BUILDing Science Identity: Exploring the Efficacy and Moderation Effects of a Nationally Funded Intervention

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Land Acknowledgement

As we gather for the ASHE 2024 Annual Conference, it is important to acknowledge that we are currently on the traditional ancestral homeland of the Dakhóta Oyáte (Dakota people), the original inhabitants and stewards of the land and waterways of Minneapolis, Minnesota.

Overview

- Background & Research Question
- Conceptual Framework
- Literature Review
- Data and Method
- Results
- Discussion

Background

- Persistent issues of underrepresentation and inequality in STEM have driven research on interventions like undergraduate research and mentorship to support diverse talent in biomedical sciences (e.g., Espinosa, 2011; Robinson, 2022; Eagan et al, 2013; 2024; Ramos et al., 2024).

- The BUILD initiative, funded by NIH, aims to boost undergraduate STEM success among underrepresented groups through targeted support for BUILD Scholars, including research, mentorship, and financial aid (Davidson et al., 2017).

- Rising education and living costs highlight the importance of considering financial factors in evaluating STEM interventions (Kerr & Wood, 2023; U.S. Department of Agriculture, 2024).

Research Questions

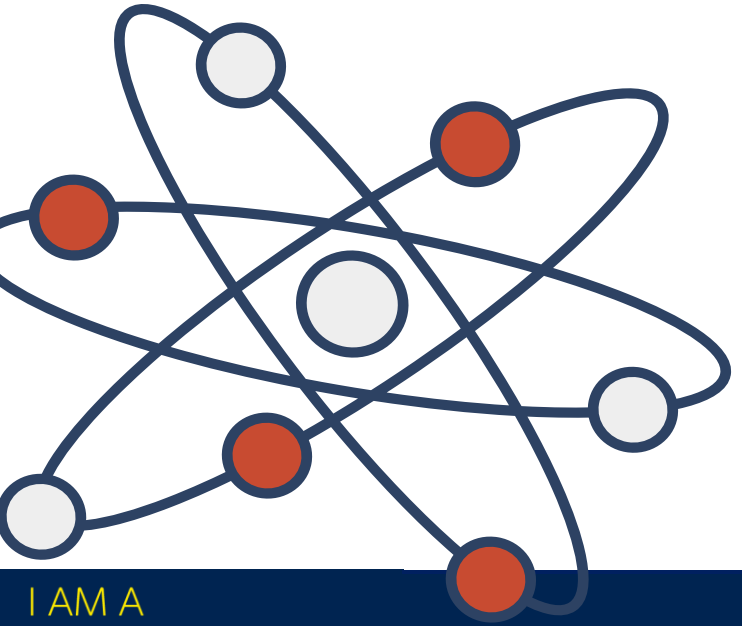
- **RQ1:** Controlling for pre-college and demographic characteristics, to what extent do BUILD Scholars develop significantly stronger science identities by the end of their senior year compared to non-Scholars?

- **RQ2:** To what extent do the component activities of BUILD (i.e., research experiences, faculty mentorship, financial support) attenuate the effect of being a BUILD Scholar on college students' development of science identity by the end of their senior year?

- **RQ3:** To what extent do students' racial/ethnic identities, first-generation status, and financial capacity (e.g., status as a Pell recipient) moderate the effect of being a BUILD Scholar on students' development of science identity by the end of their senior year in college?

Conceptual Framework

- Science Identity
  - Carlone & Johnson (2007)
  - Hazari et al. (2010)



Competence

Developing competence in a particular domain

Performance

Performing science-related tasks

Recognition

Receiving recognition as a science person from meaningful others/self

Interest

Interest in science

Literature Review:

- **Science Identity as a Predictor of Academic and Career Outcomes**
  - Strong science identity linked to STEM persistence, graduate intentions, and career commitment (Chang et al., 2011; Estrada et al., 2018; Robinson et al., 2019).
- **Demographic and Academic Variation in Science Identity Development**
  - Science identity varies by race/ethnicity, gender, SES; barriers for underrepresented groups (Byars-Winston & Rogers, 2019; Hernandez et al., 2018; Murphy & Kelp, 2023).
- **College Experiences That Promote Undergraduate Science Identity Development**
  - Research participation and mentoring enhance science identity (Eagan et al., 2024; Estrada et al., 2018). Financial aid boosts access to STEM opportunities for underrepresented, low-income students (Anderson et al., 2023; Castleman et al., 2018).
- **Characteristics of Students Engaging in Research Programs**
  - Access to UREs is inequitable; underrepresented students face financial barriers, limiting their engagement (Haeger et al., 2024; Pierszalowski et al., 2021).

Data

- **Dataset**
  - HERI Surveys: 2016-2019 Freshman Survey (TFS) and 2018-2023 College Senior Survey (CSS), supplemented with administrative records from BUILD funded 10 sites
  - Final sample compared 215 BUILD Scholars with 2,369 of non-BUILD counterparts
- **Key Variables**
  - **Outcomes:** HEIR's construct science identity (IRT adjustment: mean=50, sd = 10)
  - **Treatment:** BUILD Scholar (coded as binary)
  - **Covariates:**
    - Demographic Characteristics (e.g., race, gender, first-gen, Pell grant) and Pre-College Experiences (e.g., HS GPA; degree aspiration, baseline science identity)
    - College Experience: faculty mentorship; research exposure; off-campus work
  - **Interaction Effects:** cross-product interactions between BUILD scholar and demographic characteristics

Method

- **Method:**
  - **Stage 1 Descriptive Analyses:**
    - Used crosstabs and measures of central tendency (mean, sd)
  - **Stage 2 Propensity Score Estimation:**
    - Applied logistic regression to estimate propensity to participate in BUILD Scholar program
    - Addressed selection bias and endogeneity using a quasi-experimental design
    - Trimmed sample to ensure overlap in propensity scores (common support principle)
    - Calculated inverse probability weights for treatment effects: ATE, ATT, and ATU
  - **Stage 3 Fixed effects linear regression with inverse probability weights:**
    - Nested model: pre-test + BUILD scholar -> background -> college experience -> interaction
    - Compared results with unweighted regression model

Limitation

- **Limitation:**
  - **Secondary Data:** HERI surveys were not specifically designed for this study.
  - **Quasi-experimental Approach:** Factors not reflected in our propensity model may influence students' decisions to seek out and participate in intervention programs such as BUILD.
  - **Variability:** Sites' implementation of the BUILD program varied in intensity and in context. More nuanced participation data tracking can alleviate this concern.

Results

- Results highlight:
  - Identifying as Black student was the strongest predictor of BUILD participation (exp(b) = 3.58, p < .001).
  - Students in the social sciences were more likely to enroll in BUILD than those in the natural sciences(exp(b)=2.52, p<.001).
  - Students that intend to pursue a science career are also more likely to enroll in BUILD
  - Students with higher science identity are also more likely to enroll in BUILD (exp(b)=1.06, p<.001)
  - Students with higher high school gpasgpa's were also more likely to enroll in BUILD.

Results RQ1+RQ2

Table 2 *Predicting Science Identity Development by Senior Year*

	Model 1			Model3		
	b	SE	Beta	b	SE	Beta
Constant	27.68	0.87		20.17	1.33	
Science identity pre-test	0.49	0.02	0.41***	0.35	0.02	0.29***
BUILD Scholar	**5.95**	0.23	0.32***	**2.96**	0.27	0.16***
Race: Native American				-6.07	2.07	-0.03**
Race: Asian				-1.47	0.35	-0.07***
Race: Black				-2.62	0.43	-0.11***
Race: Latino				-0.9	0.43	-0.04*
Race: Other				-0.14	0.82	-0.01
Race: Multiracial				-1.87	0.4	-0.07***
Pell Grant recipient				0.84	0.24	0.05***
First-generation student				0.25	0.27	0.01
Financial concerns about paying for college				-0.83	0.18	-0.06***
Participated in any undergraduate research experience				3.84	0.29	0.21***
Frequency of faculty mentorship in college				0.12	0.01	0.17***

Results Q3

Table 3 *Conditional Effects of BUILD Scholar Participation on Science Identity Development*

	Model 4		
	b	SE	Beta
Interaction Terms			
Native American x BUILD	-8.91	4.23	-0.03 *
Asian American x BUILD	-0.44	0.63	-0.02
Black x BUILD	-0.12	0.70	-0.01
Latino x BUILD	**3.07**	0.70	0.10***
Other Race x BUILD	5.00	1.63	0.06***
Multiracial x BUILD	-0.82	0.77	-0.02
Pell recipient x BUILD	**2.42**	0.44	0.21***
First-generation student x BUILD	0.88	0.49	0.07

Marked p<0.05 *, p< 0.01**, p<0.001***

Discussion

- **Findings:**
  - BUILD significantly enhances students‘ science identity development through research and mentorship. After identifying and examining BUILD’s component parts, BUILD remains a positive predictor on the development of a student’s science identity.
  - BUILD provides additional benefits for underrepresented students, especially those receiving Pell grants.
- **Implication for future research:**
  - Develop surveys to quantify mentoring and research experiences to optimize program outcomes.
  - Investigate why additional funding, such as Pell grants, amplifies benefits for BUILD scholars. For example, exploring how financial support impacts outcomes beyond science identity (e.g., graduation rates, grad school admissions, career success).
- **Implication for future policy:**
  - Incorporate research and mentorship into STEM curricula.
  - Ensure sufficient funding to support STEM interventions that institutionalize program components that include mentoring, research, and financial support for students and enhance academic and professional outcomes, contributing to a stronger, more diverse STEM workforce.

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Thank you for listening ~

Welcome Contact and Further Discussion!

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