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Curricular Influences on Female Afterschool Facilitators' Computer Science Interests and Career Choices

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Abstract Underrepresented populations such as women, African-Americans, and Latinos/as often come to STEM (science, technology, engineering, and mathematics) careers by less traditional paths than White and Asian males. To better understand how and why women might shift toward STEM, particularly computer science, careers, we investigated the education and career direction of afterschool facilitators, primarily women of color in their twenties and thirties, who taught Build IT, an afterschool computer science curriculum for middle school girls. Many of these women indicated that implementing Build IT had influenced their own interest in technology and computer science and in some cases had resulted in their intent to pursue technology and computer science education. We wanted to explore the role that teaching Build IT may have played in activating or reactivating interest in careers in computer science and to see whether in the years following implementation of Build IT, these women pursued STEM education and/or careers. We reached nine facilitators who implemented the program in 2011–12 or shortly after. Many indicated that while facilitating Build IT, they learned along with the participants, increasing their interest in and confidence with technology and computer science. Seven of the nine participants pursued further STEM or computer science learning or modified their career paths to include more of a STEM or computer science focus. Through interviews, we explored what aspects of Build IT influenced these facilitators' interest and confidence in STEM and when relevant their pursuit of technology and computer science education and careers.

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Introduction

Computer science-related jobs are predicted to grow faster than all other professional sector jobs, by up to 22 % over the next decade. Yet participation of women and certain racial and ethnic groups in these jobs in the USA is low (National Science Foundation (NSF) 2011; US Department of Labor 2010). Women make up half the US workforce, but Latinas and African-American women hold only 2 % of the engineering- and computer-related jobs (NSF 2011). These gaps persist because girls and women are not pursuing computing education at the same rates as boys and men. Women have only 18 % of all computer and information sciences undergraduate degrees, the lowest percentage for women in any science, technology, engineering, and mathematics (STEM) field (National Center for Women and Information Technology (NCWIT) 2012). Unlike in most STEM fields, the gap between the number of males and the number of females participating in computing education and entering computing careers continues to widen (American Association of University Women (AAUW) 2015).

The underrepresentation of women in computing-related fields can affect the innovations and economics of a nation (AAUW 2015; Perna et al. 2009; Tyson et al. 2007). Diverse teams and perspectives generate more innovations than homogeneous teams (Page 2007; Woolley et al. 2010). Research has shown the importance of involving women on innovation and design teams in addition to men so as to address the needs of all users (Margolis and Fisher 2002; Schiebinger and Schraudner 2011; Williams 2014). The economic impact

of not having women in computing-related fields decreases nations' and companies' competitiveness in engineering and computer science as well as families' and individuals' economic opportunities (Bystydzienski and Bird 2006). Individually, women earn less than they might if they had technology skills and thus have less spending power, which also impacts their nation's economy.

The challenge of increasing women's participation in computer science as a career begins well before college and entry into the workforce. Girls are less likely than boys to have had access to constructive, creative engagements with technology that can lead to eventual pursuit of computer science degrees (Margolis et al. 2008; Warschauer and Matuchniak 2010). Afterschool settings with programs led by youth development professionals are a promising locale for girls to engage meaningfully with technology and develop an interest in computer science careers (National Research Council (NRC) 2009). Build IT, an afterschool computer science curriculum available through Girls Inc., provides such an environment for middle school girls.

Since 2008, Build IT has been implemented throughout the Girls Inc. network of afterschool affiliates in the USA and Canada that serve girls primarily from African-American and Latina backgrounds in low-income communities, both urban and rural (Koch et al. 2012). SRI International and Girls Inc. of Alameda County codeveloped Build IT with the intent of including a problem-based, equity-enriched computer science curriculum in the Girls Inc. Strong, Smart and Bold ™ afterschool programs dedicated to empowering young women. "Strong, smart, and bold" is the Girls Inc. motto that is proudly displayed visually at Girls Inc. sites and integrated into all its teaching and staff development. The national Girls Inc. office incorporated Build IT into its larger STEM curriculum and professional development offering called Operation SMART (Science, Math, and Relevant Technology), making Build IT available to all Girls Inc. affiliates.

The goal of Build IT is for middle school girls to develop information technology (IT) fluency, interest in mathematics, and knowledge of IT careers. It capitalizes on girls' interest in design and communication technologies and incorporates performance tasks for IT fluency assessment. Build IT provides structured interactions with IT professionals, such as having girls participate on engineering design and development teams.

The Build IT curriculum has demonstrated that it meets its goals of increasing middle school girls' IT fluency, interest in mathematics and computer science, and knowledge of IT careers (Koch and Gorges 2012). It capitalizes on girls' interest in design and communication technologies and incorporates performance tasks for IT fluency assessment. Build IT provides structured interactions with IT professionals, such as having girls participate on engineering design and development teams. The curriculum has also achieved its goal of increasing staff capacity to teach computer science even though staff facilitators do not have computing backgrounds (Koch and Gorges 2012).

Although not the intent of the curriculum, preliminary data suggested that Build IT may also have a profound influence on stimulating the afterschool facilitators, often women of color in their twenties and thirties, to pursue their own STEM education and careers. In our scale-up Build IT project in 2012, more than half the afterschool facilitators self-reported on a survey that they were inspired by their experience teaching Build IT to pursue a STEM career and/or further STEM education (Koch and Gorges 2012; Koch et al. 2012). These afterschool facilitators tend to come from a variety of education and career backgrounds. Girls Inc. provides training and salaries for afterschool facilitators and strives to align them with curricula they have interest in, but facilitators do not necessarily have a background or any specific interest in the content they implement beyond their commitment to seeing girls achieve in a range of fields.

In our current study, we interviewed nine afterschool facilitators who implemented Build IT in 2011–12 or shortly after. We also drew on interviews and surveys from our scale-up Build IT project in 2012. We investigated whether or not these afterschool facilitators pursued computer science or technology education and career pathways specifically as well as STEM in general. We also looked at the mechanisms in Build IT that influenced these facilitators to choose these pathways.

Theoretical Framework and Background

Four bodies of the literature informed our study: (a) STEM and computer science career pathways, (b) stereotypes and belonging in computer science fields, (c) the role of afterschool environments in STEM and computer science learning, and (d) the role of curricular materials as a tool for educators' learning.

STEM and Computer Science Pathways Disrupted

STEM professionals' pathways to their careers are varied. The pipeline metaphor—more people entering into the STEM pipeline will result in more STEM professionals coming out of the pipeline—fails to acknowledge and build our understanding of these varied STEM paths, especially those of women and underrepresented groups (Cannady et al. 2014; Jesse 2006). Underrepresented populations such as women, African-Americans, and Latinas often come to STEM careers by less traditional paths later in life

more often than White and Asian males (Harris et al. 2012; Turner et al. 2002). Pathways for those who come to STEM careers later in life reflect experiences in formal and informal settings that led them to turn away from STEM in their youth (Harris et al. 2012; Turner et al. 2002). For computer science careers specifically, stereotypes women encounter about who does computer science and feelings of not belonging can discourage them from pursuing the careers. For example, Margolis et al. (2000) found that female computer science students lost confidence and interest in computer science because they felt they did not fit with the stereotypical view of a computer scientist. Seeing and interacting with other women pursuing computer science as well as with women in computer science careers can foster a sense of belonging. In a study of computer science departments across the state of Virginia, Cohoon (2001) found that the proportion of females enrolled in the major was the strongest predictor of women's attrition from computer science majors. Computer science departments with a higher proportion of females enrolled were more likely to retain those women at a rate comparable to men.

Those who are dissuaded at a young age from technology careers may find their way back to STEM path in adulthood through learning experiences that bring them in touch with elements that counter stereotypes and encourage their sense of belonging in the field. For example, exposure to role models who work in the field and out-of-school STEM learning experiences shows promise (Harris et al. 2012; Marx and Roman 2002).

Dismantling Stereotypes and Building Belonging

The obstacles to girls and women entering the STEM workforce include limitations on the value they place on STEM careers, on their interest in STEM topics, and on their expectations of success in STEM fields (Brickhouse et al. 2000; Chambers 1983; Eccles 1994, 2005, 2007; Wang 2013). Latina and African-American girls and women encounter additional challenges including the desire to maintain a sense of ethnic identity and cultural connection while experiencing academic success (Bettie 2003; Oyserman et al. 2007), stereotypes of who does computing (Zarrett et al. 2006), and limited access to computers and learning opportunities that go beyond typing skills (Fairlie and London 2006; Margolis et al. 2011). Eccles' expectancy–value model (Eccles 2009; Eccles and Wigfield 2002; Wigfield et al. 2004) is a theoretical framework to inform and describe the influences on people's decisions to pursue STEM courses and careers. It describes how key socializers such as parents, teachers, peers, role models, and afterschool facilitators can shape youth and young adults' attitudes toward their future success. Individuals' perceptions, interpretations, and memories of these key socializing situations influence the extent to which they value and expect to succeed in STEM fields. This theoretical framework highlights the supports that women need to see STEM as part of their identity and to pursue STEM goals. To perceive the value and opportunities for success in STEM careers, girls and women need to see their interests reflected in STEM courses and in informal learning opportunities so that science, technology, and mathematics become a central part of the "girl (woman) they are" (Brickhouse et al. 2000; Koch et al. 2015). To overcome these fundamental obstacles, girls and women need opportunities to participate in tasks that are relevant to their lives and have a larger social impact, connect with role models in STEM and computer science professions who look like them, work collaboratively, and receive feedback and encouragement from parents and educators (Eccles 1994; Halpern et al. 2007; NCWIT 2007).

Stereotypes, both of women and of computing, also affect women's sense of belonging in computer science specifically. Women frequently report they feel they do not belong in computing fields (Ayre et al. 2013; Faulkner 2009). Belonging in a situation or a larger field correlates with many positive results for individuals including higher grade point average (GPA) and good health, both physical and mental (Walton and Cohen 2011). For male-dominated engineering fields including computer engineering, electrical engineering, and software engineering, women who participated in a social-belonging intervention and learned that challenges and concerns about belonging were common for all engineering students raised their engineering GPAs, improved their academic attitudes, and viewed challenges as solvable (Walton et al. 2015).

Having women as role models and peers also plays an important role in encouraging women to pursue computing. Role models can counter stereotypes, help mitigate stereotype threat for women new to the field, and show that women belong in computing (Marx and Roman 2002; Stout et al. 2011). Having female peers, such as women enrolled together in a computer science major, can also encourage persistence and foster a sense of belonging in computer science (Margolis et al. 2000). A community of other women and sympathetic men in their major to share their successes and challenges helps women feel that they belong (Cohoon 2011; Walton and Carr 2012).

Role of Afterschool Environments

Informal learning environments (e.g., afterschool and out-of-school programs, museums) show promise of sparking the interest and increasing the preparation of underrepresented youth in STEM careers (NRC, 2009). Afterschool

programs often provide more equitable (e.g., by gender, race, and socioeconomic status) opportunities for youth to learn and develop their interests than school (Fusco 2008). Programs adhering to a youth development framework including activities that are hands on, culturally relevant, and socially impactful are more likely to promote positive outcomes (Bouffard and Little 2004; Eccles and Gootman 2002; Gambone et al. 2002; James et al. 2001; McLaughlin 2000; Roth and Brooks-Gunn 1998). Afterschool environments and computer science curricula designed for this environment can focus on ways to encourage girls and women in computer science (Koch and Gorges 2012; Scott and White 2013).

In a research study commissioned by Google (2014), four factors emerged as the primary influences on women's interest in pursuing computer science careers: (a) social encouragement: opportunities for fostering computer science pursuits from family and peers; (b) self-perception: encouraging an interest in puzzles and problem-solving and showing how those skills can be translated to a successful career; (c) academic exposure: the opportunity to participate in unstructured computer science activities; and (d) career perception: the opportunity to experience and see computer science as a career with diverse applications and a broad potential for positive societal impact. Youth development-based afterschool environments provide opportunities for girls to develop personal and social assets that promote their well-being (Eccles and Gootman 2002). Thus, afterschool environments are fertile ground for engaging in computer science activities that address the four factors of social encouragement, positive self-perception, academic exposure, and career perceptions for computer science, both for youth participants and for adult facilitators.

Teaching and Educative Curriculum Materials

When we think of curriculum, we often think of the design of learning activities for students' learning. Increasingly, researchers and curriculum designers have recognized that educators, too, learn from their own interactions with the curriculum materials. If they are reading the curriculum, preparing an activity, or enacting it with their students, teachers have opportunities to learn (Remillard and Heck 2014). For example, in a study of men's and women's pathways to IT careers, Messersmith et al. (2008) found that activities such as teaching younger children computing influenced young adults to pursue IT careers. Ball and Cohen (1996) argued that curriculum materials can become more central to educators' learning if they are "created with closer attention to processes of *curriculum enactment*" (p. 7). Educative curriculum materials (ECM) have embedded tips and information that increase educators' content and pedagogical knowledge and help them develop more general knowledge that they can apply flexibly in new situations (Ball and Cohen 1996; Davis and Krajcik 2005). ECM can change teachers' pedagogical strategies and content knowledge in science and mathematics, changes that may improve teaching practice and student learning (Collopy 2003; Schneider et al. 2000). Research on the impact of ECM on teacher learning has focused on measuring changes in teacher practices and their impact on student learning. To date, research has not investigated the impact of teachers' learning from ECM on their own interests and career pursuits.

Build IT's Educative Curriculum Materials

The developers of Build IT wove ECM designs (Davis and Krajcik 2005) throughout the curriculum. We anticipated that over time professional development for the Build IT program would be done informally rather than at a dedicated time. Therefore, it was imperative to make sure that facilitators could learn from the materials themselves. The Build IT curriculum materials provide afterschool facilitators with computer science and information technology concepts and research-based gender-equitable and culturally relevant practices for engaging African-American girls and Latinas in these concepts. The materials help the facilitators access information for their own learning, learn subject matter in greater detail than what students are expected to learn, anticipate and interpret what students may think or do, understand the developers' pedagogical judgments by making them visible, and relate units and big ideas so they can help students make connections among concepts (Koch et al. 2012). The focus of these educative materials is on the enactment of the curriculum in which both afterschool facilitators and youth are learning. The developers of Build IT made every effort to have the materials, as Remillard (2000) has advocated, speak *to* teachers rather than *through* them.

Method

Research Design

The findings from our scale-up Build IT project in 2012 had shown that more than 50 % of afterschool facilitators said they were interested in or were actively pursuing their own STEM careers and/or education and that in many cases Build IT had played a role in their decisions. Those results led us to design a study with the following research questions:

1. Under what conditions do Build IT educators pursue computer science learning and careers?
2. What types of computer science learning and careers do Build IT educators indicate interest in and pursue?

We conducted a qualitative interview-based study to follow up with the facilitators who had indicated their interest in STEM education or careers as well as a few others who implemented the Build IT curriculum at about the same time. We intentionally focused this study on facilitators who indicated an interest in following a STEM pathway given their experiences with Build IT. Although what deters underrepresented populations from pursing STEM has a rich literature, detailed information on what reactivates a STEM pathway, specifically a computer science pathway, is limited. A companion mixed-methods study funded under the same NSF grant (Grant No.1339181) as this qualitative study will provide more details on which facilitators do and do not pursue a STEM pathway after their experience with Build IT.

Participants

Participants in the qualitative study were Build IT facilitators who had completed the earlier (2011–12) survey as well as some others who facilitated the program during that time period or shortly after. Because the original survey was anonymous (so that participants would feel free to give feedback on their experience), we could not perfectly match the original survey sample to the sample for this study. The original survey included the facilitators' Girls Inc. affiliate name (i.e., hiring organization) and the site where they implemented the curriculum. We contacted the Girls Inc. affiliates and attempted to contact the facilitators most likely to have completed the survey in 2011–12.

We focused on facilitators who had indicated in 2011–12 that they were interested in or were pursuing STEM education or a STEM career and/or that Build IT had had some influence on their plans for the future. We targeted this group because they were most likely to have followed STEM paths, and we wanted to learn more about those paths. We obtained contact information for appropriate facilitators from affiliates, contacted them, sent them consent forms, and scheduled telephone interviews. We conducted interviews during summer and fall 2014. The same researcher conducted all the interviews.

The possible participant pool based on the original survey responses was 16 facilitators from 12 affiliates. The final sample contained nine facilitators from seven affiliates. We are confident that six of the nine facilitators completed the original survey based on the dates they facilitated Build IT and the match between their survey responses and interview responses. For two interviewees, it is possible they completed the original survey, but there were other facilitators who worked at the same affiliates at the same time who were not available for interview. The original survey responses were too generic to match. Based on the dates when she implemented Build IT, we know that one interviewee would not have been in the original survey sample. However, she started facilitating shortly after that survey and the original facilitator from that affiliate could not be contacted, so we opted to include her in the current study.

Our interviewees were one African-American woman, three Latinas, four White women, and one woman who identified as White and Native American. Currently, three are between 25 and 29 years of age, two are between 30 and 34, two are between 40 and 49, one is over 50, and one did not provide her age. One has earned a master's degree, five have college degrees, two have completed some college, and one has a high school education.

The two main researchers who conducted the study are White women, one in her thirties and the other in her forties. These two researchers had both interacted to various degrees in person and on the phone with the women interviewed in the original grant, providing support for Build IT and the associated research under the previous grant. In addition, a White male in his thirties and an Asian female in her thirties participated in the triangulation of the data.

Reasons for nonparticipation in the interview study were that the affiliate or facilitator did not return e-mails or phone calls, e-mails were undeliverable, or the facilitators were no longer with Girls Inc. and the affiliate did not have contact information. In one case, the affiliate director seemed uncomfortable with participation in the study and we did not pursue contacting those facilitators.

Materials

Expanding on the survey used in the Build IT scale-up project in 2012, two researchers developed an interview protocol that asked afterschool facilitators about their

- Experience implementing Build IT;
- Current work and goals for the future;
- Informal learning/hobbies in STEM;
- Career/education challenges and supports; and
- Career/educational path influences.

We conducted the interview as a follow-up to learn about their current career and future plans, STEM or otherwise, allowing each interviewee to describe her path. We also asked whether Build IT had played a role in their career or educational path; we asked this question the end of the interview and only if the interviewee herself had not brought up the topic earlier. Three other members of the research team and the team's advisory board reviewed the

interview protocol, and the researchers who developed the protocol revised it based on these recommendations.

One researcher conducted all the interviews by phone. In the interviews, the researcher used the terms *STEM* and *technology* because they were familiar to the participants. In some cases, however, the participants used more specific terms, such as *information technology* and *computer science*. In the results section, we use the terminology the participants used.

We also conducted a brief, three-item survey that asked for information on participants' race/ethnicity, age, and level of formal education. We reviewed LinkedIn profiles to obtain demographic information on the participants that we later corroborated with the participants in their interviews.

Analysis

After the interviews were completed, the researcher who conducted them read through all the data and created a coding structure using a combination of topics from the interview protocol as codes and developing codes based on what came up in the interviews (as in grounded theory, Strauss and Corbin 1998). The researcher then coded the interviews and wrote analysis memos on each of the codes, bringing together information from the various interviews on a particular subject and highlighting themes across interviews (Creswell 2003). In order to triangulate the data, the preparation plans for these memos and the memos themselves were reviewed and revised with the other researchers on the team.

Participants' level of interest in STEM or computer science was a theme that emerged from the interviews. From the data analysis and for clarity in describing the data trends, we used this theme to divide the interviewees into three groups: high, moderate, and low STEM or computer science career interest. We considered two of the women to have had high levels of STEM and computer science career interest at that point in their lives—one was pursuing a computer science degree and the other received a master's degree in educational technology and is now managing a state university program aimed at growing the number and diversity of computer science graduates nationally. In the moderate-interest group, we included five women who incorporated STEM or computer science into their work lives, for example, by managing or facilitating STEM programs at their sites as their primary job, or who planned to pursue a STEM or STEM education career in the future. In the low-interest group were the two women whose focus had not seemed to shift from before starting Build IT to include STEM or computer science as a part of their career plans. The researcher wrote a new set of analysis memos based on both the original codes and these three groups of participants. We report the results based on these three categories of participants.

Results

Seven of the nine participants pursued further STEM or computer science learning or modified their career paths to include more of a computer science or STEM focus. Five of the seven (two high-STEM-interest and three moderate-STEM-interest) participants attributed their STEM career pursuits at least in part to Build IT (see Table 1). The descriptions here highlight the specific influences the Build IT curriculum materials and the Girls Inc. working environment had on the participants' education and career choices. We also describe challenges these participants have faced in pursuing STEM and computer science careers, such as gender stereotypes and work–life balance.

High STEM/Computer Science Career Interest

The two women in the high STEM/computer science career interest group, Cristina and Heather, came from the same Girls Inc. affiliate in a small high-poverty New England city. Perhaps not coincidentally, their city was the recipient of state funding for the creation of a computing center and an innovation district to attract high-technology companies and talent to the area, which brought attention to STEM education at about the same time that Build IT was being implemented at Girls Inc. The affiliate capitalized on the attention to technology in the city and region, partnered closely with local universities, and received recognition from both the state's governor and US senator for its work in STEM education for girls. The affiliate's STEM programming includes elements of the Build IT curriculum and has expanded to include a STEM summer program for youth based at a local university.

Cristina and Heather both pursued computer science education and attributed their decisions to do so to Build IT. Cristina, a Latina in her late twenties, was at the time of our interview working toward a bachelor's degree in computer science. She said,

> I told [my manager] I liked computers and she said to try Build IT. When I ran it, it was so fun for me…the things the girls were learning, I was telling them about women and STEM careers… [those discussions] helped me a lot, so I decided to quit and just go to school.

She was interested in a career in either Web design or networking.

Heather, a White woman in her forties, was director of education for her affiliate, having recently received her

Table 1 Level of STEM/computer science interest after leading build IT

Pseudonym	Age	Race	STEM/computer science career interest	Current career
Cristina	Late twenties	Latina	High	Computer science student working toward bachelor's in computer science
Heather	Forties	White	High	Manager for a program aimed at growing the computer science pipeline; earned master's in learning, media and technology
Elizabeth	Early thirties	White	Moderate	Program manager for STEM programming
Jessica	Late twenties	White/Native American	Moderate	Program manager; hopes to grow STEM programming at her affiliate
Angela	Early thirties	African-American	Moderate	Program facilitator; hopes to become program manager, science teacher, or chef
Sue	Fifties	White	Moderate	Program facilitator for STEM programming; developed robotics programming for her affiliate; plans to retire soon
Lisa	Forties	White	Moderate	Stay-at-home parent; future career possibilities include STEM options
Kayla	Unknown, probably twenties	Latina	Low	Program leader; interested in a career in education
Ana	Late twenties	Latina	Low	Program coordinator; interested in career in counseling

master's degree in learning, media, and technology. During her master's program, she did research on a computer science project to "add weight" to her degree. She had since made recommendations to Girls Inc. National on technology programming and worked on an engineering curriculum (outside Girls Inc.). She noted during the interview that at some point she would like to "work more purely with technology" education programs; after our research project ended, Heather took a new job as manager of a university-based program working to increase interest in computer science education among diverse populations.

Both women credited Build IT with growing their interest and confidence in computer science and technology. Cristina said, "After running Build IT I was inspired. What I was preaching to the girls, I wanted to follow." She noted that it was enactment of the video game creation unit that particularly inspired her: "[The girls] were always trying, trying to fix it; I realized that's what computer science is kind of about." Heather said, "I saw how girls interacted with technology and wanted to figure out how to do more of that [type of work]."

The two women highlighted similar supports and challenges to their career paths after facilitating and being inspired by Build IT. Cristina said that in her computer science program, some of her professors "find it interesting to have someone who isn't a White guy [and] want to help you." She also cited family support. Heather talked about building connections with "people who are generous with their knowledge" in K–12, informal education, and computer science worlds. Both said they had faced gender stereotypes in their pursuit of computer science learning. Cristina said, "Sometimes I do feel like I'm not being taken seriously. It sounds so cliché, but it seems like everyone at my school [who is] doing computer science is a guy. That's the only challenge." Heather felt that

> I continually have to prove myself because I'm a woman in tech. Even though my [master's] degree was in school of education, my cohort was pretty male dominated. I was taken aback that men can still blather on and get respect and the women would have to go over the top to get their point across.

Moderate STEM/Computer Science Career Interest

The women in the moderate STEM/computer science career interest group were more diverse in their career paths than those in the high-interest group. For the five women in this moderate-interest group, STEM and computer science were a component rather than a focus of their careers. In this group were two Girls Inc. program managers/directors, two Girls Inc. program facilitators, and one stay-at-home mom. They had all played a role in increasing the amount of STEM curriculum offered at their affiliates.

Elizabeth, a White woman in her early thirties, ran STEM programming and said that over the course of working with and adapting the Build IT curriculum, "Managing STEM programs became my dream job," and that "Through teaching [Build IT] I came up with [a] path for our affiliate." Elizabeth described adapting Build IT to meet the affiliate's population's needs and adding a stronger social justice focus. For example, girls create

cyberclubs that focus on topics such as ending bullying at school and work to educate their peers. Jessica, a woman of mixed race in her late twenties, was a more general program manager but wanted to grow her affiliate's teen and STEM programming, start a Lego League at her affiliate, and attract more engineers as volunteers. She said, "Build IT definitely has influenced some decisions I've made in the affiliate," and noted that Build IT is attractive to girls and helps their retention rate.

Angela, an African-American woman in her early thirties, hoped to continue to work in the field of youth development and move from providing instruction to girls directly to managing a program. She also had other thoughts about possible future careers, including science teacher and chef. Sue, a White woman in her fifties, was satisfied in her role facilitating STEM programming and was looking to retire in several years. Working with Girls Inc. was not her first career. She had developed a robotics program for her affiliate because of seeds planted while using Build IT, and the program was so popular it had a waiting list.

Lisa, a White woman in her forties, was considering a variety of career paths for when her children were older including work in informal/afterschool learning, freelance writing/curriculum development, and digital music production. She noted that

> Knowing how to make a website… the basics of HTML, that might be useful for me, in my own future… As I start any kind of home-based business, it's neat to know that in my back pocket I have that information.

She also broadened STEM programming at her affiliate while she was there, noting that she had used the Stagecast program (an object-oriented programming language) not just within Build IT, but also with other age groups.

Three of the five women in the moderate-interest group drew links between the Build IT curriculum and growth of their own interest and confidence in computer science and technology. Angela, the facilitator who planned to become a program manager, noted that "for a minute" she was even interested in a technology career: "I was on a computer every day, searching the web, learning new things about how computers work." She added,

> The whole curriculum is an eye opener—learning how to build a web page, [learning about] technology I'd never even looked into. [Before Build IT,] I'd just check my email and [log] off. [Build IT] was a ride for me and for them. I'd go home and complete what we were doing [during program time].

Elizabeth credited the curriculum itself, saying that Build IT was very explicit in showing facilitators what to do; she did not need a computer science degree to understand Build IT and be able to implement it. Sue, the facilitator who started a robotics program, said,

> It's all because of Build IT that I'm doing robotics. When I first started Build IT, I knew nothing about the computer. I was learning as the girls were learning. Build IT gave me the confidence to do [robotics]. I told the girls I was trying to be strong, smart, and bold so [they] have to be, too.

All five of the women in this category mentioned the support they received from Girls Inc., both at the affiliate and national levels, as important to their career path. They mentioned support for attending conferences and webinars and taking technology-related classes (one woman was taking a Python programming class) as well as less formal support systems, like Yahoo groups and interactions with other staff. Elizabeth, with support from her affiliate, went to a conference where her work was praised, and she felt she was doing something important. She had also received praise from her supervisor for her work. Several women mentioned the Girls Inc. national staff member charged with supporting Build IT as a big help. Lisa talked about her Operation SMART training, which she had before Build IT, as being important for teaching her that she could try new things and be successful:

> I wasn't as intimidated. I thought it was cool I'm going to learn to do websites, too. It was a slightly daunting amount of information, especially hacking the whiteboard; I had to go home, practice. But I was up for it…. By the time I got to Build IT, I had ingrained that I could take on any kind of a tech thing, figure it out even if I didn't have any knowledge.

She also said her affiliate's administrators understood that when teaching STEM, you might need extra preparation time or "wacky" supplies, and you might even ask to do things like fix a broken sink at the center together with the girls as a learning opportunity.

The five moderate-interest group members also noted other sources for increasing confidence with technology. Elizabeth and Jessica mentioned family members as useful supports for technology learning. Elizabeth said that she had previous teaching experience at an affluent school that used a lot of technology and had also taught herself HTML when she was 15.

When women in this group mentioned challenges to following their career paths, they tended to be more personal than those mentioned by the high adopters. One of the women had been planning to go to graduate school for accounting, but a major medical issue caused her to rethink that decision and choose to continue working with children. Two women cited the challenge of parenting and working.

Low STEM/Computer Science Career Interest

The two women in the low STEM/computer science career interest group, who worked at the same Girls Inc. affiliate, were both interested in continuing to work with children—Kayla in education, Ana in counseling—but were not specifically interested in a STEM-related career. Both were looking into graduate school options.

Although Build IT did not influence their career or education choices, both facilitators credited Build IT with increasing their interest and confidence in technology. Kayla said, "It definitely made me more interested in technology. I'm not very good at technology, but once we did the blogs I [thought] wow, this is not so hard, I can do this, too." She said the Build IT curriculum itself had been a support to learning, with its background information and supplemental Web sites. Ana said that in high school and college she had been interested in the life sciences, but Build IT had been her introduction to technology fields. She said,

> When I first found out I [would be teaching] technology I was excited; then I read the objectives and said I couldn't do it. But then going through the lessons I found I could do it…. [It was] great to say I taught a girl to do a video game and I made a video game.

A program coordinator who supervises staff, Ana noted that her staff had similar experiences with Build IT: They went in believing they could not do it, but by the end their confidence had grown.

Like the moderate-interest group, both women in this low-interest group cited supports from Girls Inc. as important to them in successfully facilitating Build IT and pursuing their long-term interests. Kayla cited the program coordinator's encouraging her to try out the lessons herself. Ana noted the professional development and training opportunities offered to Girls Inc. staff, saying, "I think I took every free training I could." She also spoke about her coworkers as a support system, saying that as a group they were "very much into developing [them]selves professionally and personally."

Discussion

The discussion section reviews the influences on the participants' STEM interests and career pursuits as well as the limitations of the study. The results of this qualitative study showed professional growth of all the participants, with all nine citing Build IT, the Girls Inc. environment, or both as enabling them to teach a computer science curriculum. This had been planned as part of Build IT's original goals. Beyond this goal, seven participants (two with high and five with medium STEM interests) indicated an interest in STEM learning or a career that they had not had or had not pursued before teaching Build IT. Two high-interest participants made significant changes: Heather obtained an advanced degree in education technology, brought more STEM and computer science programming to her affiliate, and then left her affiliate to take a job focused solely on computer science education; Cristina is in the process of a greater shift, from educator to computer scientist. Five moderate-interest participants shifted the direction of their careers to include more STEM-focused work. The seven high- and moderate-interest participants cited one or more of three primary influences on their STEM learning and career goals: (a) learning from the curriculum materials themselves, (b) enacting the curriculum with girls, and (c) working in the supportive context of Girls Inc.

Learning from the Curriculum Materials

Build IT curriculum developers specifically designed Build IT to teach the afterschool facilitators as well as the youth (Koch and Gorges 2012). Learning opportunities for facilitators are embedded into the Build IT program: in professional development sessions, during teaching preparation time, and in the enactment of the curriculum when both facilitators and youth are learning simultaneously. While the developers of Build IT intended the afterschool facilitators to learn from the materials so that they could effectively teach the girls and encourage them to pursue computer science careers, the fact that facilitators were considering computer science careers themselves was an unintended but welcome result.

Educative curriculum materials are designed to educate educators and provide them with the support they need for their learning, their teaching, and youths' learning (Ball and Cohen 1996; Davis and Krajcik 2005). As indicated in the results sections, several interviewees noted that the curriculum itself had supported their learning through doing the activities in preparation for teaching, reading the background information, and reviewing supplemental Web sites and materials. Delving into the curriculum for their own learning sparked interests in a technology career: "[Using the Build IT curriculum], I was on a computer every day, searching the web, learning new things about how computers work. The whole curriculum is an eye opener…" to not only the technology, but also to the career opportunities in technology.

Curriculum Enactment

Several interviewees commented about "learning alongside the girls" when they enacted the curriculum. Remillard and

Heck (2014) documented the complex, interactive nature of curriculum enactment and how events involving educators' and students' reactions provide learning opportunities for educators as well as students. In the enactment of Build IT, facilitators' learning focused on technical concepts and skills and changes in perception of who can do computer science once they learned about overcoming stereotypes about women and people of color in computing. Cristina, who is working toward a bachelor's degree in computer science, experienced both: She was inspired by seeing women in computer science *and* realized she enjoyed the troubleshooting elements of computer science through her teaching of Build IT: "What I was telling them about women and STEM, I really meant it and felt it and wanted to follow it." Another afterschool facilitator in the moderate-interest group talked about overcoming stereotypes in reference to starting her affiliate's robotics program. She was inspired by Build IT to start the robotics program, and when she encountered stereotypes like, "Girls can't do robotics," she knew how to deal with the negativity. She pushed on and built a robotics program for her affiliate, which became so popular that it had a waiting list.

Supportive Environment

While the Build IT curriculum and its enactment may have sparked the change in these women's interest and confidence in technology learning and careers, the environment of Girls Inc. and in one case the larger social environment of the local community fueled the fire for interviewees' greater interest and confidence in STEM learning and careers. The two high-interest interviewees came from the same affiliate in a city dedicated to attracting more high-technology companies to the area and to retaining its current and future local diverse workforce. Several of the companies and the local government contributed funding to Build IT and other initiatives at the local Girls Inc. to help encourage more local women and underrepresented populations to go into technology careers. Many of the interviewees from the moderate- and low-interest groups shared how supportive the Girls Inc. environment was to their implementation of Build IT and technology learning and career interests. They cited their managers and peers at their affiliates and also often mentioned the Girls Inc. National team's support.

In reviewing the results, a symbiotic relationship between the curriculum and the informal learning environment of Girls Inc. emerges: Build IT dismantles stereotypes about women and people of color in computing while the environment fosters girls' and women's sense of belonging in technology and computer science. The curriculum points out the stereotypes and how to address them. The curriculum sheds light on the feelings that many women have had about technology, showing them that they are perceptions and that if they face challenges with technology, they can overcome them. The environment of Girls Inc. offers support and encouragement for girls to be "strong, smart, and bold." While the curriculum highlights technology and computer science role models who look like the girls, Girls Inc. provides a community of predominantly women professionals dedicated to girls and women achieving strong, smart, and bold lives in whatever career and learning they choose. Girls Inc. provides an environment of social encouragement and self-perception changes for both the teaching and learning of Build IT materials, and the curriculum gives facilitators the academic exposure to computer science concepts and a balanced career perception of what computer scientists do.

Many of the women translated the personal influences the curriculum had on them into action by further developing their affiliate's computer science and technology offerings. The women in the moderate- and high-interest groups took on larger technology roles in their affiliate, introducing more computer science-relevant content. Many of them attributed this change for them and the affiliate to Build IT.

Study Limitations

While these results show promise of the influence the Build IT curriculum on facilitators' STEM interests and pursuits, the study had several limitations. First, these interviews were conduct only retrospectively with a few facilitators. Ideally, we would have tracked their STEM interests and pursuits before their use of Build IT, during their initial implementation of Build IT, and after implementation. This approach would have given us more perspective on any predisposition toward STEM or computer science careers they may have had and a better understanding of their background conditions outside Build IT and Girls Inc. that might have led to the activation of their STEM and computer science interests and career pursuits. Additionally, with more time and resources, it would have been beneficial to include more facilitators in the study to better understand pathway choices.

Second, participants had limited time to be interviewed. In several cases, the researcher had to spend significant time making sure she was talking to the right person, that is, the same person who took the survey in the previous study. The time for this confirmation resulted in reduced time for data collection through the interview itself. Participants also had limited time for the interview in general due to busy schedules. These missing data might have led to a different approach to our analysis.

Third, as discussed in the methodology, the potential pool of participants was reduced from 16 possible

participants to 9 participants. Reasons for 8 of the 16 not participating in the interview study include that the affiliate or facilitator did not return e-mails or phone calls, e-mails were undeliverable, or the facilitators were no longer with Girls Inc. and the affiliate did not have contact information. In one case, the affiliate director seemed uncomfortable with participation in the study and we did not pursue contacting those facilitators. The missing data from these 8 potential participants may have changed our analysis approach.

These limitations reduced our ability to answer the first research question—under what conditions do Build IT educators pursue computer science learning and careers—beyond identifying the influences of the Build IT curriculum, its enactment, and the Girls Inc. environment on participants' STEM and computer science interests and pursuits. For the second research question—what types of computer science learning and careers do Build IT educators indicate interest in and pursue—we might have had more diversity in the responses, including more or fewer women pursuing computer science careers.

Conclusion

Together, the curriculum and the informal learning environment of Girls Inc. supported and encouraged seven of the nine participants to pursue a STEM or computer science career or incorporate more STEM and computer science into their careers. Interest in these careers and incorporating more technology-focused learning occurred regardless of whether the facilitators had a prior interest in technology or had been uncomfortable with technology to start. They learned that they could do technology, liked it, and wanted to learn and do more. Crowley et al. (2015), describing pathways youth take to STEM careers, could easily have been describing these women who were finding their ways to technology learning and careers:

> As learners are becoming passionate about a particular interest, they increasingly seek out and create other opportunities to learn by engaging people around them, by taking on new self-directed projects, by enrolling in programs or visiting informal learning settings, and by pursuing resources in books or online. (p. 27).

This study sheds light on the possibility of attracting another demographic of underrepresented populations (women, particularly women of color, in their twenties and thirties) to computer science through the teaching of computer science in afterschool settings targeting girls. Further research is needed to explore whether or not other STEM curricula have elements that also serve as a catalyst for women's interest and confidence in computer science careers and if other, non-Girls Inc. informal learning settings provide supportive environments for women. A companion mixed-methods study funded under the same NSF grant (Grant No.1339181) as this qualitative study is currently in process to compare Build IT with other STEM curricula in both the Girls Inc. network of affiliates throughout the USA and the California School-Age Consortium (CalSAC) network of afterschool programs to understand (a) under what conditions Build IT facilitators pursue computer science learning and careers, (b) under what conditions STEM facilitators purse STEM learning and careers, (c) what types of computer science learning and careers Build IT facilitators indicate interest in and pursue, and (d) to what extent a relationship exists between facilitators' computing interests and pursuits and youth outcomes for Build IT. This work, together with that of others in the field, opens the possibility of computer science and technology careers to a group of women who may in the words of one study participant "realize that [they] missed [their] prior love for all things STEM."

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Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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