Who Belongs in Computer Science?

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ABSTRACT

Women's participation rates in the Computer Science (CS) field are alarmingly lower than men's in K-12 and higher education as well as in the workforce. Research has been done to explore when young women's potential interest in the field typically develops, but these studies primarily target the high school and undergraduate levels. This mixed methods study examined middle school students' perceptions of computer scientists' looks and character traits, students' sense of belonging in the CS community, and the relationship between stereotype adoption, gender, and sense of belonging. Ninety-five (95) participants depicted computer scientists through drawing and a written explanation of their depiction. A subset of participants also had their sense of belonging in CS measured through the CS Sense of Belongingness Scale. A 2 (gender) x 2 (stereotype adoption) ANOVA was used to examine the relationships between students' perceptions, their sense of belonging, and gender. Results from the study suggest that there were significant differences between girls' and boys' perceptions of computer scientists' appearance; however, there were no differences in their perceptions of computer scientists' character traits. There were also no differences in students' sense of belonging based on the stereotype adoption levels and gender. Despite its limited sample size, this study provides insights on how middle school students think about computer scientists and the stereotypes they hold.

CCS CONCEPTS

• **Applied computing** → *Education*; • **Social and professional topics** → **Computer science education**; **K-12 education**; • **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

KEYWORDS

women in CS, equity, representation, sense of belonging

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1 INTRODUCTION

Gender participation rates in the Computer Science (CS) field are dramatically skewed toward men from K-12 classrooms through college and into the workforce. Although women held 57% of all professional occupations in the U.S. in 2018, only 26% of professional computing occupations were held by women [1]. This does not appear to be a short-term phenomenon or limited to the job market as women's underrepresentation is equally as dramatic in K-16 education. In 2017, women earned 57% of all bachelor's degrees, but only accounted for 19% of Computer and Information Systems bachelor's degrees earned [2]. Likewise, in 2018, while 56% of all Advanced Placement (AP) exam-takers were women, they only accounted for 28% of AP CS exams taken [6]. This inequity not only causes women to miss out on rewarding career opportunities but employers and society, on the whole, miss out on the innovation, perspectives, and synergies that are inherent in design teams that are representative of the populations they strive to develop software for.

How and when do women determine whether they are interested in the CS field? While there are many efforts underway at the high school and undergraduate levels, there is evidence that women's career interests are often shaped in their middle school years [28][18][25]. In one study, Tai et al. [28] surveyed eighth-grade students to gauge their interest in pursuing a profession in a science field and then tracked the sample to determine which students ended up earning a bachelor's degree in science. The authors found that middle schoolers who had a self-expressed interest in a science career earned science degrees at a significantly higher rate than students without that stated goal. In another study, when examining how and why professional scientists were drawn to their fields, Maltese and Tai [18] found that the bulk of their participants' science career interest was sparked prior to high school. Additionally, Sadler et al. [25] examined high school students' interest in STEM careers and found that students' interest coming into high school was by far the most important factor in determining their interest in STEM professions at high school graduation. This work suggests that adolescents' middle school years might be a formative time in the development of their career interests.

While research has emerged exploring why high school [11] and undergraduate women [14] pursue or don't pursue computing, there is also a need for more research to explore adolescent middle school students' perceptions of CS. Pantic et al. [24] examined middle school students' perceptions about computer scientists and whether those perceptions differed based on gender or exposure to hands-on computer science work. The authors found that young women are less likely to hold stereotypical perceptions of computer scientists than young men and hands-on experience with the CS field was also correlated with lower levels of stereotype adoption in both adolescent men and women.

The current study extends Pantic et al.'s [24] work by focusing on gender differences in middle school students' perceptions about computer scientists in a required CS course as opposed to an elective CS course. In addition, the study also explored the role of gender and stereotype view of CS on middle school students' sense of belonging. The aim of this survey-based study was to explore who middle school students' feel fits in the computer science field and whether these perceptions are associated with their own sense of belonging in the domain. Specifically, this study examines:

RQ1: What gender differences exist in middle school students' perceptions about what a computer scientist looks like and what are their character traits?

RQ2: What gender differences exist in students' perceptions and sense of belonging in computer science?

In order to explore these questions, this study draws upon several related frameworks: social cognitive career theory (SCCT), sense of belonging, and stereotypes of the computer science field.

1.1 Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) lends insights into how individuals determine what professions appeal to them. Lent et al. [15] posited that basic career interests, a form of choice goal, are forged through the relationship between one's self-efficacy and outcome expectations. SCCT, founded on Bandura's [3] social cognitive theory, suggests that learners gravitate toward career fields where their self-efficacy, i.e., beliefs about their ability to do well, are high. If middle school students see others similar to themselves succeed in the CS field, their self-efficacy, or belief in their ability to achieve, will likely improve. Additionally, learners are more likely to be drawn to careers that offer the outcomes they seek, such as social approval, a high salary, or self-satisfaction. Further, students' career interests are shaped by their self-efficacy, or their belief in their capability in a field [15].

Prior research has examined what factors influence students' interest in pursuing computer science at the undergraduate and high school level. In a qualitative study, Lewis et al. [17] used semi-structured interviews to examine how university students determine whether they are interested in CS. Taking a grounded theory approach to their data analysis, the authors found four characteristics that students believe one must possess to feel at home in CS: a singular focus on CS, asocial, competitive, and male. Though the researchers found these stereotypes were difficult to overcome, students were more successful at overcoming them when they were provided examples of computer scientists who do not fit this mold [17]. In another study, using survey data from 1600 high school and college students, Google [14] sought to identify explainable factors that influence high school-aged young women's decisions to pursue CS. In line with SCCT, they found that social encouragement, self perception, academic exposure, and career perception strongly influenced whether or not young women enter the CS field. Shapiro et al. [26] also found that social gendered messages from parents, teachers, media, and other sources may impact adolescents' career goals. Results from their survey of over 1200 middle school students suggested that messages about gender could shape middle school students', especially girls', career interests - perhaps mediated through the self-efficacy and outcome expectations laid out in the SCCT. Given these findings, this study examines how middle school students conceive who belongs in computer science and explore whether those ideas are related to their own sense of belonging.

1.2 Belonging and CS Stereotypes

Good et al. [12] explained students' sense of belonging to a field as "one's personal belief that one is an accepted member of an academic community whose presence and contributions are valued" (p. 701). Research has suggested that students' sense of belonging may also play a key role in their decision whether a field "is for them" and that higher academic belonging is associated with students liking school more and having higher self-efficacy and increased task utility [16]. Further, while examining students' math sense of belonging, Good et al. [12] found that men and women students' impression of membership and approval in the domain can predict their desire to pursue the field in the future.

Within computer science, women have been found to often hold negative stereotypes about the CS field [27] and these stereotypes have a persistent influence on their view of the field [8] while "the male computer 'nerd' seems to be a prominent stereotype in Western culture" [23]. When asked to represent a computer user, 305 middle school students often envisioned a man with stereotypically "nerdy" features such as glasses, abnormal body weight, or negative social characteristics [23]. Cheryan et al. [9] found the CS field to be stereotyped as a domain geared toward men replete with minimal social interaction, fixation on technological hardware, and innate intelligence. The authors suggest that since in American society these characteristics are more admired in men than women, women students express lower interest in CS when these stereotypes are present. Conversely, women students' sense of belonging and interest in the domain demonstrate significant improvement when the stereotypes are removed [9].

Furthermore, stereotypes can also influence students' self-perceptions about their own belonging in the field. Master et al. [21] examined the impact of CS stereotypes on a sample of high school girls. The researchers found that "girls' lower sense of belonging could be traced to lower feelings of fit with computer science stereotypes" [21]. While previously held stereotypes of the CS field appear to play a critical role in women students' decision making, physical classroom environments may also send messages and contribute to these stereotypes. Master et al. [21] experiment found that a physical classroom educational environment that does not convey current CS stereotypes increased women high school students' interest in CS courses. In a similar experiment conducted in an introductory undergraduate virtual course, Cheryan et al. [10] found that stripping the design of the virtual course of prevailing CS stereotypes significantly increased women students' interest.

While prior research has examined the impact of stereotypes on women's interest in CS, few studies have explored how this phenomenon plays out at the middle school level. Given that middle school years have been found to be a seminal time for students to form their interest in and perceptions of a career field, it is critical to inspect the middle school CS environment.

The current study leverages the SCCT framework and sense of belonging and CS stereotype constructs in an effort to paint a fuller

picture of adolescents' impressions of the field. SCCT implies that women students' would be drawn to CS at higher levels if their self beliefs about their abilities (self-efficacy) and desirable outcomes such as social approval were high. Sense of belonging theory also suggests that improvements in academic belonging would lead to these increased levels of self-efficacy. Further, young women's sense of belonging in CS and notion of social approval can improve through modifying their stereotypes of the field's culture. Applied together, these three constructs can offer insights to the effort to improve participation in the CS field at this critical age.

2 THE PRESENT STUDY

This study examined middle school students' perceptions of who is a computer scientist using the Draw a Computer Scientist task [20]. In addition, this study also examined how student perceptions relate to their own sense of belonging and gender differences between students' sense of belonging in computer science.

2.1 Positionality

As I examined stereotypes about who belongs in Computer Science (CS) and the stereotypes of the field, I must consider my own positionality. I have taken many CS courses and worked in environments that many would consider the prototypical, "geeky" surroundings. As such, many of the objects that "speak" to newcomers to a computing environment have become expected and are effectively camouflaged into the environment. As I was not only the researcher and but also the teacher in the classroom where the study was conducted, my unrecognized choices in classroom decor and environment could very well have impacted participants' perceptions of CS environments as the classroom where they took the survey may be the only physical CS environment they feel they have ever experienced. Additionally, as a simultaneous researcher and teacher, I was susceptible to slipping out of my role as a researcher as the participants in the study were also my students. While these relationships with the participants and the environment likely influenced the integrity of the study, I was also in a position to have insights into participants' perceptions that third party researchers might not have.

2.2 Methods

This exploratory sequential mixed methods study sought insight both through quantitative and qualitative sources. Through qualitative and quantitative analysis, the initial portion of the study explored students' perceptions of computer scientists' looks and character traits and whether there were any differences. The second portion of the study quantitatively investigated students' sense of belonging in the CS community and the relationship between stereotype adoption, gender, and sense of belonging. This mixed methods approach allowed for a deeper interpretation of students' perceptions of the field. Making use of a survey to examine these phenomena made the most sense as the study did not attempt to establish a cause-effect relationship through a treatment.

2.3 Sample

Participants included sixth- and seventh-grade students (ages 11-14) enrolled in a required two-week introductory CS course in a rural public middle school in the Western United States. Two-hundred fifteen potential participants were offered the opportunity to take part in the study and 95 participated, resulting in a participation rate of approximately 44%. These 6th and 7th grade classes are the first and second stand-alone CS courses that the school offers and are the only mandatory CS courses. Students may elect to take subsequent, optional CS courses in later grades. Instead of seeking participants who have already demonstrated a high level of interest in CS (and likely a high sense of belonging), participants were intentionally recruited from the mandatory, introductory CS courses. The sample included 42 boys and 53 girls.

2.4 Measures

The study made use of two measures in order to assess participants' perceptions of computer scientists and their physical environment and also the relationship between a physical environment and the participants' belonging in CS.

2.5 Draw a Computer Scientist Task

In order to measure students' conceptions of what a computer scientist looks like, participants were asked to imagine a computer scientist and his/her surroundings and draw and describe the scene in writing. Mead & Metraux [22] originally pioneered the 'Draw-a-Scientist-Test' (DAST) when they asked high school students to express their conceptions of scientists through images. Subsequently, Martin [20] adapted the method for use with undergraduate students in an introductory CS course. The DAST approach has been found to be an efficient means to identify professional stereotypes and frees the participants from the limitations of written and verbal language, especially limited vocabulary [7]. More recently, Martin [20] and Pantic et al. [24] have employed the DAST measure to examine undergraduate and middle school students' perceptions of computer scientists, respectively. All ninety-five participants completed this task.

2.6 CS Sense of Belongingness Scale Measure

Participants' sense of belonging in CS was measured through a modified form of Good et al.'s [12] Math Sense of Belongingness Scale. The original version of the measure was developed to gauge students' belonging in mathematics. The authors measured five factors (membership, acceptance, affect, desire to fade, and trust) as a means to quantify students' sense of math belonging. The research found the measure to be a strong predictor of students' plans to persist in the field. Subsequently, Good [13] adapted the measure for CS belonging and substituted the terms "mathematics" and "math" with the phrase "computer science." Good's [13] CS scale also exchanged the original 8-point response scale for a 7-point scale in an effort to increase consistency and minimize response error.

The CS Sense of Belongingness Scale is composed of subscales which appraise students' feeling of membership in the CS community (membership), feeling of acceptance by the CS community (acceptance), comfort level in that community (affect), trust in others in the community (trust), and eagerness to blend in or not be noticed in the CS community (desire to fade). A composite score is computed by finding the mean of an individual's five independent

subscale scores. The adapted CS scale has been found to have high internal validity. In the current study, the CS Sense of Belongingness measure had a Cronbach's alpha of 0.96. Thirty-five participants completed this measure, which included 18 boys and 17 girls.

3 PROCEDURES

3.1 Informed Consent

Students in the classes involved in the study received written and verbal notice and explanation of the research study. Potential participants were provided the choice whether to participate and indicated their choice and signed a paper assent form regardless of their choice. Students who opted to participate in the study received a paper consent form explaining the study to their parent/s or guardian/s. These adults were also asked to indicate whether they would like their student to participate and return the signed form regardless of their choice. The study only examined survey results from students who choose to participate and whose parents consented on the written form.

3.2 Data Collection

Participants were students enrolled in 6th and 7th grade introductory CS courses held in October 2019, January 2020, and March 2020. Participants were asked to fill out a paper questionnaire which asked open-ended questions about how they would describe a computer scientist and what they believe a computer scientist does. Participants were then asked to draw and describe the person they imagine when they hear the phrase "computer scientist." Finally, participants provided demographic information, including their gender and races/ethnicities.

3.3 Data Analysis

Collected data was analyzed in a variety of ways. To better understand participants' perceptions of what a computer scientist looks like, qualitative analysis was conducted on the Draw a Computer Scientist depictions. Participants' computer scientist drawings were analyzed inductively without the use of a pre-existing codebook. Inter-rater reliability on the codes identified was calculated to be 86.67%. As participants' ability to communicate their mental image of a computer scientist was likely limited by their confidence in their drawing and writing abilities, care was taken to examine both the DAST images as well as participants' written descriptions of their depictions in order to capture details that might not be present in either the drawn or written depiction. This allowed for participants to express their ideas in multiple ways. Due to the challenge of drawing certain traits on a white paper with a pencil (i.e., white, male, female, tall), some codes were only observed through participants' written explanations of their depiction. The initial phase of coding was designed to become familiar with and get a sense of the overall data before combing over each response in the second pass, which was coded as much as possible without regard for whether each data point was representative of the entire data set. The codes were then collapsed into overarching themes, in an effort to describe students' perceptions of characteristics of a computer scientist. In order to address the first research question, two overarching themes were used - computer scientists' appearance and computer scientists' character traits. While non-stereotypical appearance (i.e., fancy clothes, tall, neat) and character trait (i.e., kind, creative) codes were both identified, the stereotypical codes were examined using further analysis. The stereotypical codes were identified from the research base that has examined stereotypes in the CS field [24][23][9][21].

The computer scientists' appearance included six stereotypical codes that emerged from the data (Male, White, Lab Coat, Goggles, Glasses, and Messy Hair), and participants received a score of 1 for each of the stereotypical codes they included in their DAST. Similarly, the computer scientists' character traits included three stereotypical codes (Smart, Nerd, Cyborg), and participants received a score of 1 for each of the stereotypical characteristics they included. Each participant was then given a total stereotypical computer scientists' appearance score by summing up the six codes and a stereotypical computer scientists' character traits score by summing up the three codes. The decision whether a code was stereotypical was informed by previous research that had identified prevailing stereotypes in CS [24][21][16][4][8][23][20][5][19]. Independent sample t-tests were then conducted to compare gender differences with gender as the independent variable and participants' stereotypical CS appearance and stereotypical CS character traits scores the dependent variables.

In order to address the second research question, the qualitative codes were quantified to measure the level of CS stereotypes that participants held. Specifically, participants' stereotypical depictions of computer scientists were quantified as 1 and non-stereotypical depictions as 0 for each code. For example, if a participant depicted computer scientists as creative (0), nerdy (1) cyborgs (1), the participant was categorized as a stereotype adopter given that their computer scientist depiction or description demonstrated at least one stereotype. Alternatively, participants were categorized as stereotype non-adopters if their computer scientist depiction or description did not demonstrate any stereotypes.

In order to examine how students' perceptions were related to their sense of belonging and the role of gender differences, a 2 (gender) x 2 (stereotype adoption) ANOVA was conducted with gender (boy, girl) and stereotype adoption (no, yes) as independent variables and sense of belonging composite score as the dependent variable.

4 RESULTS

The analysis of participants' computer scientist drawings and their accompanying written descriptions was conducted for all 95 participants. This process identified codes and those codes were then grouped into the prevailing themes of the computer scientist's looks and character traits. Similar to Pantic et al.'s [24] approach, the open coding analysis of the DAST depictions was coupled with a deductive identification of computer scientist stereotypes in the extant research base. A review of previous literature documenting stereotypical perceptions of computer scientists was conducted to inform which codes would be deemed stereotypical [24][21][16][4][8][23][20][5][19]. Table 1 presents the number of depictions demonstrating each code.

As discussed previously, each participant was given a stereotypical CS appearance score and a stereotypical CS character traits

Table 1: Draw a Computer Scientist Codes, Themes, and Counts

Gender	n	Looks	n	Work Duties	n	Character Traits	n
Man	25	Lab Coat	9	Builds Computers	14	Smart	34
Woman	9	Goggles	3	Builds Robot	5	Nerdy	8
		Glasses	10	Write code	35	Creative	3
		Messy	11	Make games	10	Cyborg	6
Total	34	Total	33	Total	64	Total	51

Table 2: Draw a Computer Scientist Depictions Descriptive Statistics

	Gender	n	Mean	Standard Deviation
CS Appearance*	Girls	53	0.75	0.87
	Boys	42	0.45	0.50
CS Character Traits	Girls	53	0.49	0.61
	Boys	42	0.45	0.63

*$p < 0.05$.

Table 3: Descriptive Statistics Belonging

Stereotype Adoption	Gender	N	Mean	Standard Deviation
No	Girls	7	136.14	26.26
	Boys	11	137.45	35.30
Yes	Girls	10	120.30	22.73
	Boys	7	139.29	29.57
Total	Girls	17	126.82	24.78
	Boys	18	138.17	32.29

score. Table 2 shows descriptive statistics for CS appearance and CS character traits for girls and boys.

On average, girls' DAST depictions demonstrated more stereotypes of computer scientists' appearance (M = 0.75, SE = 0.12) than boys' depictions (M = 0.45, SE = 0.09). This difference, 0.30, 95% CI [-0.01, 0.61], was significant $t(89) = 2.05$, $p = .04$ and represented a small-sized effect, $d = 0.40$.

On average, girls' DAST depictions demonstrated slightly more stereotypes of computer scientists' character traits (M = 0.49, SE = 0.08) than boys' depictions (M = 0.45, SE = 0.10). This difference, 0.04, 95% CI [-0.21, 0.29], was not significant $t(93) = 0.30$, $p = .77$ and represented a minimal-sized effect, $d = 0.06$.

For the second research question, 36 participants also completed the CS Sense of Belongingness Scale. Table 3 shows the descriptive statistics by participants' stereotype adoption. Results suggest that for the non-stereotype adopters, girls had a similar sense of belonging score (M = 136.14) as boys (M = 137.45); however, for stereotype adopters, girls' sense of belonging score (M = 120.30) was considerably lower than boys' (M = 139.29).

Results from the two-way ANOVA suggest that the main effect of gender was non-significant, $F(1, 31) = 1.01$, $p = .322$. The main effect of stereotype adoption was also non-significant, $F(1, 31) = .48$, $p = .493$. Additionally, the interaction effect was non-significant, $F(1, 31) = .77$, $p = .388$.

4.1 Discussion

Overall results from the study suggest that there were significant differences between girls and boys on computer scientists' appearance; however, there are no differences on what they believe to be the character traits of a computer scientist. There were also no differences in students' sense of belonging based on the stereotype adoption levels and gender.

While previous studies have used the DAST instrument to examine students' perceptions about computer scientists [24][20], the current findings help provide broader insights into adolescents' perceptions of computer scientists. Prior studies have drawn their samples from elective courses or enrichment programs where participants might have particular perceptions that help shape their desire to take the course. However, the sample for the current study was drawn from a course that participants were required to take. As a result, this study provides a glimpse of how a wider array of middle school students think about computer scientists and what stereotypes they hold. Additionally, the results examined the potential associations between middle school students' gender, perceptions of CS, and their sense of belonging in the CS field. While merely exploratory in the current study, this relationship should be further examined with a larger sample size. Studies could extend this potential relationship by documenting the connection between students' stereotype adoption and their sense of academic belonging, perceived social approval, and self-efficacy. SCCT suggests that young women's participation in CS would increase.

Extant research has also considered students' perceptions of both computer scientists' appearance and character traits but has not quantitatively compared their adoption levels. Our finding that girls more commonly perceive appearance as part of computer scientists' composition than character traits should be explored further. Special attention should be given to how these stereotypes are formed and their influence on other CS outcomes, such as sense of belonging. Research conducted by Google and Gallup [11] hinted that media's depictions of computer scientists could play a role in perpetuating these appearance stereotypes. In a survey of 7th - 12th graders in the United States, researchers found that both students and parents perceive that computer scientists in TV and movies are typically portrayed by White or Asian men who often wear glasses. Given in this study, girls were more likely to identify computer scientists' appearance as White, male, and wearing glasses/goggles suggests that these stereotypes are formed during middle school years. In conjunction with prior research that middle school years often play an important role in career trajectories [28] [18][25], findings from this study should inform future research on whether and how classroom-based interventions can remove the harmful effect of such stereotypes. For example, future research could remove stereotypical depictions of computer scientists from the classroom and examine its influence on middle schoolers. Yadav et al. [29] suggested that teachers also view such

an approach to be an important factor in increasing participation of women in high school CS courses. Future work should explore this at the middle school level. Future research could also make use of interviews in addition to or in place of DAST and written depictions to allow a wider range of participants to express their ideas without the limitations of their drawing and writing abilities. Further, if participants, especially young participants, have limited ability to communicate their mental image of a computer scientist, future studies could consider having participants use a search engine or select from a pool of pre-selected images that represent their mental picture of a computer scientist to avoid the restrictions of drawing and writing.

4.2 Implications

Though the interaction effect between the independent (gender and stereotype adoption) and dependent (sense of belonging) variables was non-significant, it is notable that girls with stereotype adoption had a considerably lower average sense of belonging than girls without stereotype adoption (120.30 versus 136.14) and also compared to boys with stereotype adoption (120.30 versus 139.29). The non-significant interaction effect was likely due to the low sample size (N = 36) for the DAST portion of the study. Further research with a larger, more diverse sample could further explore this potential interaction, and if it is found to be significant, why appearance stereotype adoption has a negative impact on girls' sense of belonging but not boys'.

The finding that girls' higher levels of adoption of stereotypes concerning computer scientists' appearance (Male, White, Lab Coat, Goggles, Glasses, and Messy Hair) offers insights into how early appearance stereotypes emerge. Future research might explore the origin of these appearance stereotypes and precisely when they materialize. Studies could also examine potential treatments aimed at overcoming these perceptions.

4.3 Limitations

The following limitations should be noted. First, the limited sample size (N = 36) was insufficient to demonstrate significant relationships through the use of an ANOVA. The study's planned data collection was hampered by the Coronavirus outbreak in Spring 2020 which closed the school where the study was conducted. In addition, the sample is not representative of the U.S. or global adolescent population. Seventy-nine percent of participants identified as White, 12% as Latinx / Hispanic, and 3% as Black / African American. A larger scale replication study with a sample more representative of the larger population would make the results more generalizable.

5 CONCLUSION

Middle school is a crucial time that can help shape young women's interest in potential career paths. Given the dramatically low participation rates of women in high school and college CS courses, the middle school experience may be key to boosting their interest in the subject. This study examined middle school students' perceptions of computer scientists and their sense of belonging in the CS field. The results suggest that at the middle school level, girls hold more stereotypical views of a computer scientist's appearance; however, there do not seem to be differences in boys' and girls' conceptions of computer scientists' character traits. Additionally, the study did not find notable differences in middle school students' sense of belonging in CS based on their stereotype adoption levels and gender. These results suggest a need to have a diverse representation of what a computer scientist looks like at the middle school level.

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