- **Key Outcome Variables of Interest:**

- We grouped predictor variables into three conceptually related, temporally aligned blocks.
- The first block featured demographic variables, including gender, race/ethnicity, socioeconomic status, academic GPA, and whether a parent currently works in a STEM field.
- Block 2 consists of dummy-coded parental involvement variables, including support for using computer technology, visits to science museums, helping with homework weekly, participation in school meetings, teacher conferences, fundraising events, and discussions about science.
- Block 3 represents the student's science self-efficacy scale, expected highest education level (Bachelor, Master, PhD), and relevant study activities, including whether the student received academic instruction outside of school, participated in a science club, or had a science tutor from the SCCT framework.





Table 1. Distribution of Science Identity Among High School Seniors Grouped by Gender and Race (n = 5600)

Demographic	Mean	SD
Gender: Men	0.37	0.96
Gender: Women	0.19	0.99
Race: White	0.29	0.97
Race: Black	0.13	1.00
Race: Asian	0.50	0.95
Race: Hispanic	0.10	0.97
Race: Multiracial	0.32	1.00

Table 2. Predicting Science Identity Development in High School (n = 5600)

	Model 3			
	B	SE	t-value	p-value
Constant	-0.34	0.08	-4.33	0.000
<i>Block 1: Demographic Variables</i>				
Science Identity Pre-test (Freshman year)	0.39	0.01	26.92	0.000
Gender: Women	-0.07	0.03	-2.89	0.004
Race: Native	0.03	0.12	0.24	0.808
Race: Asian	0.08	0.04	1.74	0.082
Race: Black	-0.13	0.05	-2.69	0.007
Race: Hispanic	-0.02	0.04	-0.55	0.580
Race: Multiracial	0.04	0.04	0.87	0.385
Low SES	0.00	0.04	-0.10	0.924
Middle SES	0.00	0.03	0.04	0.966
Parental Occupation in STEM	0.06	0.03	1.98	0.048
Academic GPA	0.13	0.02	6.29	0.000



Findings

Block 2: Parental Involvement Variables

Provide IT Support	0.04	0.02	1.52	0.129
Visit Museum Often	0.05	0.03	2.02	0.044
Help Homework Weekly	0.00	0.02	0.17	0.865
Participate School Meeting	-0.01	0.04	-0.34	0.736
Participate Teacher Conference	0.02	0.03	0.90	0.366
Participate Fund Raise	0.02	0.03	0.67	0.506
Dad Talk Science	0.02	0.03	0.48	0.632
Mom Talk Science	0.00	0.03	-0.12	0.906

Block 3: SCCT

Science Self-efficacy	0.10	0.02	6.95	0.000
<u>Bachelor Degree</u> Expectation	-0.05	0.04	-1.52	0.128
<u>Master Degree</u> Expectation	-0.04	0.03	-1.24	0.216
PhD Degree Expectation	0.11	0.03	3.17	0.002
Received academic instruction outside of school	0.06	0.03	1.75	0.079
Participated in a science club	0.10	0.07	1.55	0.121
Had a science tutor	-0.09	0.08	-1.04	0.297



Table 3. Logistic Regression Analysis for Predicting STEM Major Aspirations Among High School Seniors (n = 5600)

	B	Exp(B)	SE	Z-value	p-value
Constant	-2.57	0.076	0.23	-11.02	0.000
<i>Block 1: Demographic Variables</i>					
Gender: Women	-1.22	0.296	0.07	-17.15	0.000
Race: Native	0.55	1.735	0.32	1.72	0.086
Race: Asian	0.75	2.106	0.11	6.65	0.000
Race: Black	0.01	1.006	0.15	0.04	0.968
Race: Hispanic	0.31	1.365	0.11	2.78	0.006
Race: Multiracial	0.15	1.163	0.13	1.20	0.230
Low SES	-0.23	0.796	0.10	-2.19	0.029
Middle SES	-0.13	0.879	0.10	-1.29	0.198
Parental Occupation in STEM	0.11	1.120	0.08	1.34	0.181
Academic GPA	0.58	1.793	0.06	9.36	0.000



Block 2: Parental Involvement Variables

Provide IT Support	0.02	1.021	0.07	0.31	0.760
Visit Museum Often	0.04	1.043	0.07	0.57	0.569
Help Homework Weekly	-0.12	0.888	0.07	-1.73	0.085
Participate School Meeting	-0.07	0.934	0.12	-0.58	0.562
Participate Teacher Conference	0.11	1.117	0.07	1.55	0.120
Participate Fund Raise	-0.18	0.837	0.07	-2.43	0.015
Dad Talk Science	0.02	1.018	0.09	0.20	0.843
Mom Talk Science	0.09	1.092	0.09	0.96	0.339

Block 3: SCCT

Science Identity (Senior year)	0.72	2.053	0.04	18.68	0.000
<u>Bachelor Degree</u> Expectation	-0.02	0.979	0.11	-0.20	0.840
<u>Master Degree</u> Expectation	0.17	1.181	0.09	1.76	0.079
PhD Degree Expectation	0.15	1.166	0.09	1.62	0.106
Received academic instruction outside of school	-0.07	0.930	0.09	-0.79	0.431
Participated in a science club	0.34	1.403	0.17	1.95	0.051
Had a science tutor	-0.30	0.741	0.25	-1.21	0.228



Limitations



Insufficient Variables: The study's limited range of variables may restrict the ability to fully understand the complex dynamics affecting STEM education outcomes. Science self-efficacy, science identity, science-related skills.



Theoretical Misalignment: The theoretical framework may not adequately capture for the contextual or cultural factors influencing educational outcomes, the finding might oversimplify the complexities of educational disparities.



Limited Generalizability: Given the focus on specific demographic groups and educational settings, the results of the study may not be generalizable to other populations or educational contexts.

Conclusion and Discussion

This study aims to investigate the relationship among parental involvement, students' science identity, and their aspirations for STEM majors through the lens of SCCT. While prior studies have examined the factors influence the development of science identity and STEM major aspiration separately, this research seeks to provide insights into the mechanisms through which parental involvement, high school study activities, and students' science identity jointly shape high school students' STEM aspirations. Future research will incorporate additional variables related to high school students' involvement in science activities, such as participation in science competitions and attendance at science camps, to examine their relevance to students' science identity and STEM major aspirations.



Thank you!

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