





Pre-College STEM Camps as Gender Equalizer:

Mediational Relations Between Youth Gender, Career Decidedness, and Socioemotional Development

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Background

- Women and girls have a history of being marginalized from STEM fields (Hughes et al., 2013).
- Female students engage in STEM careers at lower rates (Dasgupta & Stout, 2014)
- Informal STEM programs and courses are a promising mechanism for engaging underrepresented groups (such as female students) and encouraging them to pursue a STEM career (Beier et al., 2018).
- Specific factors promoting STEM career decidedness are less understood (Liben & Coyle, 2014), particularly within adolescent samples.



Broader Evaluation Context

- Increasing interest in pre-collegiate programs that can build college and career-related knowledge and skills in adolescents.
- Program evaluation within these setting comes with unique challenges
 - Implementation quality varies (instructor expertise, participant engagement and buy-in, fidelity)
 - Validated measures are not always applied
 - Program outcomes vary
- Organizing structures are being created to facilitate improved practices within pre-collegiate programs, such as the "camps on campus" group
 - Complementary goals....build skills, but also cultivate future higher ed students & build affinity for college





Purpose and Hypotheses

Purpose:

 To examine program factors explaining the relation between gender and career decidedness resulting from a precollegiate STEM camp experience.

Hypotheses:

- Instructor behaviors (H1), counselor behaviors (H2), camp structure engagement (H3), and social-emotional skill development (H4) will *mediate the relationship* between youth <u>gender</u> and STEM <u>career decidedness</u>.
- Instructor behaviors (H5), counselor behaviors (H6), camp structure engagement (H7), and social-emotional skill development (H8) will mediate the relationship between youth gender and STEM career undecidedness.



Conceptual Model of Potential Mediational Processes





Participants and Data Collection

- Youth ages 13-17 completed a 1-week pre-collegiate STEM camp. (Cross-sectional design w/data collected at the end of the program)
- Data collected from 390 youth; 365 usable responses (RR= ~86%)
 - Average of 15.58 years old (SD = 1.12 years)
 - ~52% male, ~47% female, <.01% non-binary
 - Primarily white (~70%), African-American (~19%), or Asian (~5%)
- Post-hoc power analyses supported that 365 respondents was sufficient for testing the measurement and structural models (Cohen, Cohen, West, & Aiken, 2003).

Program

- Thanks Summer Scholars!!
- STEM camps were provided on Clemson's campus, with students interacting directly with professors.
- Current Clemson students served as camp counselors to guide and mentor the program participants
- STEM camps targeted specific subjectmatter areas:
 - Bioengineering, veterinary medicine, civil engineering, autonomous vehicle engineering, audio engineering, built environment design





• *Parental Perceptions of Developmental Outcomes Scale (PPD0)*—social-emotional skills associated with camp experiences (e.g., communication, responsibility, self-regulation, attitude, exploration; adapted from parent version by Garst & Gagnon, 2016)

Measures

 Career Decidedness / Career Undecidedness — aspirations toward a STEM career in two dimensions (e.g., I see how my interests can become a career; I am confused about a future career; adapted from Hirschi, 2009)



 Engagement and Support—supportive camp counselor behaviors, supportive STEM instructor behaviors (adapted from Tiffany et al., 2012) and participant engagement with the program (items used by the camp)

Data Analyses

- Confirmatory Factor Analysis
 - CFA confirmed the measures worked.

Structural Equation Model

- Partially mediated model = <u>direct paths</u> from the IV (youth gender) to the DVs (career decidedness and undecidedness)
- Fully mediated model = <u>no direct paths</u> between the IV (youth gender) and DVs (career decidedness and career undecidedness)
- Appropriateness of mediation testing
 - Both models exhibited <u>no substantive</u> <u>differences</u> between their fit indices, and the S/Bχ² difference test indicated <u>no</u> <u>statistically significant differences</u> between the models
 - Analyses supported <u>the fully mediated</u> <u>model</u>



No support for the 8 hypotheses.



8

No evidence of a significant direct effect of youth gender on career decidedness or career undecidedness.



No evidence of significant indirect (i.e., mediational) effects utilizing the eight potential mediator factors.



Systematic STEM opportunities may be working. Programs and resources directed toward alleviating longstanding suppression of females from the STEM professions could be influencing career aspiration (Krishnamurthi et al., 2013).











Limitations

- *High between-factor correlations* in the socioemotional factors suggest poor discriminant validity of these factors. Second-order factor may a common cause.
 - 10-factors comprising the measure in this should be explored with greater ranges (e.g., 1 to 7 vs. 1 to 5).
- Cross-sectional design limits conclusions.
 - Longitudinal designs could provide support for the findings, but also illustrate if shifts (or lack thereof) in career decidedness scores are <u>moderated</u> by STEM youth gender [i.e., male youth may have different slopes (i.e., shifts) than their female counterparts...and other factors may be involved such as prior STEM experiences]
- *Selection bias in the sample* because youth opted-in to the STEM camp.
 - Randomized design assigning youth to either a STEM or non-STEM experience may demonstrate if STEM career decidedness is due to the camp context or factors exclusive of camp.

Conclusions

- In this study, with this sample, at this site, gender did not play a meaningful role in STEM career decidedness or undecidedness.
- The lack of effects may be explained by the developing trend of orientation towards enhancing equity within the STEM field.
- However, the lack of representation of people of color and those with disabilities within STEM fields remains problematic and may stifle the next generation of scientists and problem-solvers.
- Opportunities to explore other dimensions of STEM camp experiences for adolescents (e.g., different racial/ethnic groups, SES groups).



Between-Factor Correlations

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1. Career Decidedness	.733									
F2. Career Undecidedness	509	.634								
F3. S.C.C.B.	.449	189	.733							
F4. C.S.E.	.463	188	.440	.772	_					
F5. S.C.I.B.	.581	231	.363	.353	.715					
F6. Communication	.523	237	.497	.475	.437	.838				
F7. Responsibility	.566	288	.392	.461	.448	.822	.832			
F8. Self-Regulation	.554	232	.417	.456	.426	.776	.831	.814		
F9. Attitude	.620	308	.376	.462	.438	.786	.852	.829	.855	_
F10. Exploration	.606	235	.386	.439	.486	.720	.804	.740	.846	.835

Note: All factor correlations $p \le .05$; **Bold** indicates \sqrt{AVE} ; S.C.C.B. = Supportive Camp Counselor Behaviors; C.S.E. = Camp Structure Engagement; S.C.I.B. = Supportive Course Instructor Behaviors



Sobel Tests of Mediational Effects

Sobel Test (Mediating Effect on Career Decidedness)						
Gender \rightarrow S.C.C.B. \rightarrow C.D.	.014	.015	.346			
Gender \rightarrow C.S.E. \rightarrow C.D.	.001	.012	.937			
Gender \rightarrow S.C.I.B. \rightarrow C.D.	.034	.028	.217			
Gender \rightarrow Communication \rightarrow C.D.	006•	.017	.724			
Gender \rightarrow Responsibility \rightarrow C.D.	.001	.004	.884			
Gender \rightarrow Self-Regulation \rightarrow C.D.	.002•	.007	.716			
Gender \rightarrow Attitude \rightarrow C.D.	.001	.038	.972			
Gender \rightarrow Exploration \rightarrow C.D.	.015	.016	.351			

Sobel Test (Mediating Effect on Career Undecidedness)						
Gender \rightarrow S.C.C.B. \rightarrow C.U.	004•	.007	.565			
Gender \rightarrow C.S.E. \rightarrow C.U.	.001	.003	.938			
Gender \rightarrow S.C.I.B. \rightarrow C.U.	009•	.010	.406			
Gender \rightarrow Communication \rightarrow C.U.	.005	.015	.736			
Gender \rightarrow Responsibility \rightarrow C.U.	008•	.023	.724			
Gender \rightarrow Self-Regulation \rightarrow C.U.	.005	.013	.710			
Gender → Attitude → C.U.	001•	.041	.972			
Gender \rightarrow Exploration \rightarrow C.U.	.027•	.027	.302			

