NISE Net Online Workshop

STEM Identity & Career Interest for Students Traditionally Underrepresented in STEM

January 14, 2025

Today's Presenters:

- **Dr. Susan Sunbury,** Smithsonian Astrophysical Observatory
- **Dr. Tingting Reid,** Harvard University, Harvard College Observatory
- **Amdad Ahmed Awsaf,** Florida International University, Talking Science

Welcome! As we wait to get started with today's discussion, please…

Introduce yourself! Type your name, institution, and location into the Chat Box

Questions? Feel free to type your questions into the Chat Box at any time throughout the webinar. During the Q&A you may also use the raise hand feature (see "Participants" on the toolbar) and we will call on you in the order questions are received.

Today's workshop will be recorded; those registered will receive an email when available here: nisenet.org/online-workshop-recordings

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Project Goal:

Develop a student survey which can be used with STEM and non-STEM first year college students to test whether earlier exposure to certain Out-of-School Time (OST) programs and opportunities within programs predicts a boost in attitudes related to STEM interest, identity and careers, especially for students underrepresented in STEM

- **Generate hypotheses to be incorporated into the survey instrument;**
- **Develop, pilot test, and validate instrument;**
- **Analyze initial data and disseminate preliminary findings**

Hypotheses Generation:

1. STEM Education Research Literature
2. Stakeholders – 25 interviews with and over 100 surveys to OST providers across the country
3. College STEM Students and Young Professionals (Amazon M-Turk) over 100 students, 500 turkers

Hypotheses Generation: Stakeholders

- Providing relevant and real-world examples for students to picture STEM careers and picture themselves in STEM careers
- Including relevant and real-world issues in their programs
- Importance of location, be in on a college campus or in a natural setting (wherever science happens)
- Building community among participants
- Building relationships with adults (especially young adults, i.e. undergrads and graduate students, not just professors)
- Having instructors, guest speakers, or mentors that look like their participants
- Finding ways for participants to connect with someone who has a similar story

Instrument Development:

1. Mining of previous instruments (ours and others)
2. Incorporate results from the literature and surveys/interviews with stakeholders and students

The Instrument:

Comprehensive survey – 29 questions (15-20 minutes to complete

- **Career interest**
- **STEM interest**
- **STEM identity**
- **Participation in OST activities – structured and unstructured**
- **Family interest and involvement in STEM**
- **Barriers to participation in OST STEM activities**
- **Demographics**

The Instrument: Career Interest

1. **Which of the following describes what you want(ed) to be at the beginning of middle school, in high school (beginning and end), and at the beginning of college?** *Mark all that apply. Leave blank those that do not apply.*

	Beginning of Middle School	Beginning of High School	End of High School	Beginning of first semester of College
Didn't know at that time				
Medical doctor (e.g., physician, dentist, vet.)				
Health professional (e.g., nurse, pharmacist)				
Life scientist (e.g., biologist, medical researcher)				
Astronomer				
Earth/Environmental scientist (e.g., geologist)				
Physical Scientist (e.g., chemist, physicist)				
Other Scientist				
Computer scientist/programmer/IT specialist				
Engineer				
Mathematician/Statistician				
Science or Math teacher				
Other teacher				
Anthropologist/Archaeologist				
Social scientist (e.g., psychologist, sociologist)				
Humanities professional (e.g., historian, writer)				
Visual/Performing artist (e.g., painter, sculptor, actor, musician, dancer)				
Business person (e.g., entrepreneur, manager)				
Lawyer				
Politician				
Athlete/Coach				
Military personnel				
Other non-STEM related career				

The Instrument: STEM Interest

6. At the *end of middle school* and the *end of high school*, how interested were you in:

	At the *end of middle school*						At the *end of high school*					
	Not at all interested					Extremely interested	Not at all interested					Extremely interested
	0	1	2	3	4	5	0	1	2	3	4	5
Science	0	1	2	3	4	5	0	1	2	3	4	5
Mathematics	0	1	2	3	4	5	0	1	2	3	4	5
Engineering	0	1	2	3	4	5	0	1	2	3	4	5
Computer Science	0	1	2	3	4	5	0	1	2	3	4	5
English/Language Arts	0	1	2	3	4	5	0	1	2	3	4	5

The Instrument: STEM Identity

14. How strongly do you agree or disagree with the following statements?

	Strongly Disagree 0	1	2	3	4	5 Strongly Agree
I saw myself as a STEM person at the **beginning of middle school**.	0	1	2	3	4	5
I saw myself as a STEM person at the **beginning of high school**.	0	1	2	3	4	5
I saw myself as a STEM person at the **end of high school**.	0	1	2	3	4	5
I see myself as a STEM person **now**.	0	1	2	3	4	5

15. How strongly do you agree or disagree with the following statements?

	Strongly Disagree 0	1	2	3	4	5 Strongly Agree
My family sees me as a STEM person.	0	1	2	3	4	5
My friends/classmates see me as a STEM person.	0	1	2	3	4	5
My teachers see me as a STEM person.	0	1	2	3	4	5
Topics in STEM excite my curiosity.	0	1	2	3	4	5
I enjoy learning about STEM.	0	1	2	3	4	5
I am interested in learning more about STEM.	0	1	2	3	4	5
I feel confident in my ability to learn STEM.	0	1	2	3	4	5
I understand concepts I have studied in STEM.	0	1	2	3	4	5
I can do well on tests/exams in STEM.	0	1	2	3	4	5

The Instrument: Unstructured Activities

7. Which of the following free-time experiences did you have while growing up?
Mark all that apply. Leave blank those that do not apply.

	If you had these free-time experiences, please mark how often and during which time period you participated					
	K-4		5-8		9-12	
	Sometimes	Often	Sometimes	Often	Sometimes	Often
Taking apart/working on/building mechanical or electrical devices	○	○	○	○	○	○
Baking/cooking/kitchen chemistry	○	○	○	○	○	○
Using science equipment (e.g., microscope, telescope)	○	○	○	○	○	○
Using STEM toys/kits (e.g., building/construction sets, such as LEGOs, circuit boards, model rockets, science kits)	○	○	○	○	○	○
Reading non-fiction science (e.g., news, books, magazines, journals - hardcopy or online)	○	○	○	○	○	○
Reading science fiction (hardcopy or online)	○	○	○	○	○	○
Watching educational STEM-related TV, movies, or online videos (PBS, documentaries, Youtube, etc.)	○	○	○	○	○	○
Watching STEM-related TV, movies, or online videos for entertainment (dramas, scifi., etc.)	○	○	○	○	○	○
Playing computer/video games	○	○	○	○	○	○
Following STEM on social media	○	○	○	○	○	○
Writing about STEM, including creating online blogs/podcasts/ videos	○	○	○	○	○	○
Taking care of/raising/training an animal/pet	○	○	○	○	○	○
Indoor/outdoor gardening	○	○	○	○	○	○
Exploring nature (e.g., rock collecting, birdwatching)	○	○	○	○	○	○
Observing objects in the sky (stars, clouds, weather events)	○	○	○	○	○	○
I did NOT participate in any of these types of activities ○						

The Instrument: Structured Activities

8. **Did you participate in any of the following out-of-school time programs/activities during your middle or high school years?** *Mark all that apply. Leave blank those that do not apply.*

	If you participated in any of these out-of-school time programs/ activities, please mark how often and during which time period you participated				This activity/ program increased my interest in STEM
	5-8		9-12		
	Sometimes	Often	Sometimes	Often	Mark if yes
STEM-related extracurricular clubs/teams at school	○	○	○	○	○
STEM-related clubs/teams outside of school	○	○	○	○	○
Outdoor STEM-related programs	○	○	○	○	○
Maker/DIY STEM activities/events	○	○	○	○	○
STEM-related vacations or summer camps	○	○	○	○	○
STEM-related programs that collect/analyze data for scientists (e.g., citizen science)	○	○	○	○	○
STEM-related lectures or talks (online or in person)	○	○	○	○	○
STEM-related courses/workshops outside of school (online or in person)	○	○	○	○	○
STEM-related competitions (e.g., science fairs, hackathons)	○	○	○	○	○
STEM-related academic/research programs	○	○	○	○	○
STEM-related job-shadowing experiences	○	○	○	○	○
Work, volunteer, or internship position (paid or unpaid) in a STEM-related setting (e.g., lab, hospital, vet's office, camp, museum, zoo)	○	○	○	○	○
I did NOT participate in any of these types of programs/activities ○					

The Instrument: Opportunities

11. If you participated in STEM programs/activities outside of school, did you experience the following opportunities? *Mark all that apply. Leave blank those that do not apply.*

	If you experienced the following opportunities in out-of-school time STEM program, please mark how often and during which time period you participated				This opportunity increased my interest in STEM
	5-8		9-12		
	Sometimes	Often	Sometimes	Often	Mark if yes
Interacting directly with someone who works in a STEM career (e.g., as a guest speaker, on a field trip)	○	○	○	○	○
Working with older students (e.g., college students, graduate students)	○	○	○	○	○
Spending time on a college campus	○	○	○	○	○
Learning about STEM careers	○	○	○	○	○
Learning about the contributions and experiences of people of color and women in STEM	○	○	○	○	○
Taking on a leadership role	○	○	○	○	○
Working with/mentoring/tutoring younger students	○	○	○	○	○
Participating in hands-on STEM activities	○	○	○	○	○
Working on real world STEM issues/problems	○	○	○	○	○
Choosing, designing, or carrying out my own STEM project	○	○	○	○	○
Participating in STEM-related activities that make a scientific impact	○	○	○	○	○
Participating in STEM-related activities that are meaningful to me	○	○	○	○	○
Participating in STEM-related activities that make an impact on my community	○	○	○	○	○
Participating in STEM-related activities that make society and/or science more equitable	○	○	○	○	○
Having positive relationships with adults	○	○	○	○	○
Being recognized by program leaders for my contributions (or ideas) during the program	○	○	○	○	○
Sharing aspects of my cultural experiences or identity during the program	○	○	○	○	○
Giving feedback to leaders/providers during/after the program, including voicing my confusion or concerns	○	○	○	○	○
Finding others in the program that have similar interests	○	○	○	○	○
Becoming part of a community (network)	○	○	○	○	○
Presenting some aspect of my experience to close or extended family, friends or others (virtually or in-person)	○	○	○	○	○
Engaging in additional STEM opportunities after the program ends (as a result of the program)	○	○	○	○	○
Returning to the program as an alumnus/a/ helper/mentor	○	○	○	○	○
I did NOT experience any of these opportunities ○					

The Instrument: Family Experiences

20. How often did you do the following while growing up?
Mark all that apply.

	Not at all 0	1	2	3	4	5 Very often
Visit libraries, science centers, museums, nature centers, etc., with my family	0	1	2	3	4	5
Attend STEM events or programs for families (e.g., family science night)	0	1	2	3	4	5
Talk about any topic I found interesting with my parent(s)/ caregiver(s)	0	1	2	3	4	5
Talk about STEM topics with my parent(s)/caregiver(s)	0	1	2	3	4	5
Talk about my career plans with my parent(s)/caregiver(s)	0	1	2	3	4	5
Watch STEM-related videos or shows with my siblings/cousins	0	1	2	3	4	5

The Instrument: Additional Experiences

13. Growing up did you experience any of the following:
Mark all that apply.

- ☐ I was often called upon to answer questions in my STEM classes.
- ☐ At least one teacher recommended me for an advanced STEM class.
- ☐ I was invited by an adult to participate in a STEM competition.
- ☐ I was accepted into a STEM program or school that required an application.
- ☐ I received awards (e.g., certificates, trophies) for STEM activities I participated in.

- ☐ At least one teacher did not recommend me for an advanced STEM class I believed I belonged in.
- ☐ I had a negative learning experience during an out-of-school STEM program.
- ☐ I had a negative learning experience with STEM at school (in a class or with a teacher).
- ☐ **I did not experience any of the above.**

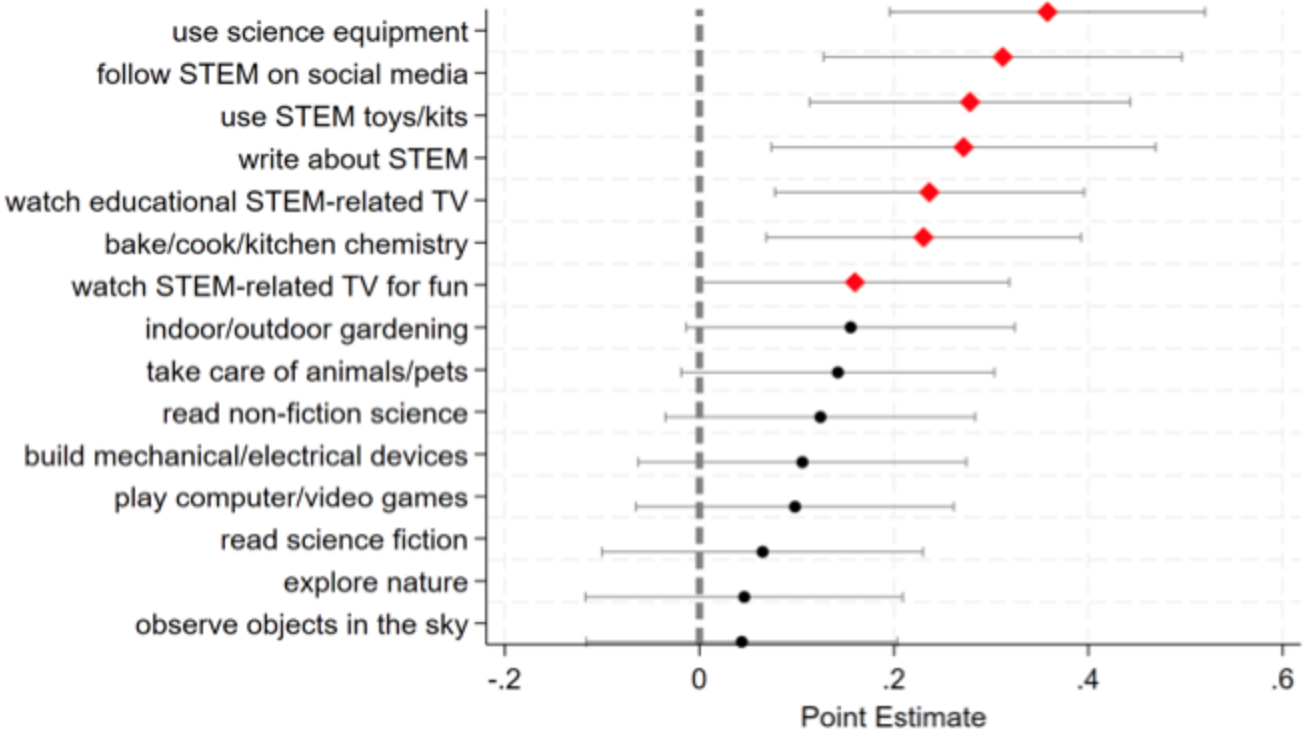
Pilot Testing:

1. Focus groups –Targeted administration of preliminary survey followed by student discussions with program staff concerning item clarity and completeness of listed options
2. Test-retest reliability –Repeated administration of the survey to the same group of students at Florida International University
3. Large pilot study – beginning of the year, first year college students in mandatory English/FYE classes – STEM and non-STEM students,at Historically Black Colleges and Universities (HBCU), Hispanic Serving Institutions (HSI) and large public universities

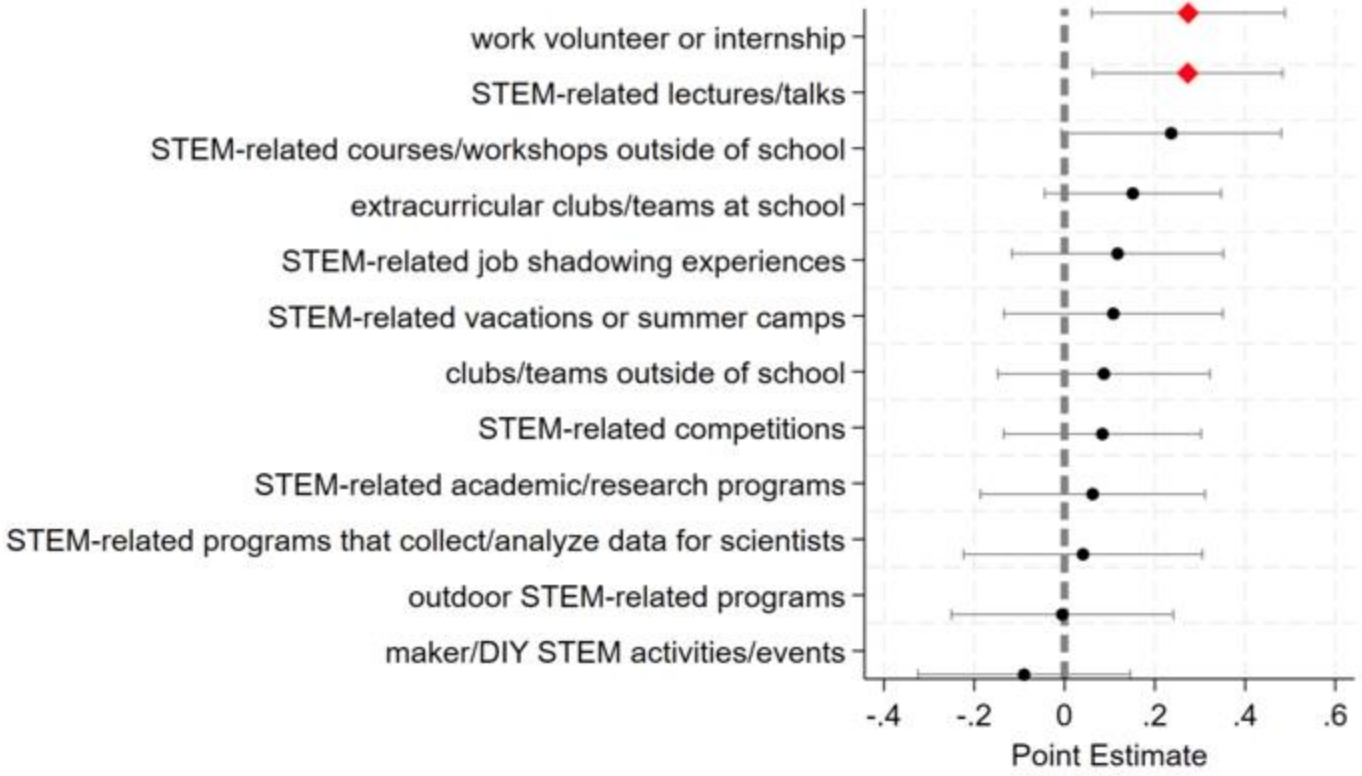
Which OST Activities, Opportunities, and Family Experiences are Significant Predictors of STEM General Interest and STEM Career Interest?

Individual regression results

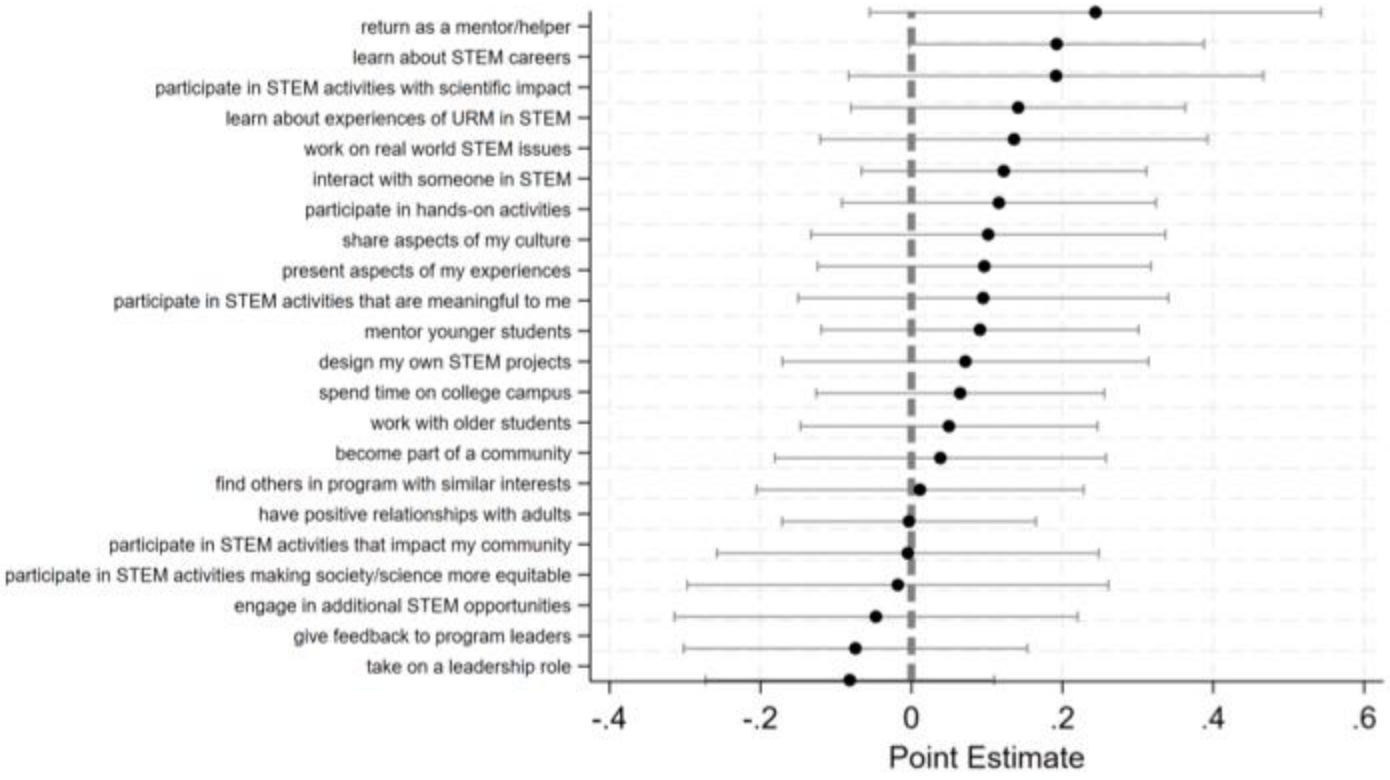
The Association between Unstructured Activities and End of High School STEM General Interest



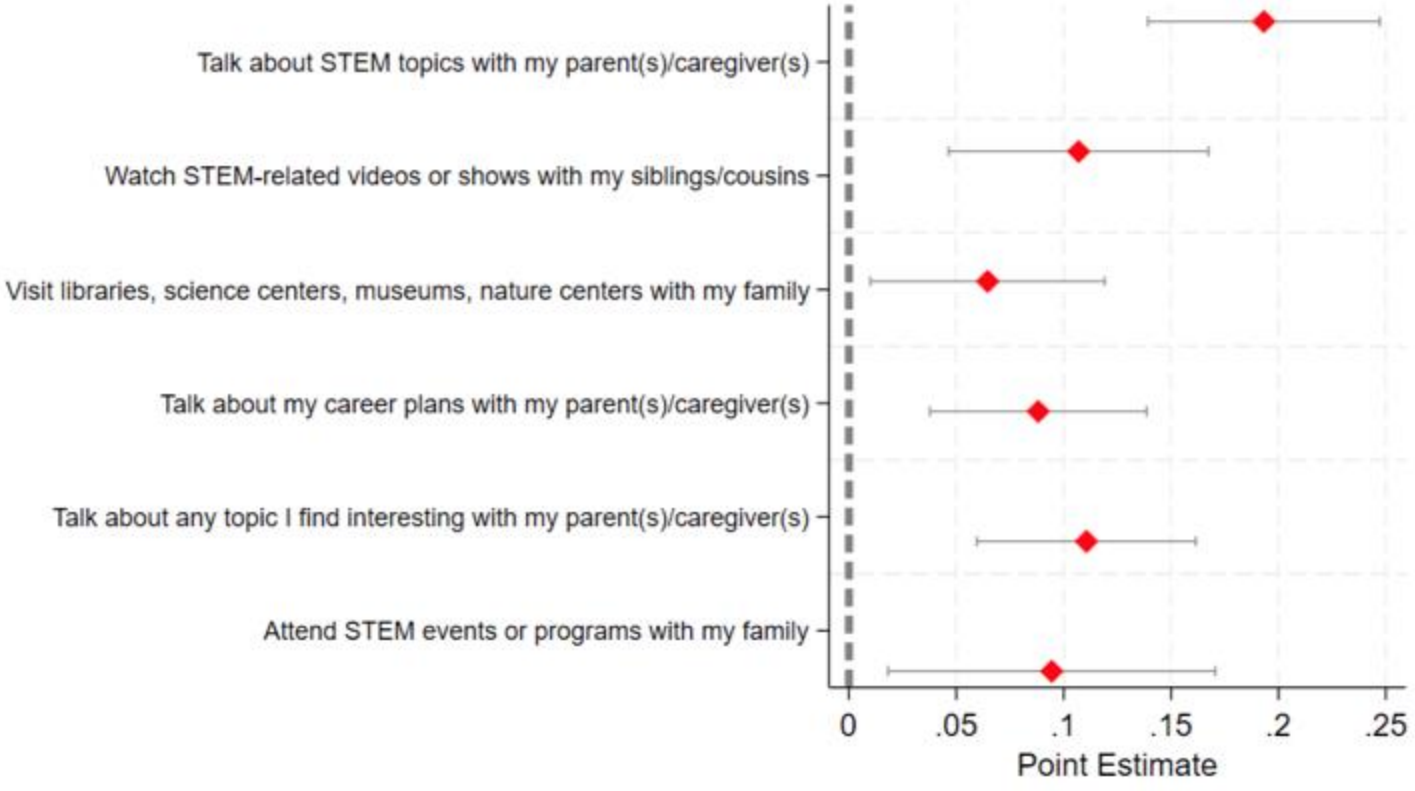
The Association between Structured Activities and End of High School STEM General Interest



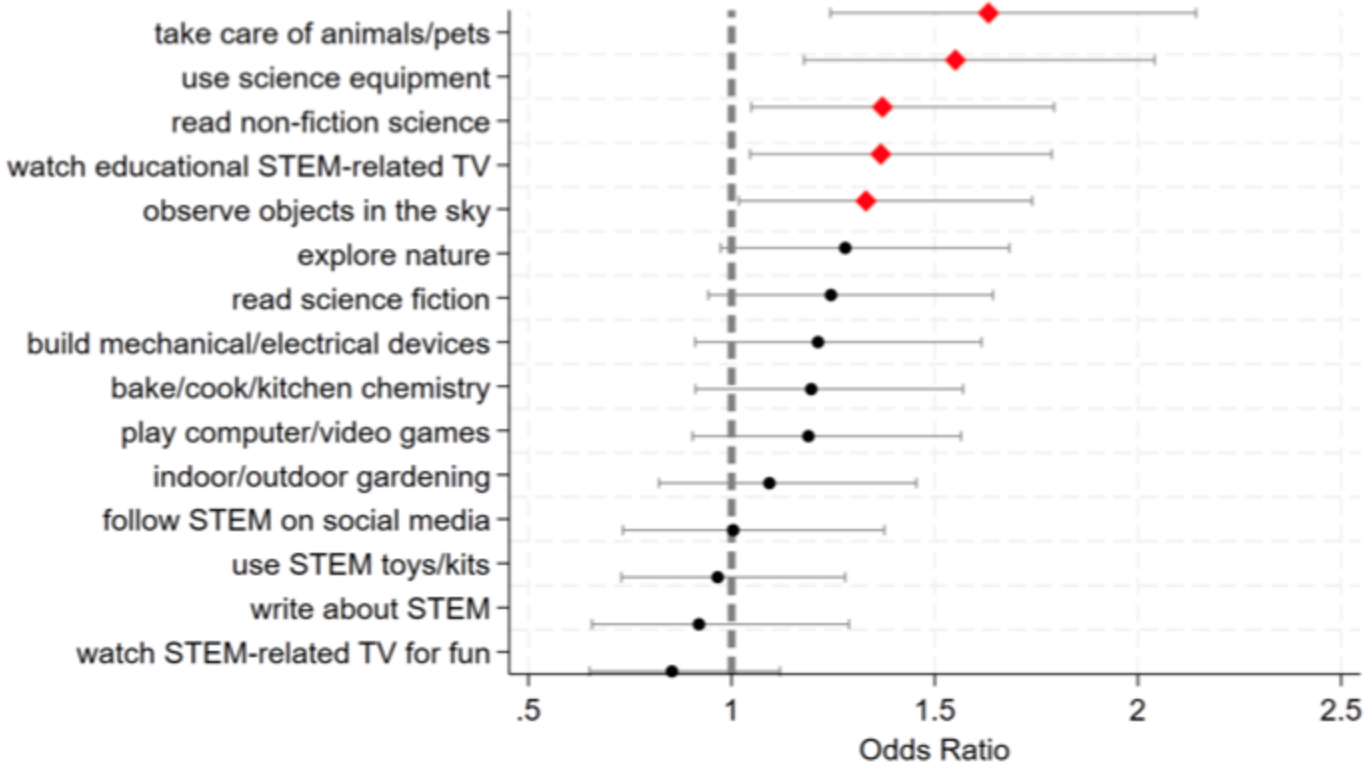
The Association between Opportunities and End of High School STEM General Interest



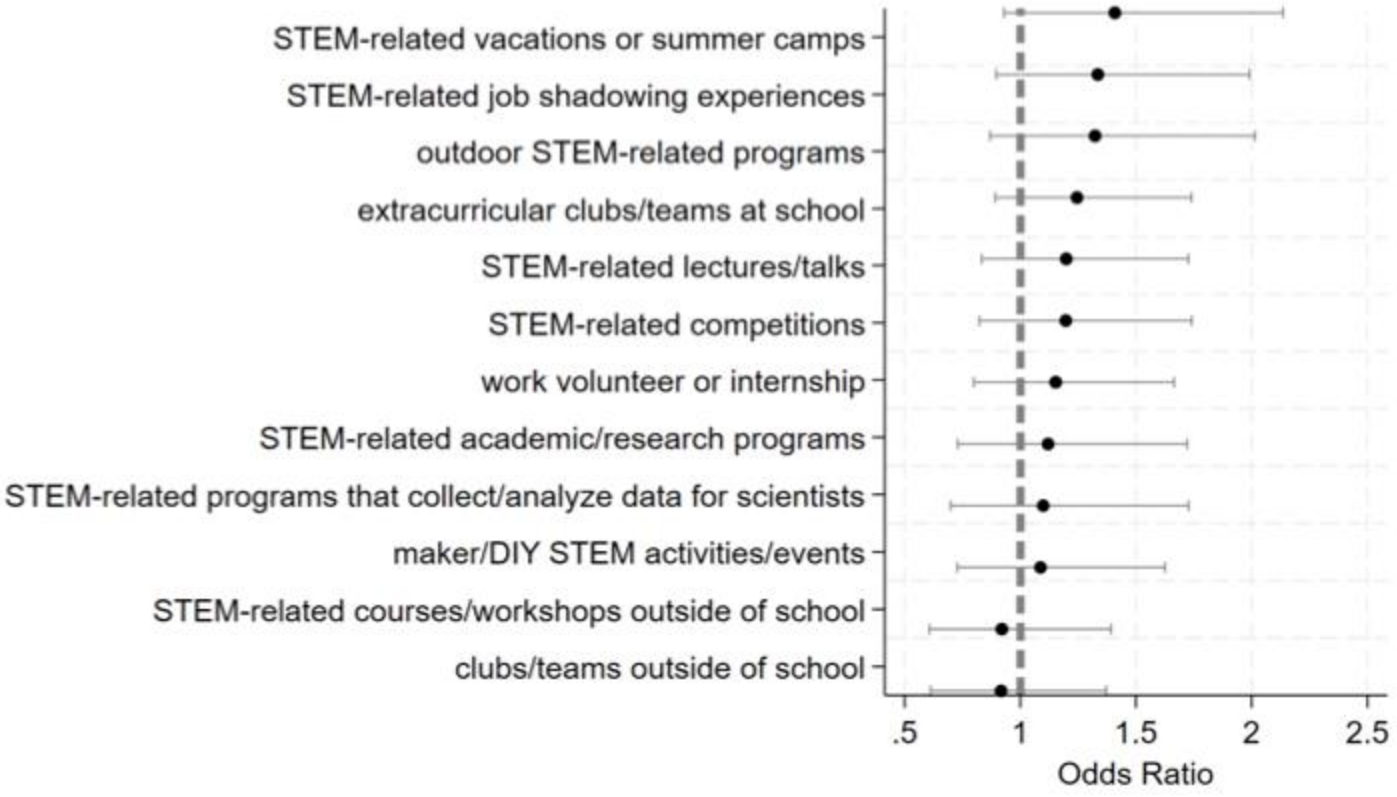
The Association between Family Experiences and End of High School STEM General Interest



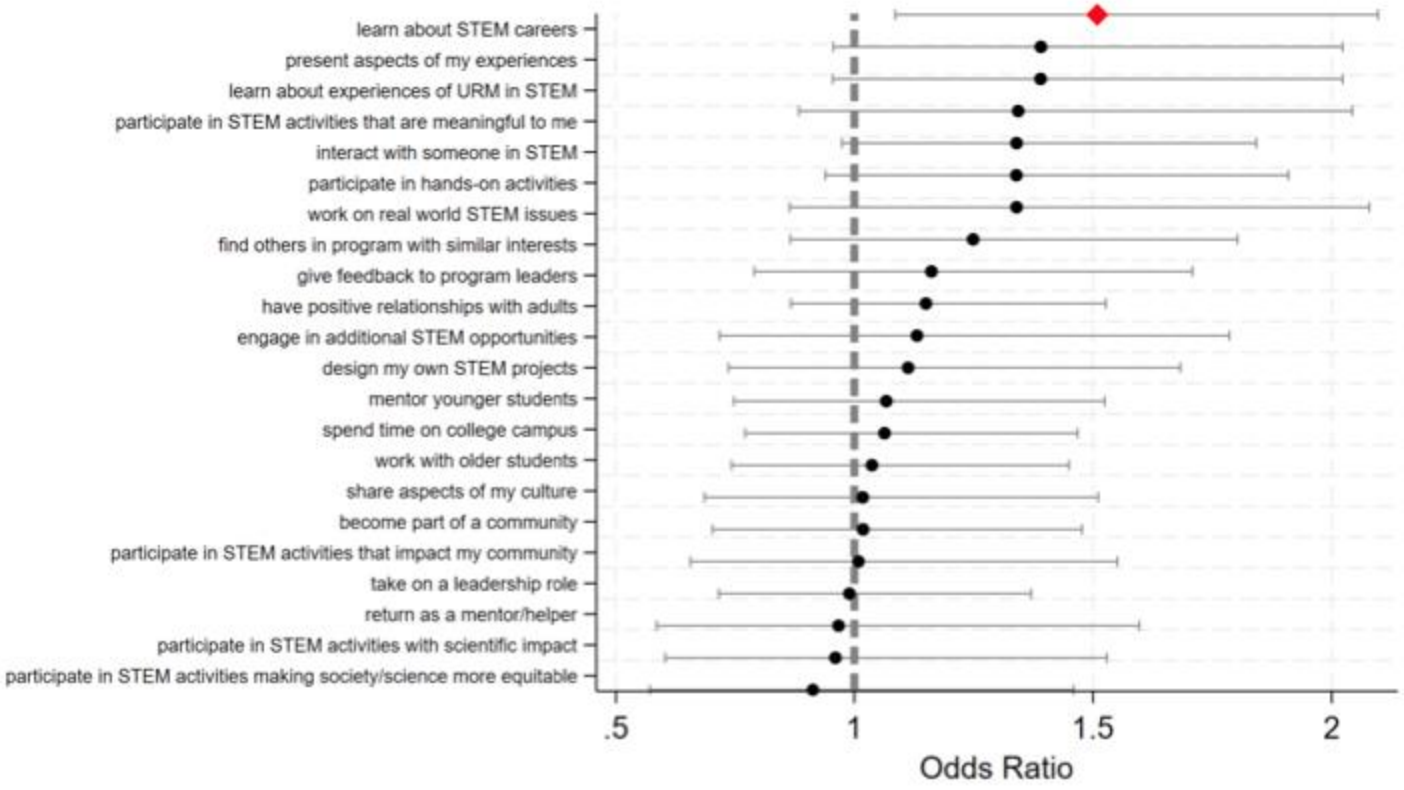
The Association between Unstructured Activities and End of High School STEM Career Interest



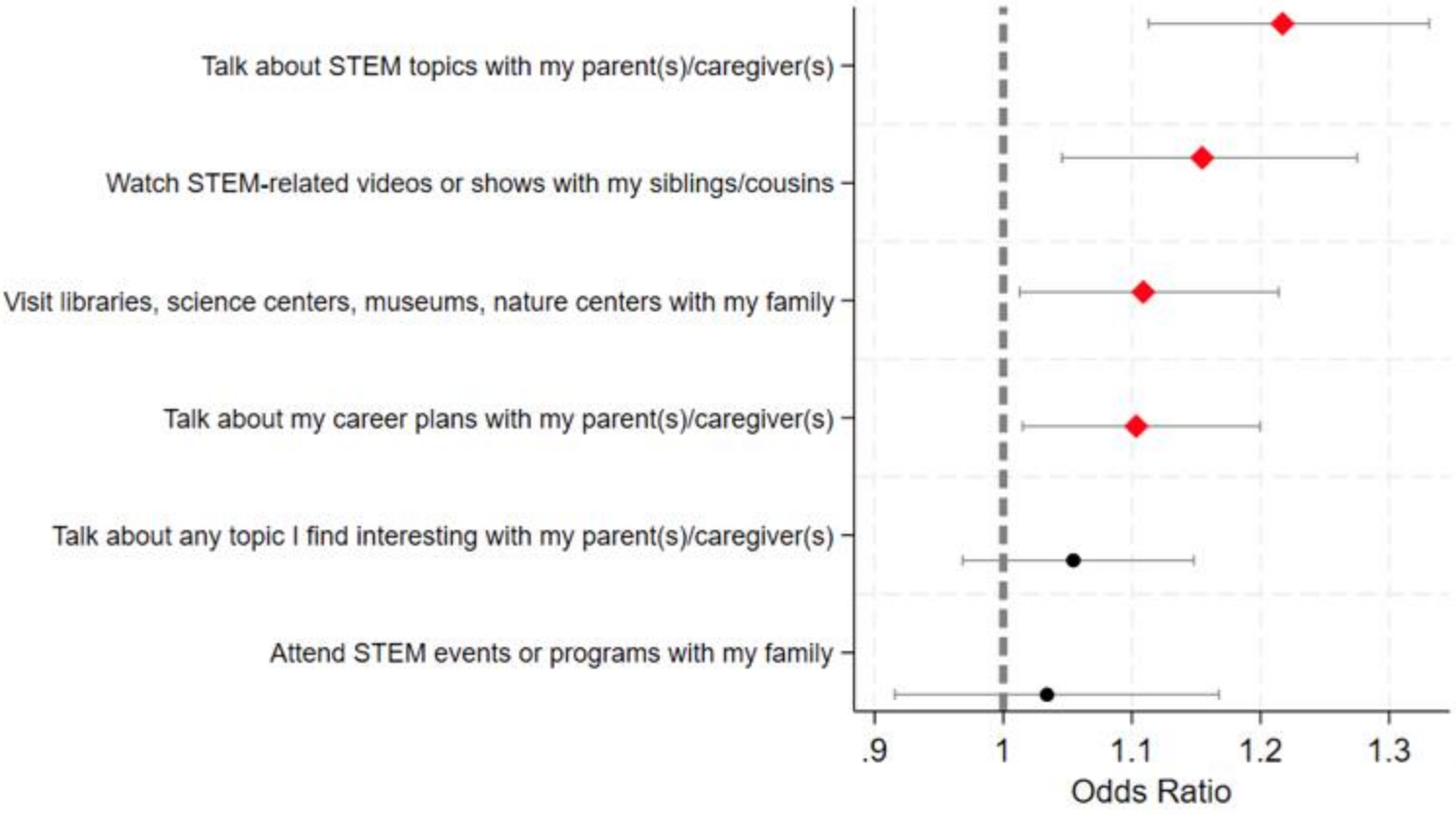
The Association between Structured Activities and End of High School STEM Career Interest



The Association between Opportunities and End of High School STEM Career Interest



The Association between Family Experiences and End of High School STEM Career Interest



Significant Predictors of STEM General Interest and STEM Career Interest

Multivariate regression results

Statistically significant in both individual and comprehensive models (positive effect (+))

Statistically significant in both individual and comprehensive models (negative effect (-))

Statistically significant in the individual model only (positive effect (+))

Statistically significant in the comprehensive model (positive effect (+))

Statistically significant in the individual model only (negative effect (-))

Statistically significant in the comprehensive model (negative effect (-))

Predictors		EHS STEM General Interest
Unstructured OST activities	build mechanical/electrical devices	
	bake/cook/kitchen chemistry	+
	use science equipment	+
	use STEM toys/kits	+
	read non-fiction science	
	read science fiction	
	watch educational STEM-related TV	+
	watch STEM-related TV/movies/videos	+
	play computer/video games	
	follow STEM on social media	+
	write about STEM	+
	take care of animals/pets	
	indoor/outdoor gardening	
	explore nature	
	observe objects in the sky	
Controls	Prior STEM Interest/Career Interest	+
	Female	
	Black	+
	Hispanic	

Predictors		EHS STEM Career Interest
Unstructured OST activities	build mechanical/electrical devices	
	bake/cook/kitchen chemistry	
	use science equipment	+
	use STEM toys/kits	
	read non-fiction science	+
	read science fiction	
	watch educational STEM-related TV	+
	watch STEM-related TV/movies/videos	-
	play computer/video games	
	follow STEM on social media	
	write about STEM	
	take care of animals/pets	+
	indoor/outdoor gardening	
	explore nature	
	observe objects in the sky	+
Controls	Prior STEM Interest/Career Interest	+
	Female	
	Black	
	Hispanic	-

		EHS STEM General Interest
Predictors		
Structured OST activities	extracurricular clubs/teams at school	
	clubs/teams outside of school	
	outdoor STEM-related programs	
	maker/DIY STEM activities/events	
	STEM-related vacations or summer camps	
	STEM-related programs that collect/analyze data for scientists	
	STEM-related lectures/talks	+
	STEM-related courses/workshops outside of school	
	STEM-related competitions	
	STEM-related academic/research programs	
	STEM-related job shadowing experiences	
	work volunteer or internship	+
Controls	Prior STEM Interest/Career Interest	+
	Female	
	Black	+
	Hispanic	

			EHS STEM Career Interest
Predictors			
Structured OST activities	extracurricular clubs/teams at school		
	clubs/teams outside of school		-
	outdoor STEM-related programs		
	maker/DIY STEM activities/events		
	STEM-related vacations or summer camps		
	STEM-related programs that collect/analyze data for scientists		
	STEM-related lectures/talks		
	STEM-related courses/workshops outside of school		-
	STEM-related competitions		
	STEM-related academic/research programs		
	STEM-related job shadowing experiences		
	work volunteer or internship		
Controls	Prior STEM Interest/Career Interest		+
	Female		
	Black		
	Hispanic		-

		EHS STEM General Interest
Predictors		
Opportunities within STEM Programs	interact with someone in STEM	
	work with older students	
	spend time on college campus	
	learn about STEM careers	
	learn about experiences of URM in STEM	
	take on a leadership role	
	mentor younger students	
	participate in hands-on activities	
	work on real world STEM issues	
	design my own STEM projects	
	participate in STEM activities with scientific impact	
	participate in STEM activities that are meaningful to me	
	participate in STEM activities that impact my community	
	participate in STEM activities making society/science more equitable	
	have positive relationships with adults	
	be recognized by program leaders	
	share aspects of my culture	
	give feedback to program leaders	
	find others in program with similar interests	
	become part of a community	
	present aspects of my experiences	
	engage in additional STEM opportunities	-
	return as a mentor/helper	
Controls	Prior STEM Interest/Career Interest	+
	Female	
	Black	+
	Hispanic	

		EHS STEM Career Interest
Predictors		
Opportunities within STEM Programs	interact with someone in STEM	
	work with older students	
	spend time on college campus	
	learn about STEM careers	+
	learn about experiences of URM in STEM	
	take on a leadership role	
	mentor younger students	
	participate in hands-on activities	
	work on real world STEM issues	
	design my own STEM projects	
	participate in STEM activities with scientific impact	
	participate in STEM activities that are meaningful to me	+
	participate in STEM activities that impact my community	
	participate in STEM activities making society/science more equitable	
	have positive relationships with adults	
	be recognized by program leaders	
	share aspects of my culture	
	give feedback to program leaders	
	find others in program with similar interests	
	become part of a community	
	present aspects of my experiences	
	engage in additional STEM opportunities	
	return as a mentor/helper	
Controls	Prior STEM Interest/Career Interest	+
	Female	
	Black	
	Hispanic	-

		EHS STEM General Interest	
Family Experiences	Visit libraries, museums, science centers, etc., with my family	+	
	Attend STEM events or programs for families (e.g., family science night)	+	
	Talk about any topic I found interesting with my parent(s)/caregiver(s)	+	
	Talk about STEM topics with my parent(s)/caregiver(s)	+	
	Talk about my career plans with my parent(s)/caregiver(s)	+	
	Watch STEM-related videos or shows with my siblings/cousins	+	
Controls	Prior STEM Interest/Career Interest	+	
	Female		-
	Black		+
	Hispanic		

			EHS STEM Career Interest
Family Experiences	Visit libraries, museums, science centers, etc., with my family		+
	Attend STEM events or programs for families (e.g., family science night)		
	Talk about any topic I found interesting with my parent(s)/caregiver(s)		
	Talk about STEM topics with my parent(s)/caregiver(s)		+
	Talk about my career plans with my parent(s)/caregiver(s)		+
	Watch STEM-related videos or shows with my siblings/cousins		+
Controls	Prior STEM Interest/Career Interest		+
	Female		
	Black		
	Hispanic		

Key Takeaways

- *Using science equipment* was conducive to boosting both STEM general interest and STEM career interest.
- *Talking about STEM topics with parents and caregivers* was also associated with higher levels of STEM general interest and stronger STEM career interest.

Associations Between Event-Based (Mis)Recognition by STEM Authorities and STEM Identity

Amdad Ahmed Awsaf | Remy Dou | Susan Sunbury | Gerhard Sonnert | Philip Sadler

NSF
AISL 2215050

FIU

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Funding Partners

CAREER:AISL-1846167
AISL-2215050
AISL-2313936

FIU Arts, Sciences & Education

Introduction and Problem

Conceptualizing STEM Identity

- "Being recognized as a certain 'kind of person,' in a given context" [1]

- STEM identity is described via multiple components [2]

  Such as,

  - students' feeling of recognition by others;
  - students' interest in the subject; and
  - students' beliefs about their performance/competence in the subject area

1. Gee, J. P. (2000). Identity as an analytic lens for research in Education. Review of Research in Education, 25, 99. https://doi.org/10.2307/1167322

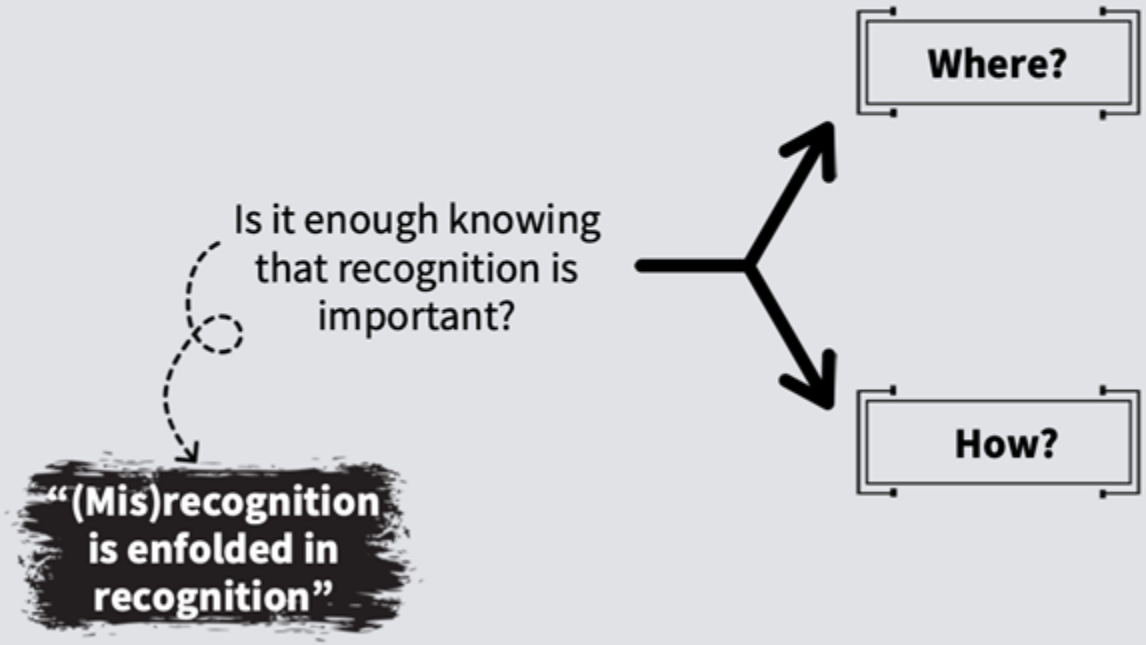
2. Godwin, A., Potvin, G., Hazari, Z., & Lock, R. (2016). Identity, critical agency, and engineering: An affective model for predicting engineering as a career choice. Journal of Engineering Education, 105(2), 312–340. https://doi.org/10.1002/jee.20118.

Why is it important?

- Recognition (or misrecognition) by STEM authorities (including, but not limited to, teachers, mentors, OST providers) shapes STEM identity
- Marginalized groups often lack recognition of their STEM abilities, affecting STEM engagement [3, 4]

3. Avraamidou, L. (2022). Identities in/out of physics and the politics of recognition. Journal of Research in Science Teaching, 59(1), 58–94. https://doi.org/10.1002/tea.21721
4. Riedinger, K. (2015). Identity Development of Youth during Participation at an Informal Science Education Camp. The International Journal of Environmental and Science Education, 10(3), 453–475. http://files.eric.ed.gov/fulltext/EJ1069257.pdf

Why does “recognition” matter?



5. Sebrechts, M., Tonkens, E., & Da Roit, B. (2019). Unfolding recognition: an empirical-theoretical contribution to the concept. Distinktion Journal of Social Theory, 20(2), 173–189. https://doi.org/10.1080/1600910x.2019.1586741

Research Purpose

Given the increased interest in fostering young people's "STEM identity", we aim to understand how **recognition and misrecognition experiences** are associated with college students'

(1) STEM identity

and

(2) STEM career interests

Research Questions

1. To what extent do experiences of STEM recognition or misrecognition shape racially and ethnically underrepresented youth's **STEM identities**?

2. To what extent do reported experiences of recognition or misrecognition in STEM contexts relate to the **STEM career interests** of racially and ethnically underrepresented youth?

Research Design

Methods

- Survey of 1,134 undergraduate students from Minority Serving Institutions (MSIs)
  - 67% first-year; 50% female, 38% male

- Key Outcomes: STEM Identity (*M = 2.29; SD = 1.98*) & STEM Career interest

- **Independent variables**

<u>Recognition by STEM authorities</u>

- Called to answer questions
- Receiving teacher recommendations.
- Invitations from adults
- Acceptance into STEM programs
- Receiving awards

<u>Lack of recognition (misrecognition)</u>

- Lack of teacher recommendations
- Negative out-of-school experiences
- Negative school experiences

Methods

13. Growing up did you experience any of the following:
Mark all that apply.

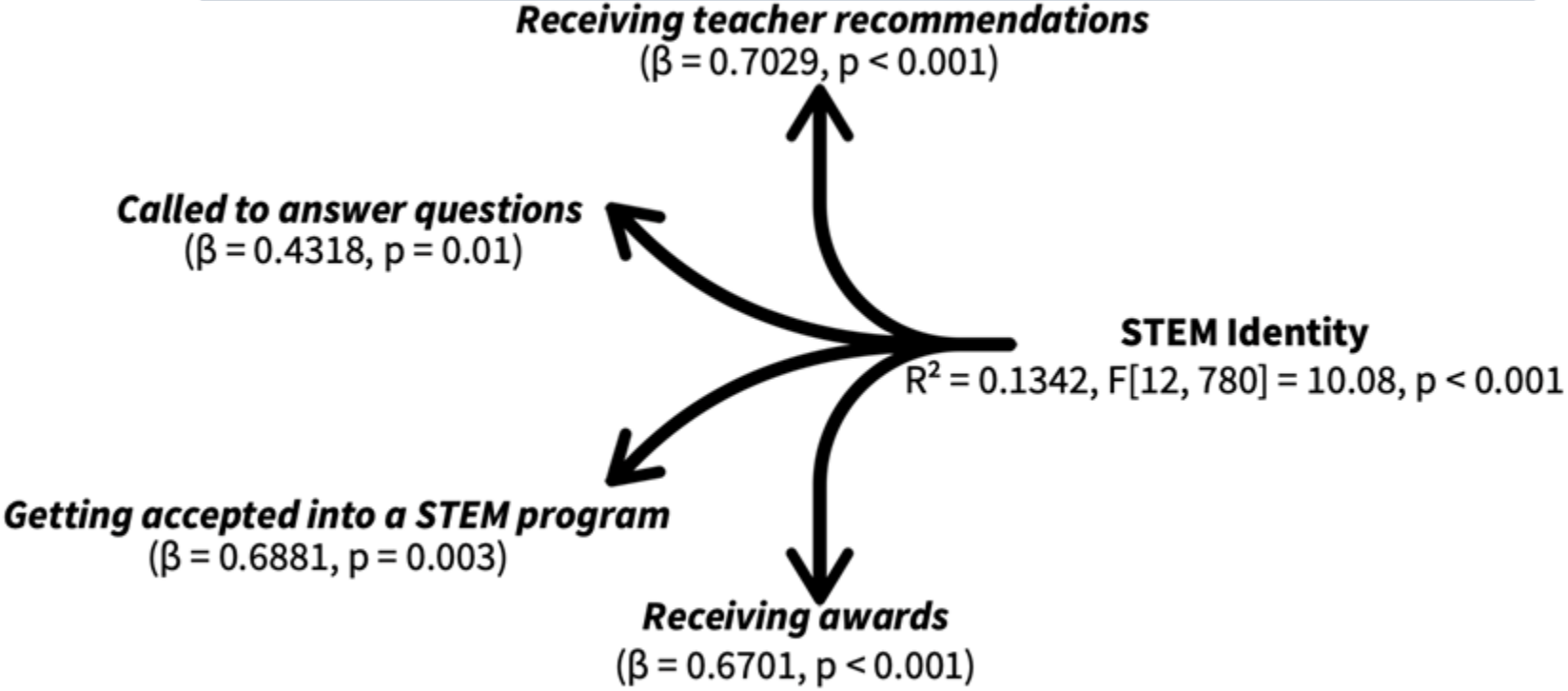
- ○ I was often called upon to answer questions in my STEM classes.
- ○ At least one teacher recommended me for an advanced STEM class.
- ○ I was invited by an adult to participate in a STEM competition.
- ○ I was accepted into a STEM program or school that required an application.
- ○ I received awards (e.g., certificates, trophies) for STEM activities I participated in.

- ○ At least one teacher did not recommend me for an advanced STEM class I believed I belonged in.
- ○ I had a negative learning experience during an out-of-school STEM program.
- ○ I had a negative learning experience with STEM at school (in a class or with a teacher).

Analysis

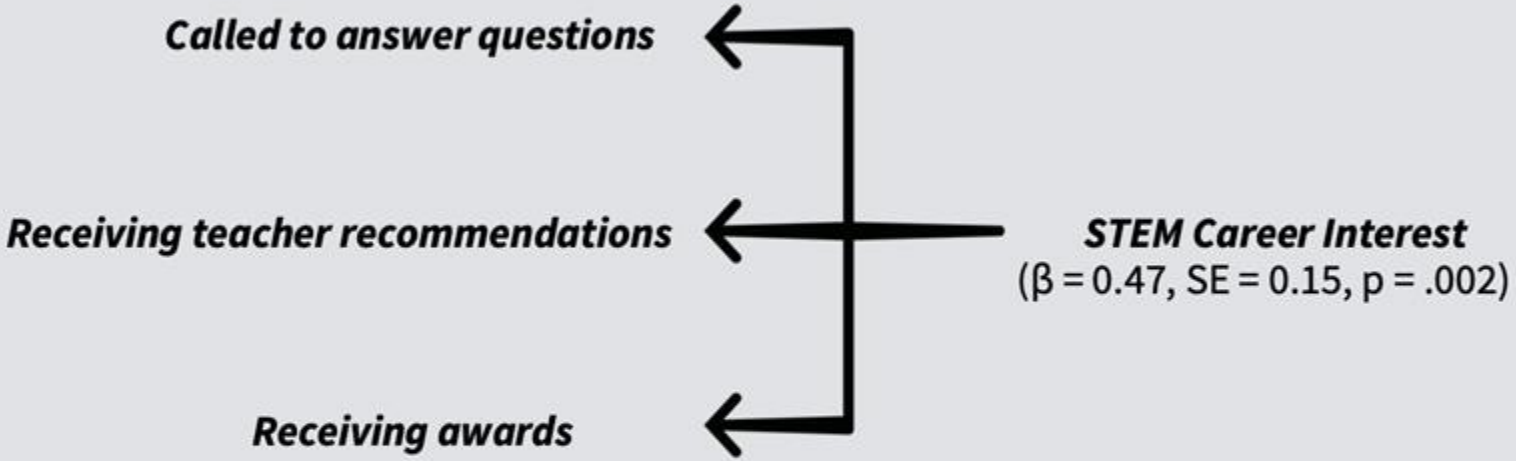
- Principle component analysis
- Logistic regression
- Multiple linear regression analysis

Predictors of STEM Identity



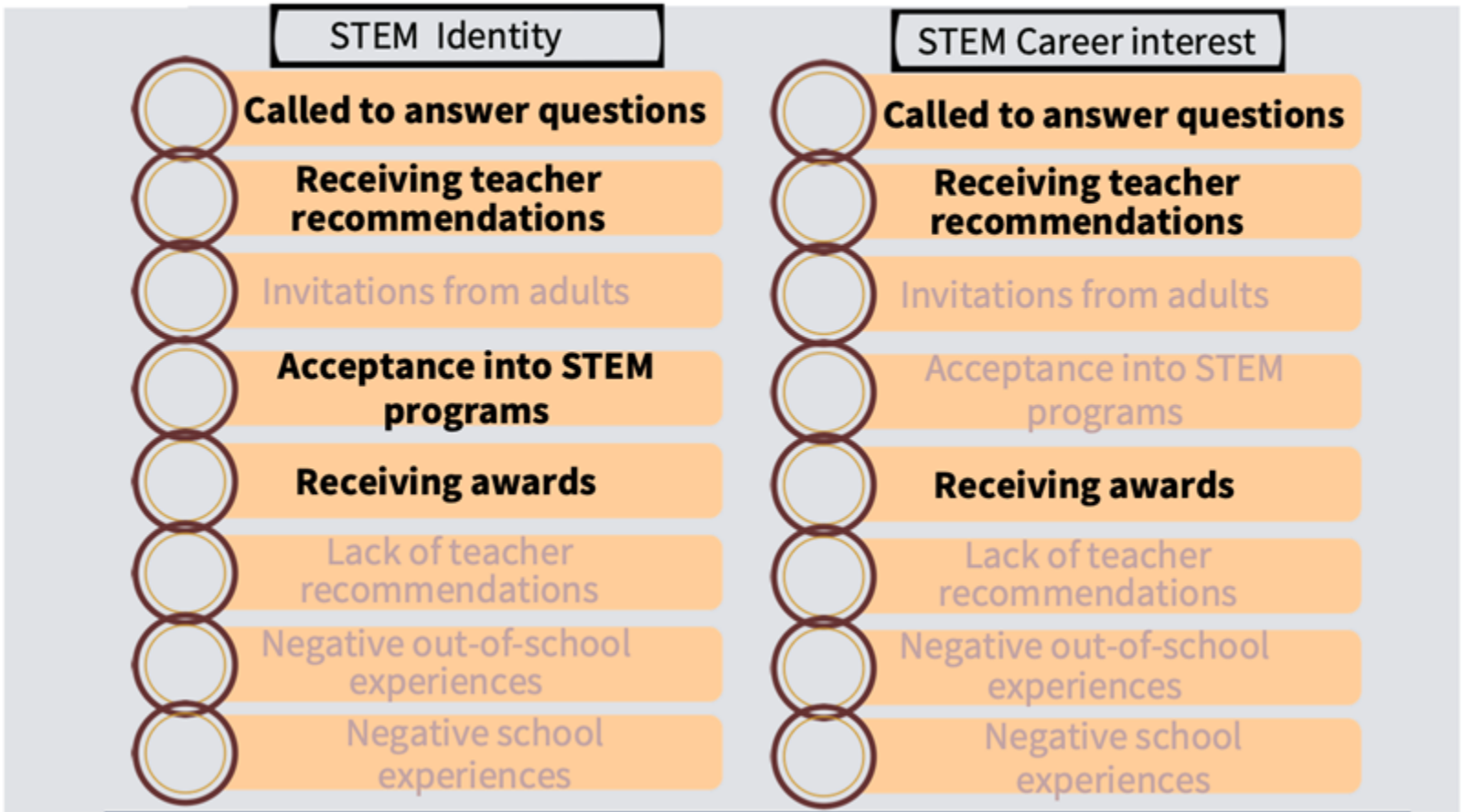
- Being invited by adults to participate in a STEM competition was non-significant
- Misrecognition was not significant

Predictors of STEM Career Interest

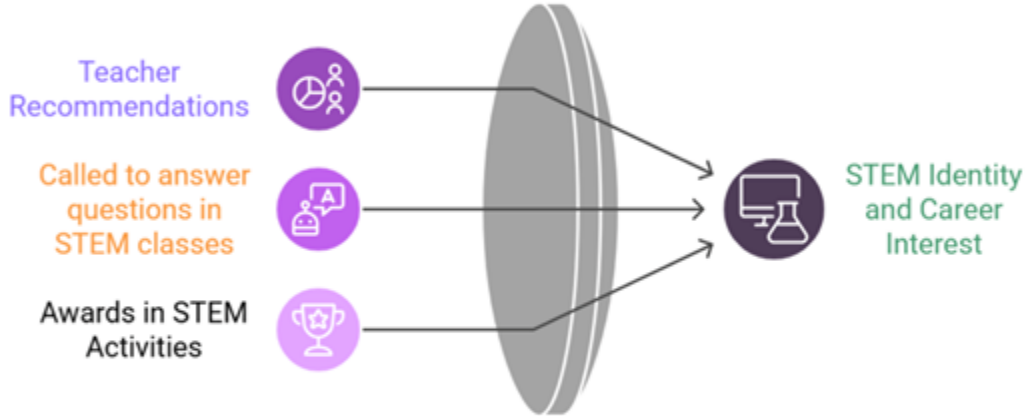


- Having at least one of the experiences listed exhibited 1.59 higher odds of STEM career interest
- Being ***invited by adults to participate in a STEM competition*** and ***getting accepted into a STEM program*** were non-significant
- Misrecognition was not significant

(Mis)Recognition events that matters



Contributions & Implications



Support students from marginalized groups, such as women and racial/ethnic minorities

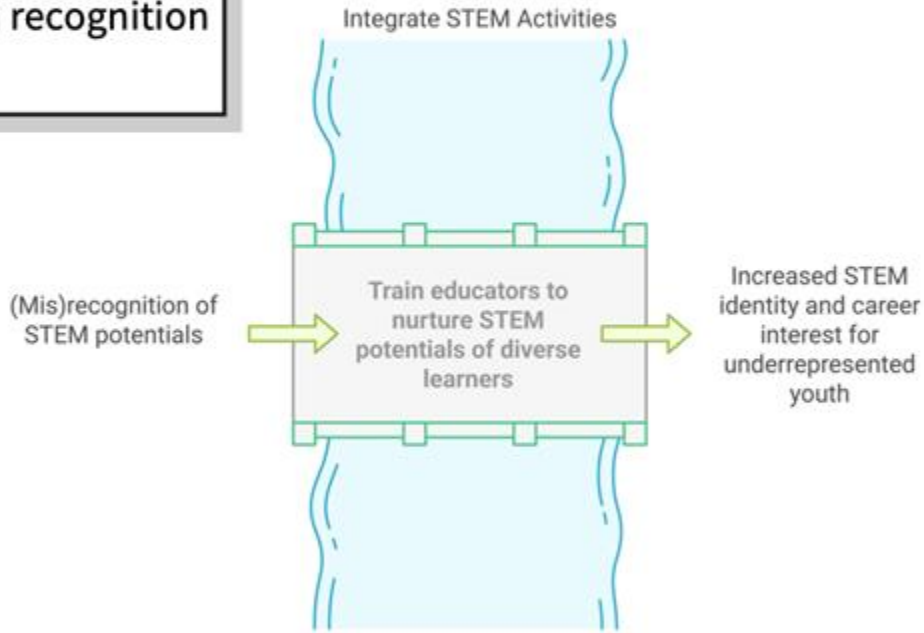
6. Habig, B., Gupta, P., Levine, B., & Adams, J. (2018). An informal science education program's impact on STEM major and STEM career outcomes. Research in Science Education, 50(3), 1051–1074. https://doi.org/10.1007/s11165-018-9722-y

Contributions & Implications

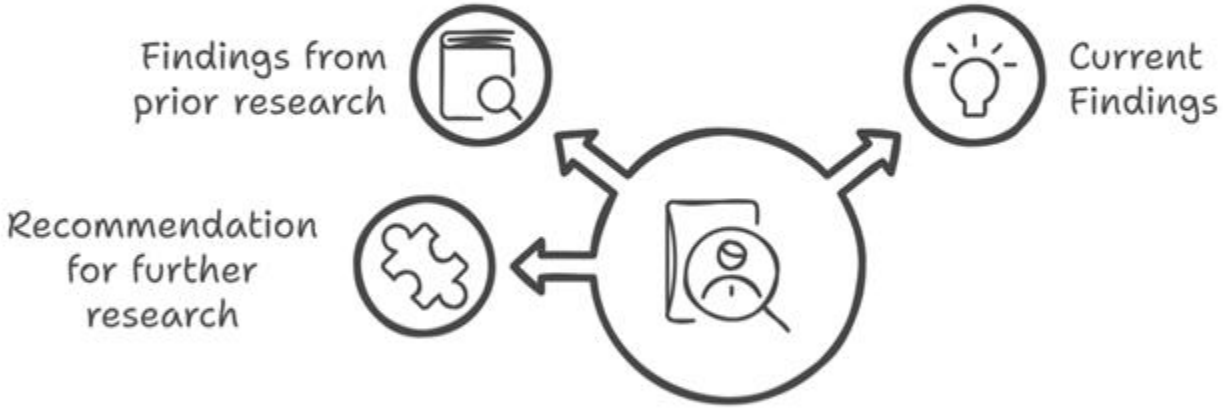
Specific interventions to foster STEM identity and career interest

Contributions & Implications

Collaborative efforts with formal and informal educators can reform recognition approaches



Insights from misrecognition events



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Tuesday, February 11, 2025
2pm-3pm Eastern / 11am-12pm Pacific

More about STEM Learning Ecosystems in 2025:

- **March:** Museum Experiences Participating in STEM Learning Ecosystems
- **April:** Creating Relevant & Meaningful STEM Experiences

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Thank You

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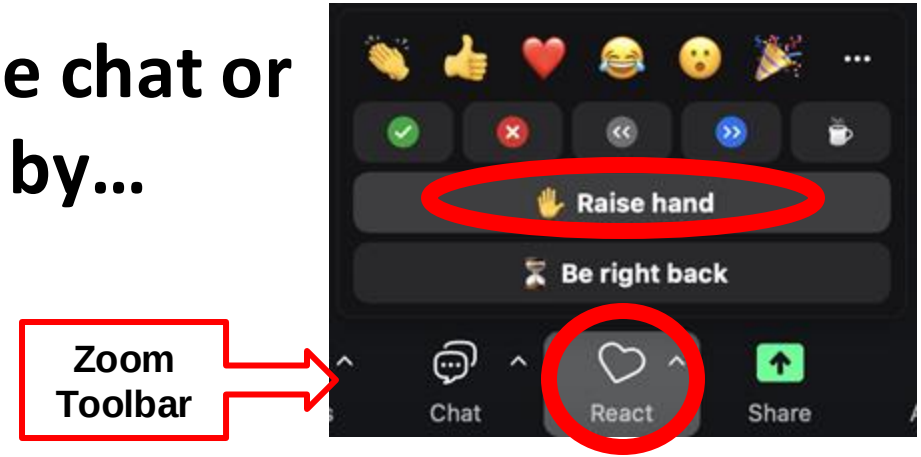
Q&A: Chat or Raise Hand Feature

Type your question into the chat or use the raise hand feature by…



Instructions

- Click on the “Reactions” button in the meeting toolbar.
- Select the “Raise Hand” icon from the list of options.
- Your raised hand will appear next to your name in the participant list, alerting the host that you wish to speak.
- Click “Lower Hand” when you no longer need to speak.

Please note some Zoom navigation toolbars look different