

REVEALING HIDDEN FIGURES: CRITICAL ANALYSIS OF GIRLS AND WOMEN
OF COLOR IN STEM PICTURE STORYBOOKS

by

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Revealing Hidden Figures: Critical Analysis of Girls and Women of Color in STEM
Picture Storybooks

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Dedication

This is dedicated to my loving parents, supporting sister, and granddaddy, now deceased—although you passed away while I was young, your teachings remained.

Acknowledgements

During the orientation of my doctoral program, Dr. Kitsantas said, “all roads lead to dissertation.” At the time, I thought her words were a catchy phrase, but over time, it became a mantra throughout my doctoral journey. Every road leading up to orientation and every road thereafter has led to this dissertation. So, thank you to my family, who instilled in me a thirst for knowledge and a joy for learning through their words and deeds. Thank you to my parents, who read and listened to multiple renditions of this work, most of which will never see the light of day. Thank you to my committee chair and advisor, Dr. Peters-Burton, who has been my critic and encourager since the beginning of my doctoral program; your support has played a role in me becoming the scholar I am today. Thank you to my committee members, Drs. Cai and Gilbert, whose feedback and encouragement have made this dissertation possible. Thank you to the many critical peers I have met along the way— my Holmes Scholars, my Doctoral Tribe, and my friends; thank you for listening to me as I tirelessly worked to make sense of my research and for your feedback and encouragement. This work is a reflection of the roads I have taken, and I am so grateful to the people I have met as I journeyed toward this dissertation.

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List of Abbreviations

Accelerated Reader	AR
Best STEM Booklist	BTB
Children’s Book Council	CBC
Cooperative Children’s Book Center.....	CCBC
Critical Race Theory	CRT
National Center for Science and Engineering Statistics	NCSES
National Science Foundation	NSF
National Science Teacher Association.....	NSTA
Outstanding Science Trade Books	OST
Science and Engineering	S&E
Science, Technology, Engineering, and Mathematics	STEM

Abstract

REVEALING HIDDEN FIGURES: CRITICAL ANALYSIS OF GIRLS AND WOMEN OF COLOR IN STEM PICTURE STORYBOOKS

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George Mason University, 2022

Dissertation Director: Dr. Erin Peters-Burton

The more individuals consume media that portray people who participate in science, technology, engineering, and mathematics (STEM) as White and able-bodied men, the more likely individuals within STEM communities will only recognize those who fit that image as belonging there, thereby alienating individuals who do not fit the portrayed media image (Carlone & Johnson, 2007; Farland-Smith et al., 2017; Rawson & McCool, 2014). Additionally, reports indicate a lack of diverse representation in children's literature (Cooperative Children's Book Center, 2018; Huyck & Dahlen, 2019). Specifically, girls and people of color are significantly less likely to be portrayed as participating in STEM in children's literature (Farland-Smith et al., 2017; Kelly, 2018). While many researchers have explored the representation and misrepresentations of girls and people of color within children's literature (Campbell et al., 2016; Gooden & Gooden, 2001; Yoo-Lee et al., 2014), few have examined the intersectionality of the two,

the representation of girls and women of color within children's literature (Brooks & McNair, 2015; Muhammad & Haddix, 2016). Moreover, most research analyzing the representation of diverse characters participating in STEM in children's literature has been limited to the presence or lack of diverse characters. It does not explore the portrayal of diverse characters participating in STEM (Farland-Smith et al., 2017; Kelly, 2018). Utilizing critical race theory, I conducted a critical content analysis of children's literature to answer the following question: How are girls and women protagonists of color portrayed participating in STEM in children's picture storybooks intended for grades K–3? Findings suggest that in children's literature published from 2016 to 2020, little diversity exists regarding the appearances of women and girl protagonists of color (i.e., skin complexions, hair texture, and hairstyles) as well as their STEM experiences, with many portrayed as outcasts exhibiting signs of brilliance while burdened with the task of overcoming oppression by dominant ideology through their perseverance.

Chapter One

Positionality

To understand my positionality, you must first get to know a little girl who was unsure of what she was seeking; she just felt restless knowing she had not discovered it yet. So, I write to give voice to the little girl who grew into womanhood, having found the words she needed to express what she was seeking; that little girl was me.

I am a Black woman born and raised in a two-parent, middle-class family in a small town in the South. As a young child, reading was not an activity I actively pursued, rather one I felt coerced into doing by my mother and school. My elementary and middle schools participated in Accelerated Reader (AR), a reading program that associates points to books and distributes a percentage of the points to students depending upon their success in answering test questions. To the joy of my teachers and parents, I was frequently one of the top AR students at my school, scoring many AR points and winning various prizes such as free pizza, a certificate, and a pencil. However, my parents' joy was short-lived, as, to my mother's dismay, if I did not receive AR points, I did not want to read; I preferred playing sports with my father and grandfather. To me, reading was a chore, not an enjoyment. Looking back, I realize that I did not feel any connection to the books I read. I selected books based on the number of points I could potentially receive instead of any genuine interest.

My mother noticed how I clinically selected books and tried exposing me to various books until, after years of trying, something finally caught my attention: a nonfiction book about wolves. As a child, I was fascinated by wolves, and that fascination led me to the new possibility of actually enjoying what I read. So, I searched my school library for more books about wolves, and my mom purchased a few for me too. It was during that time that I came across *Julie of the Wolves* by Jean Carolyn Craighead and *Island of the Blue Dolphins* by Scott O'Dell. After reading *Julie of the Wolves*, I realized what I was looking for in a book. I did not want to read books about protagonists who did not look like me; the only way I could truly connect to a character was if I could imagine myself as them. Looking back, I do not believe it was a coincidence that the first fiction books to pique my interest contained girls of color as the protagonists. So, I asked my mom to help me find books with girl protagonists. I do not remember seeing many books with girls of color as protagonists, but the few I remember reading I did not like; I later realized the reason I did not like the books was because I did not relate to the characters' experiences or personalities. As I grew older, I began exploring more books with girl protagonists and came across many books I enjoyed. That enjoyment of reading followed me into my adult life, where I still search for books with women protagonists. To this day, I often find myself seeking out women protagonists of color when reading for enjoyment. Still, I rarely find the connection I am seeking because of an inability to relate to the setting, characters, or plot, as many of the books I find featuring Black women protagonists have been filled with stereotypical representations—

what Stephens and Phillips (2003) refer to as sexual scripts of Black women as “baby mamas” (p. 32) or “gold diggers” (p. 18) frequently portrayed as living in poverty.

As a scholar, I wish I could have spoken to the little girl to help her discover what she was seeking and help her find it a bit earlier. While I cannot go back to the past, I can presently use my knowledge and platform to help others who may also be looking for something in a book they cannot yet explain. I wish to shed light on figures who may have been hidden, yet whom many have yearned for, by exploring girls of color who participate in science, technology, engineering, and mathematics (STEM) in children’s literature.

Context

Reports from the National Science Foundation (NSF, 2018) indicate there is a disparity in the number of people from historically marginalized communities (i.e., women and people of color) who pursue STEM career pathways compared to the number of White men. While women continue to take the lead in graduating with degrees in biology, psychology, and other social sciences, improving the percentage of women is needed in fields that are mathematics intensive. Specifically, in 2018, 19% of bachelor’s degrees in computer science went to women from all races and ethnicities, 21% in engineering, 19% in statistics and physical science, and 42% in mathematics (NSF, 2018; NSF & National Center for Science and Engineering Statistics [NCSES], 2019). Although the percentage of women graduates with a bachelor’s degree was higher in mathematics than in the other mathematics-intensive fields, not all women who graduated with STEM degrees worked in STEM careers; reports indicated more men than women

were hired full-time in science and engineering careers (NSF & NCSES, 2019).

Moreover, in the United States, only 22% of bachelor's degrees and 9% of doctorates in science and engineering were awarded to Latinx, Blacks, and American Indians/Alaska Natives (NSF, 2018; NSF & NCSES, 2019). Of these graduates, only about half pursued careers in science and engineering. Reports further indicated that racial disparities in mathematics and science achievement between Black, White, Latinx, Native American, and Pacific Islander students may begin as early as fourth grade (NSF & NCSES, 2019).

Not addressing the racial disparity in STEM participation could have major economic impacts. With the U.S. population projected to be approximately 450 million by the year 2050, the National Intelligence Council (2012) projected a 35% increase in demand for food, a 40% increase in demand for water, and a 50% increase in demand for energy. Thus, discovering ways to supply people with more resources for a lower cost while minimizing effects on the environment may prove vital in years to come (Hegedus & Temple, 2011; Zoback, 2001). As such, there is a need for scientists and engineers who can solve current environmental issues and predict future outcomes. Although reports of U.S. labor trends predict science and engineering jobs will grow faster than other fields, few people from historically marginalized groups are represented (NSF & NCSES, 2019; National Intelligence Council, 2012). While there has been an increase of Blacks, Latinx, Native Americans, and Pacific Islanders in STEM professions, the percentage has been relatively small, ranging from 2%-8%; this could pose a future issue considering that people from historically minoritized communities are the fastest-growing population in the U.S. The projected 2060 demographics indicate people of color will make up more

than half the U.S. population (Barton et al., 2014; Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline, 2011; Ortman & Guarneri, 2009).

Thus, to combat the disparity of people from historically marginalized communities who participate in STEM, researchers have explored the numerous factors that can influence STEM participation (Xie et al., 2015). One factor that has been of particular interest to researchers is the influence of media on individuals' STEM beliefs (Britner & Pajares, 2006; N. Chambers et al., 2018; Farland-Smith et al., 2017), STEM career aspirations (N. Chambers et al., 2018), and STEM participation (Cheryan et al., 2013).

Mass Media

Before examining mass media, I must first define communication.

Communication has been defined as the practice of disseminating a message from a source to an intended audience (Campbell et al., 2016; Sandman et al., 1972).

Communication consists of three parts: a medium, a source, and an audience. A medium, the singular form of media, is the channel used to transmit that message; a source is a person or resource sharing a message; and the audience is the receivers or listeners of the message (Campbell et al., 2016; Sandman et al., 1972). For example, if T'Challa wrote a letter to Shuri, T'Challa would be the source, Shuri would be the audience, and the letter would be the medium used to communicate. In the case of this example, the audience was small. However, this is not always the case; in media like television, films, and published books, the message is intended for a broader audience.

Mass communication is the process of transmitting a message to a broad, often heterogeneous audience from a source via a medium. As such, mass media are the channels used to disseminate mass communications (Campbell et al., 2016; Howitt, 1982). There are times when the message is explicit, such as a billboard on a highway enticing drivers to visit a gas station, and other times when the messages are subliminal and may be presented as images instead of words. For example, the Barbie doll, a popular toy in the United States, is a source sending subliminal messages about society's view of beauty and women to its young audience. While words are not used, the image sends a message to children who play with the doll that their bodies should be thinner (Dittmar et al., 2006). Other examples of mass media are billboards, television, social media platforms, and books. As in the Barbie example above, mass media messages are not always overt.

Hegemony and Mass Media

Mass media are filled with subliminal messages that reflect the dominating ideology of society. Dominion over societal ideologies, culture, and values is called hegemony. Hegemony is not permanent; rather, social groups continue to fight for dominance and “ideas reflect the economic basis of society, and thus the ruling ideas are those of the ruling class” (S. Hall, 1997b, p. 32). An example of hegemony is the culture of Christmas in the United States. While some do not celebrate any holiday in December, other social groups celebrate holidays such as Kwanzaa and Hanukkah. Despite the diverse number of holidays celebrated in December, the ruling ideology and culture in the United States is that Christmas is at the forefront, as evidenced by the numerous

advertisements (Figure 1) and television programs (Figure 2) related to Christmas. Christmas, December 25, has even been recognized as a national holiday, often signaling paid time off for employees. As represented by the Christmas-related advertisements and television programming, the dominant ideology in the United States is that people celebrate Christmas during the winter. In comparison to Christmas, there is minimal recognition of winter holidays such as Kwanzaa and Hanukkah.

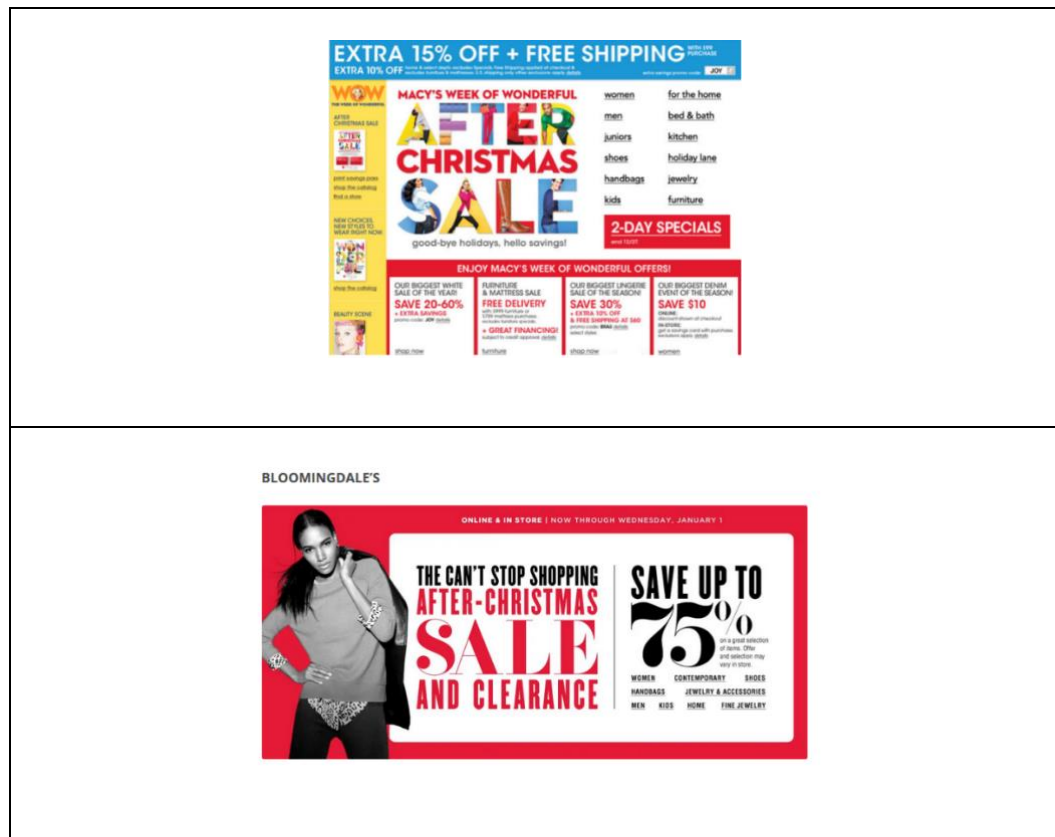


Figure 1. Examples of Christmas-related advertisements. From “Macy’s After-Christmas Sale,” Bindra, 2014, *The Stylish City*, <https://thestylishecitiy.com/macys-after-christmas-sale-2>; “Bloomingdale’s After Christmas Sale 2017,” M. Hall, 2017, *The Recessionista*, <https://therecessionista.com/blomming/>.



Figure 2. Examples of Christmas-related television programming. From “New Movies—Miracles of Christmas 2018,” Hallmark Movies and Mysteries, 2018, <https://www.hallmarkmoviesandmysteries.com/miracles-of-christmas/new-movies-2018>, copyright 2020 Crown Media; “Freeform’s 2019 25 Days of Christmas Schedule is out now,” Chip, 2019, <https://chipandco.com/freeforms-2019-25-days-of-christmas-schedule-is-out-now-368965/>, copyright 2000 Universal Studios.

Mass media messages reflect the hegemonic beliefs of a society, and thus are often embedded with societal stereotypes (Altheide, 1984; S. Hall, 1979). Stereotypes minimize the traits of a person or group to inflated characteristics: they “get hold of the few simple, vivid, memorable, easily grasped and widely recognized characteristics about a person, reduce everything about the person to those traits, exaggerate and simplify them” (S. Hall, 1997a, p. 247), thereby making a division between those who fit and those who do not. A stereotype “divides the normal and the acceptable from the abnormal and the unacceptable. It then excludes or expels everything which does not fit, which is different” (S. Hall, 1997a, p. 247). Media do not create stereotypes; rather, media are often used to transmit messages that align with the hegemonic power structures of a given society (Altheide, 1984; S. Hall, 1979).

Influence of Media

Cultivation theory, a sociocultural theory used within communications (Gerbner, 1973), posits that the hegemonic beliefs of society are presented through mass communication, and the more a person is exposed to that mass communication, the more likely they will view the world from a similar perspective as the media portrayed (Gerbner, 1973; Shanahan et al., 1999). Rather than examining the immediate short-term impacts a specific message may have on a person's attitude or beliefs, cultivation is a continual process that focuses on the broader long-term impacts of media consumption (Shanahan et al., 1999). Although originally developed to examine television's role in people's perception of the world (Gerbner, 1973), the theory can be applied to any dominant medium like film or books (Shanahan et al., 1999). The basis of cultivation theory is that the underlying messages of mass media are unchanging and consistent. As such, the symbolic messages of mass media are both a reflection and a reproduction of dominant ideologies about the world (Gerbner, 1990; Shanahan et al., 1999).

Cultivation also argues that there are times when people are given a “double dose” of information—information from media is also experienced in real life (Gerbner et al., 1980; Shanahan et al., 1999). Having a “double dose” of influence from media as well as from real-life experiences is called resonance (Shanahan et al., 1999, p. 66). When the subliminal messages of the media are echoed in real life, the influence of the media may be stronger. For example, suppose the media sends the message that women of color do not belong in STEM and youth do not see women of color participating in STEM in their

everyday lives. In that case, the influence of media may be stronger; youth may also believe that women of color do not participate in STEM fields.

While cultivation alone does not necessarily lead to developments or changes in a person's attitudes, beliefs, and behavior, it is one factor that when combined with other variables, such as experiences, can have detrimental impacts. For example, increased exposure to negative stereotypes of social groups is positively correlated to increased social biases and has a negative impact on the experiences of marginalized groups (Cohen et al., 2009; Steele & Aronson, 1995; Wang & Degol, 2013). A meta-analysis of 33 studies revealed that repeated exposure to negative stereotypical views of an individual's social group (e.g., ethnicity, gender, age) could negatively impact an individual's cognitive performance, academic achievement, interest, and career aspirations (Appel & Weber, 2021).

Influence of Media in STEM

The pervasive impacts of media also extend into STEM; media can influence an individual's recognition of themselves as a scientist, mathematician, or engineer as well as their belief in their competency (Britner & Pajares, 2006; Farland-Smith et al., 2017; Hackett et al., 1992). Given media's rendition of people in STEM has historically been of White, able-bodied, middle-class men (N. Chambers et al., 2018), the more individuals consume these media portrayals, the more likely individuals within STEM communities will only recognize those who fit that image as belonging in STEM, thereby alienating individuals who do not fit the portrayed media image (Carlone & Johnson, 2007; Farland-Smith et al., 2017; Rawson & McCool, 2014). While research suggests prolonged

exposure to counter-stereotypic images of marginalized groups participating in science could positively affect STEM achievement (Good et al., 2010), it is unclear whether counter-stereotypic images can change students' perceptions of scientists (Sharkawy, 2012). Regardless of the uncertainty of the various effects counter-stereotypic images could have on an audience, the pervasive influence of media on an individual's personal factors (e.g., affects, beliefs, and skills) has been continuously documented (Britner & Pajares, 2006; Cohen et al., 2009; Farland-Smith et al., 2017; Hackett et al., 1992; Steele & Aronson, 1995; Wang & Degol, 2013).

Considering the potentially pervasive impacts of media, under- and misrepresentations of women and people of color in the media persist (Long & Steinke, 1996; McCabe et al., 2011; Steinke & Tavaréz, 2018). Reports indicate two men are portrayed on television screens for every one woman. The lack of representation of women has also been seen in books, where men appear six times more often as protagonists compared to women (McCabe et al., 2011). Additionally, when women are portrayed in the media, few are seen in STEM; rather, women have been portrayed in stereotypical roles such as cooking, cleaning, or doing other indoor tasks (Long & Steinke, 1996; Steinke & Tavaréz, 2018). This under-representation in media is not limited to women. Characters of color are less likely to have speaking roles in films and television from broadcast networks, cable, and online streaming, with the percentage of speaking roles for Whites (72%) being larger than for Blacks (12%), Latinx (6%), Asians (5%), Middle Easterners (2%), and Others (3%; S. L. Smith et al., 2016). This deficit in speaking roles for people of color also translates to their overall STEM representation in

the media. Girls and people of color are significantly less likely to be portrayed as scientists (Long et al., 2001). To understand this inequity, I used critical race theory to examine the portrayal of women and girls of color participating in STEM. Counter-storytelling, a tenet of critical race theory, gives voice to populations that have historically been marginalized; my study sought to give voice to oppressed populations.

Critical Race Theory

Critical race theory (CRT) was originally developed in the 1970s by attorneys, legal scholars, and activists who felt there needed to be a way to understand the backsliding from the advances made in the civil rights era (Bell, 1995; Delgado & Stefancic, 2017). The work of CRT “is often disruptive because its commitment to anti-racism goes well beyond civil rights, integration, affirmative action, and other liberal measures” (Bell, 1995, p. 899). CRT was created to examine the relationship between power, race, and racism from a broader perspective and take note of the more understated forms of racism that occur throughout society (Bell, 1995; Delgado & Stefancic, 2017). Later CRT theorists like Gloria Ladson-Billings began incorporating critical race ideas into education to understand issues relating to affirmative action, bilingual and multicultural education, and school curriculum (Ladson-Billings, 1998; Ladson-Billings & Tate, 1995; Taylor, 2000). As such, the tenets of CRT are as follows:

1. “Racism is ordinary, not aberrational” (Delgado & Stefancic, 2017, p. 7). This tenet assumes racism is so ingrained within the society that many do not recognize it as such and thus accept it as a normal occurrence.

2. Race is an intersecting social construct and thus is subject to change when convenient to the group in power. Intersectionality addresses the ways in which a person's life opportunities and outcomes differ across various social groups. A person is not limited to one social group; rather, they may identify with multiple social groups (e.g., gender, class, race, nationality, language) simultaneously (Crenshaw, 1991; Davis, 2008; Núñez, 2014). Changes made to race are done to exclude others, exude control, and address labor needs.
3. Use of experiential knowledge to create counter-storytelling, also referred to as counternarratives, that draws on the knowledge and struggles of individuals from marginalized populations to expose racism and push against preconceived notions.
4. Commitment to social justice whereby systematic oppression ends by giving power to populations that have been historically marginalized.

Organization of Dissertation

To study how protagonists who are girls and women of color are portrayed participating in STEM in children's picture storybooks intended for grades K-3, I used a CRT framework to examine picture books published from 2016-2020. While researchers have used descriptive statistical analysis to report the presence or lack of women and people of color within STEM-related children's picture books (Farland-Smith et al., 2017; Kelly, 2018), no researcher has critically examined how girls and women of color protagonists are portrayed participating in STEM within children's books as I sought to do within this study.

Chapter 2 provides a review of literature relevant to the research study. It gives a context of children's multicultural literature by providing statistical data and critiques of multicultural literature embedded with stereotypes. Chapter 2 further reveals a literature review of the early influence of stereotypes on youth.

Chapter 3 describes the method for conducting the study. This study used three coding techniques (i.e., descriptive coding, narrative coding, and rubric) and theming to examine the illustrations and text within children's picture storybooks using critical content analysis.

Chapter 4 discusses the results derived from the inquiry. The chapter provides an analysis of STEM-related children's picture books published from 2016–2020. Data were themed to identify patterns and relational meaning.

Chapter 5 discusses how the results found in this study relate to the theoretical framework of CRT. Implications, suggestions for future research, and limitations of this study are also discussed.

Chapter Two

Defining STEM

A definitive definition of the acronym STEM has been elusive since its conception decades ago by the NSF (Breiner et al., 2012). NSF operationalizes STEM as consisting of science, technology, engineering, mathematics, computer science, psychology, economics, and social science. Yet, this meaning of STEM is not shared across fields. Given its elusiveness, it is crucial to operationalize STEM for this study. In education, many operationalize STEM as consisting of only science and mathematics, often neglecting technology and engineering (Bybee, 2013). However, for this study, I referenced part of NSF's definition of STEM, excluding psychology, economics, and social science. Additionally, I included computer science, in light of Barack Obama signing the STEM Education Act of 2015 into law, which extended STEM education to include computer science. As such, for the purposes of my study, STEM consists of science, technology, engineering, mathematics, and computer science. Aside from its definition, another aspect of STEM that has also been elusive is the representation of women of color participating in STEM fields.

STEM Participation

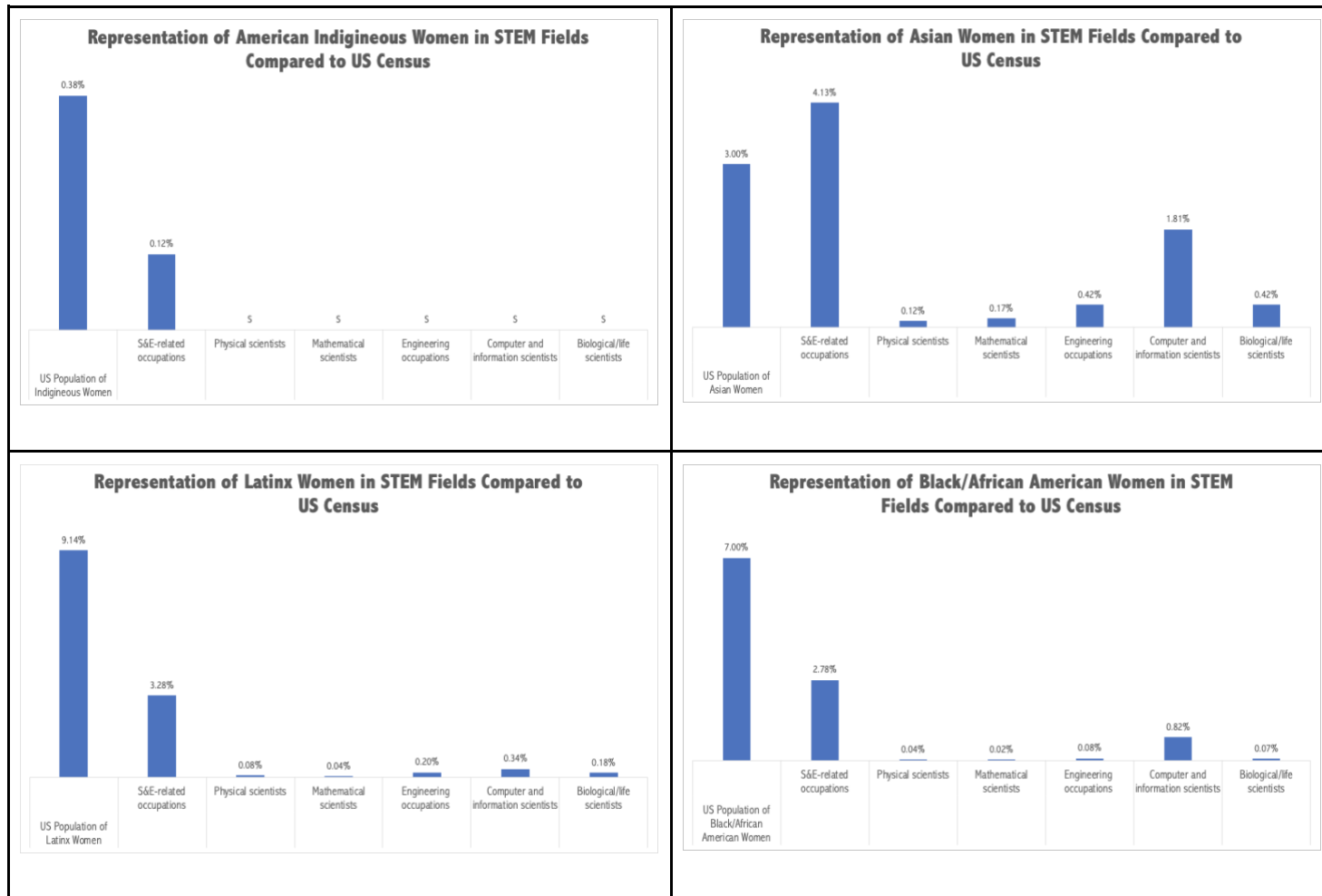
Recognizing a disparity in marginalized American populations' participation in STEM, the NSF is committed to broadening STEM participation by increasing the number of people in marginalized communities (i.e., women and people of color) who pursue STEM career pathways (NSF, 2018). Pathways to a STEM career encompass

various levels of institutions in multiple geographical regions. As such, “STEM participation” is an umbrella term used to comprise a variety of STEM activities throughout institutions, such as majoring and graduating with a STEM degree, pursuing a STEM career, taking advanced STEM classes in K-12 settings, or engaging in STEM activities outside of the classroom.

Reports from the NSF and NCSSES (2017) indicated that Black, Latinx, Asian, Indigenous (i.e., American Indian/Alaska Native), and Native Hawaiian/Other Pacific Islander women are marginalized in biological/life science, computer and information science, mathematical science, physical science, and engineering. Figure 3 depicts the percentages of women represented in science and engineering (S&E) occupations (i.e., biological/life scientist, computer and information scientist, mathematical scientist, physical scientist, engineer) and S&E-related occupations, which include health occupations, after graduating with a bachelor’s, master’s, or Ph.D. degree. As shown in Figure 3, there are small percentages of women of color participating in computer and information science, mathematical science, physical science, and engineering occupations. Fields that appear to have the smallest percentages of women of color are math-intensive fields such as physical and mathematical science, where there is an increased likelihood of women changing their college majors or leaving their careers after joining the workforce (Ceci & Williams, 2010; Hewlett et al., 2008). Of the women of color with occupations in computer and information science, Asian women have the highest percentage of participation at 1.81%, very close to their percentage of the U.S.

population, 3%. The field that contains the largest percentage of women of color is S&E-related occupations, which include health care occupations (Frye, 2020).

Despite the large percentage of women of color in S&E-related occupations, it is important to note that the percentages of Black, Latinx, Indigenous, and Native Hawaiian/Other Pacific Islander women in these occupations do not reflect the U.S. demographics. The higher percentage of women in health care occupations is unsurprising, as nursing has historically been performed by and stereotypically portrayed as an occupation for women; research suggests stereotypes such as these begin in youth (Cvencek et al., 2011; McLaughlin et al., 2010).



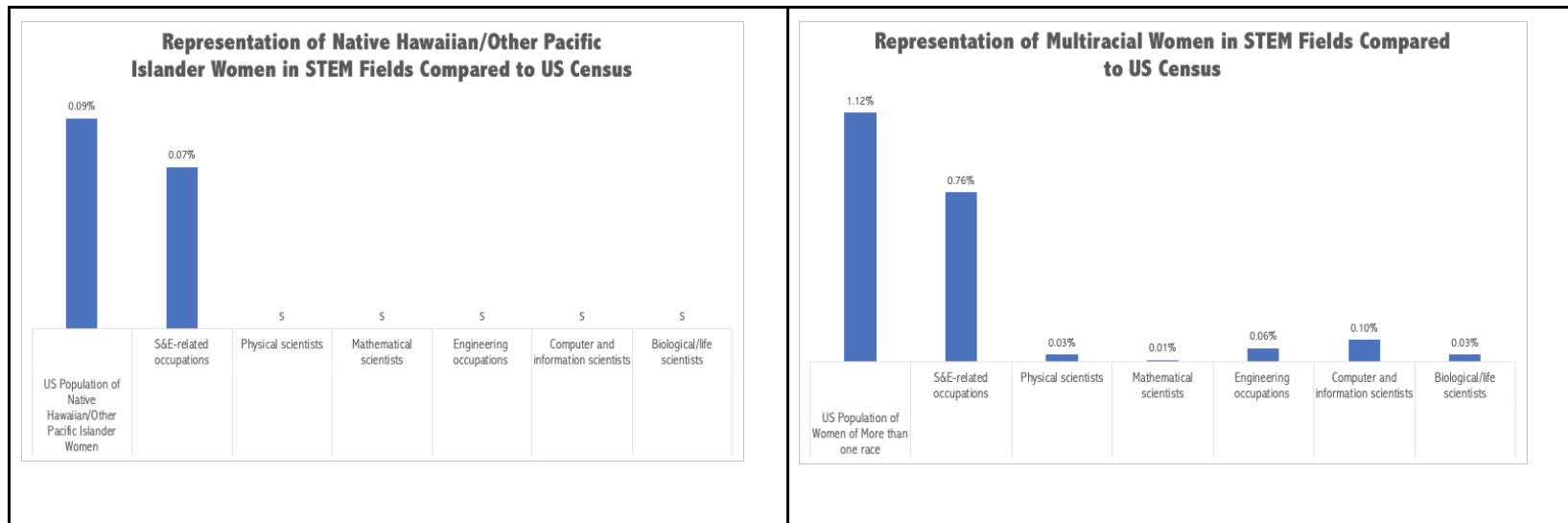


Figure 3. Percentages of women of color employed in S&E or S&E-related occupations in comparison to the U.S. census (NSF & NCSES, 2017). S = the estimated population is less than 500 and thus has been suppressed to maintain confidentiality.

Early Impacts of Stereotypes

The pervasive impacts of stereotypes begin at an early age (Cvencek et al., 2011). When children are exposed to media young, they are able to delineate between gendered behaviors as early as preschool and begin noticing racial societal biases as early as the age of 2 (Gettys & Cann, 1981; Golden & Jacoby, 2018; Powell-Hopson & Hopson, 1988). In Powell-Hopson and Hopson's (1988) doll study, individuals as young as preschool age perceived Black dolls negatively and White dolls in a more positive light, with students commenting that "evil witches are black and angels are white" and "the bad guy wears black and the good guys wear white" (p. 61). The children's stereotypical views were also evident in their actions, as the students often chose to play with the White dolls as opposed to the Black dolls. The students' comments suggested that their ideology and behaviors were due to their awareness of society's racial biases. Similarly, research from Golden and Jacoby (2018) suggests that in addition to being aware of societies' viewpoints regarding race, children are also aware of gender stereotypes; this was evident in preschool girls' pretend play after watching Disney princess films. During pretend play, the girls often made comments regarding beauty, such as "I'm gonna be a beautiful Rapunzel," and stereotypical views of boys, as evident by comments such as "[Boys] can't dress up like them. Only they can be like this [points down to her own pants]" (Golden & Jacoby, 2018, p. 305). As with Powell-Hopson and Hopson's (1988) study, Golden and Jacoby noted that children's stereotypes are derived from media. More evidence of youth's ability to pick up societal gendered views comes from Gettys and Cann's (1981) study and the Draw-a-Scientist Test (D. W. Chambers, 1983; Farland-

Smith et al., 2017). Gettys and Cann studied 155 children aged 2–8. They were shown similarly dressed male and female dolls. The researchers named occupations (e.g., doctor, secretary, police, teacher, basketball player, librarian, and construction worker) and asked the children to point to the doll they believe did that job. Gettys and Cann found that children as early as the age of 2 were able to delineate between gendered professions (e.g., identify librarian and teacher as often portrayed as professions for women).

Likewise, the Draw-a-Scientist Test reveals that for over 50 years, youth have been likely to draw a monolithic view of scientists as White men working in a laboratory. Recognizing this monolithic view of scientists, in developing the Draw-a-Scientist checklist, researchers (Farland-Smith, 2012; Finson et al., 1995) included characteristics of stereotypical images within the checklist. For example, in the “appearance” section of the modified Draw-a-Scientist checklist, the rubric states,

Illustrations which score a “2” in APPEARANCE can be referred to as “traditional.” These drawings contain a standard looking white male. Illustrations which score a “3” in APPEARANCE can be referred to as “broader than traditional.” These drawings include a minority or woman scientist. (Farland-Smith, 2012, p. 115)

From the rubric, Farland-Smith (2012) used “traditional” to refer to the stereotypical image youth are more likely to draw when asked to make a picture of a scientist. As evident from the aforementioned research (Golden & Jacoby, 2018; Powell-Hopson & Hopson, 1988), youth derive gendered and racial stereotypes from the media (e.g., dolls and films).

The pervasive impacts of media are particularly concerning in STEM, as stereotypical viewpoints about STEM may be an attributing factor to a lack of interest in STEM participation and STEM careers (Archer et al., 2013; N. Chambers et al., 2018). In a study by N. Chambers et al. (2018), youth aged 7–11 drew a picture of a career they would like to have as an adult and answered what influenced their aspirations. Media (e.g., television, radio, film) was one of the most influential factors in youths' career aspiration. Moreover, the study noticed that boys were four times more likely to have engineering career aspirations than girls, and girls were nine times more likely to have teaching aspirations than boys. The concept of having gendered career aspirations was further emphasized in Archer et al.'s (2013) study, which questioned approximately 10,000 students and found girls were more likely to aspire toward nurturing STEM professions (e.g., doctors, veterinarians, nursing), traditionally portrayed as occupations for women (Archer et al., 2013; N. Chambers et al., 2018). Examining girls' interest in traditionally gendered STEM professions has revealed that girls are more likely to have STEM-related career aspirations if they (a) believe they can succeed in STEM, (b) see STEM as a place for them, and (c) believe others recognize STEM as a place for them (Archer et al., 2015; Carlone & Johnson, 2007; Dou et al., 2019). Being consistently exposed to media images that epitomize stereotypical gendered notions of STEM careers may be one factor that negatively influences youth's attitudes and beliefs about STEM participation.

Having stereotypical representations of women in STEM in media is particularly concerning for women and girls of color, who may feel pressured to conform to

stereotypes, believing STEM is not a place for them, and therefore may choose not to engage in STEM activities or have STEM career aspirations because it has historically been portrayed as for Whites and men (Archer et al., 2013; Bian et al., 2017; N. Chambers et al., 2018). In particular, girls and women of color are uniquely positioned as subject to oppression for both their gender and their race/ethnicity, and forced to overcome barriers in STEM such as discrimination and feelings of isolation based on both their gender and race/ethnicity (Brown et al., 2016; Carlone & Johnson, 2007). Counternarratives, stories that give voice to the experimental experiences of the oppressed, have been used to combat stereotypical representations (Delgado, 1995). Multicultural literature can potentially act as counternarratives and provide a different perspective for women and girls of color than that of the dominant ideologies (Hughes-Hassell, 2009).

Bishop (1990) posed a “windows, mirrors, and sliding doors” analogy that I, too, will use to address the potential use of multicultural literature as a counternarrative. She wrote:

Books are sometimes windows, offering views of worlds that may be real or imagined, familiar or strange. These windows are also sliding glass doors, and readers have only to walk through in imagination to become part of whatever world has been created and recreated by the author. When lighting conditions are just right, however, a window can also be a mirror. Literature transforms human experience and reflects it back to us, and in that reflection, we can see our own lives and experiences as part of the larger human experience. Reading, then,

becomes a means of self-affirmation, and readers often seek their mirrors in books. (Bishop, 1990, p. xi)

Bishop's (1990) concept speaks to the subliminal messages readers absorb. When people read books, they become situated within the world the author created. While the worlds within the books may stem from an individual's mind, books are filled with ideologies and knowledge of a society from a moment within time and are often used to teach readers about the world from a specific perspective (Acevedo, 2017; Ghiso & Campano, 2013). Just as authors come from various environments and have various beliefs, the worlds within books reflect the ideas of the authors and the world they live in. As such, when people read books, they learn how to navigate a world and learn about cultures portrayed within the books they read. Exposing individuals to multicultural literature may allow them to see their own culture represented as well as generate opportunities for them to learn about different cultures.

Multicultural Literature

Yet, there is some inconsistency regarding the definition of multicultural literature and its use in education (Cai, 2002; Cai & Bishop, 1994). Kruse and Horning (1990) stated that multicultural literature "focus[es] on People of Color" (p. vii). While Kruse and Horning's definition provided a narrow scope of multicultural literature, limiting it to only diverse racial groups, Harris (1994) widened the definition to say multicultural literature covers more than race: it "feature[s] People of Color, the elderly, gays and lesbians, religious minorities, language minorities, people with disabilities, gender issues, and concerns about class" (p. 117). Still, Bishop (1990) expanded the definition more by

acknowledging multicultural literature may be “*by* and *about* people who are members of groups considered to be outside the sociopolitical mainstream of the United States” (p. 39). Bishop’s definition acknowledges works written by authors whose voices have historically been oppressed, as well as the characters within the stories. However, Cai (2002) noted that despite the varying definitions, there is one commonality: “multicultural literature is about groups of people that are distinguished racially, culturally, linguistically and in other ways from the dominant white, Anglo-Saxon, Protestant, patriarchal culture” (Cai, 2002, p. 4). As this research focused on the portrayal of girls and women of color in multicultural children’s literature, I used Cai and Bishop’s (1994) definition, which encompasses the various ways women and girls of color may identify. Considering the early impacts of media stereotypes, multicultural literature may be particularly beneficial to youth.

Children’s Literature

Children’s Literature in the Classroom

Despite children’s early and prolonged exposure to them, children’s books are a medium that has received little amount of attention from researchers. Beginning at an early age, youth are exposed to books. Reports indicate 52% of parents begin reading aloud to their children before the age of 2 (Scholastic Inc. & YouGov, 2019). Children’s literature is used for a variety of purposes and settings in the early development of youth. Reading promotes students’ vocabulary, expressive language development, and reading comprehension (Cassano & Dougherty, 2018; Dickinson & Smith, 1994; Nagy & Anderson, 1984; Whitehurst et al., 1988).

Children's literature is not only used to promote literacy development: it is also used to teach STEM content and promote STEM literacy. As elementary students' instructional time on science concepts is minimal, teachers use books to introduce students to scientific and mathematics content (Judson, 2013; Kelly, 2018). Readers of children's literature are presented with scientific and mathematics content within an applied setting (Madrazo, 1997). As such, STEM-related books can help youth build their STEM literacy. Building STEM literacy allows youth to understand STEM disciplines for the sake of identifying and inquiring about STEM-related issues (Bybee, 2010) and helps them to understand STEM for the purposes of "civic and cultural affairs and economic productivity for all" (National Research Council, 2011, p. 4). Yet, STEM content and literacy are not the only uses for children's literature.

Multicultural Children's Literature

In addition to teaching literacy (e.g., reading comprehension, vocabulary) and STEM concepts, books help youth understand themselves as well as the world around them (Rawson & McCool, 2014). As such, the way in which characters are consistently portrayed within children's literature can influence their perception of themselves and others (Britner & Pajares, 2006; N. Chambers et al., 2018; Farland-Smith et al., 2017; Hackett et al., 1992; Handelsman & Sakraney, 2015).

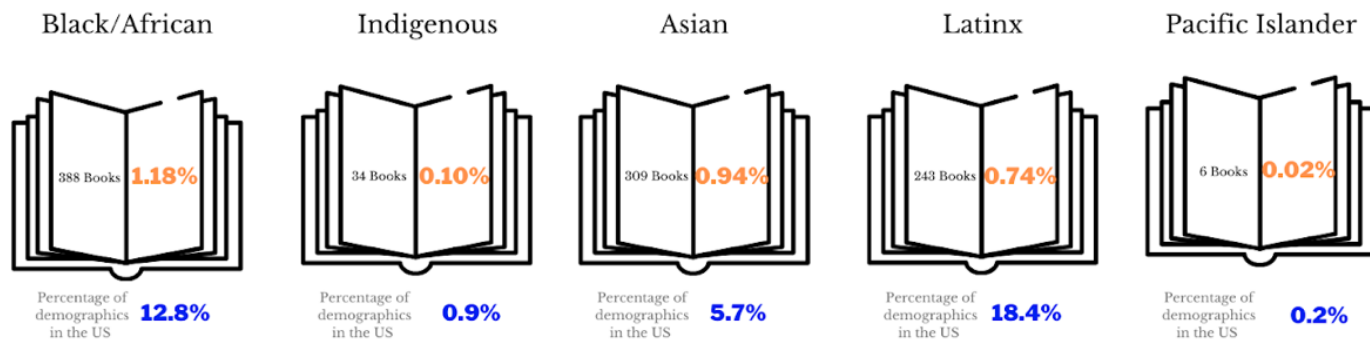
Yet, data indicate children's literature is not representative of the U.S. demographics, and thus is lacking in diversity (Cooperative Children's Book Center [CCBC], 2018). Figure 4 statistics were calculated using Harbison (2019) and the CCBC data. Harbison (2019) identified the total number of children's and teen/young adult

books published in 2018, while the CCBC inventory identified the percentage of children's and teen/young adult books published in 2018 that were multicultural. As shown in Figure 4, there was a lack of representation of Black/African/African American, Asian Pacific Islander/Asian Pacific American, Latinx, Indigenous, and Asian/Asian American characters in these books.

The lack of diversity in children's literature is particularly concerning, as girls of color are more likely to connect their readings to their everyday lives and enjoy reading when the characters in the books look like them and mirror their own cultures and experiences (Bishop, 1990; Hefflin & Barksdale-Ladd, 2001; Hughes-Hassell et al., 2009; Pérez Huber et al., 2020). Moreover, when White students only see themselves represented in material, it creates a cultural norm whereby they believe only Whites belong (Bishop, 2012). This is especially of note in the STEM fields, where the dominant representation is of White men.

Exclusion of women and girls of color from media narratives about STEM creates an ethnocentric atmosphere within the field (Bishop, 2012; Braden & Rodríguez, 2016), thus creating a vicious cycle whereby those who fit the image believe women and girls of color do not belong, and women and girls of color avoid STEM, as they too think they do not belong (Carlone & Johnson, 2007). Exposing youth to multicultural literature is potentially beneficial to all youth, not only youth of color, as "stories by people of color can catalyze the necessary cognitive conflict to jar dysconscious racism," thus creating opportunities for youth to see material that challenges the stereotypical images in their minds (Ladson-Billings, 1998, p. 14).

Of the 32,903 children and teen/young adult books published in the US in **2018**, below is the percentage of books featuring people of color compared to the US census.



Percentages were calculated from data compiled by the Cooperative Children's Book Center (CCBC), whose inventory contains 3,682 books written by and about people of color in the US. The total number of children and teen/young adult books was reported from The Library and Trade Book Almanac (64th edition).

Figure 4. Percentages of characters of color in 2018 children's and teen/young adult books.

Critiques of Multicultural Literature

While multicultural children's literature has the potential of allowing youth to see, understand, and accept that there are cultures different from their own, "when children cannot find themselves reflected in the books they read, or when the images they see are distorted, negative, or laughable, they learn a powerful lesson about how they are devalued in the society of which they are a part" (Bishop, 1990, p. 557). When the characters are from a similar background as the reader, without negative stereotypes, a book can be affirming; it shows the child that they have a place within society. However, often characters are laden with negative stereotypical representations (CCBC, 2018; Kelly, 2018). African Americans are frequently rendered as slaves in the 1800s or as athletes; Asians are rarely portrayed in modern eras; Native Americans are depicted as "noble savages living in peace with nature" (Edmonds, 1986, p. 34); Latinx are viewed as being raised in the "ghetto" (Harlin & Morgan, 2009). These racial stereotypes may be partly attributed to authors writing about social groups to which they do not belong, while their own "cultural identity and background may adversely influence their literacy choices without the author knowing it" (Cai, 2002, p. 63). Yet, the responsibility does not lie with the authors alone; publishers and publishing companies also play a role in the production of diverse books (Cai, 2002). The stories in multicultural literature only operate as counternarratives when they give voice to the experiential experiences of those from diverse cultures, who have been historically oppressed. Moreover,

current practical demonstrations of multicultural education in schools often reduce it to trivial examples and artifacts of cultures such as eating ethnic or

cultural foods, singing songs or dancing, reading folktales, and other less than scholarly pursuits of the fundamentally different conceptions of knowledge or quests for social justice. (Ladson-Billings & Tate, 1995, p. 24)

Having examples of women and girls of color pursuing STEM-related knowledge or exhibiting signs of resistance through STEM participation is vital, as the experiences of people of color are not one-dimensional and consist of more than eating, dancing, and celebrating holidays. Multicultural literature does not act as counternarratives when the stories reinforce stereotypes from the dominant ideological viewpoint, and should therefore be examined critically (Ladson-Billings, 1998; Yenika-Agbaw, 2014).

Multicultural STEM Children's Books

While studies have examined children's science literature for the presence and lack of characters of color, little effort has been made to critically examine the books for stereotypes (Farland-Smith et al., 2017; Kelly, 2018). Farland-Smith et al. (2017) conducted an analysis of 148 books on the National Science Teacher Association (NSTA) 2014–2016 recommendation list. Only approximately 36% of the scientists portrayed within the books in 2014 were women. In 2015 and 2016, this percentage dropped, with only approximately 20% of the scientists portrayed as women within NSTA's recommended books. However, this disparity does not end there. Of the books listed on NSTA's 2014 list, only 4.6% of the scientists were people of color. In 2015, this dropped to only 2.83%. The number increased marginally in 2016, with 10.81% of the scientists being people of color (Farland-Smith et al., 2017). It is of note that the percentages from Farland-Smith et al. were based on images gathered from 148 books. As such, the

percentages derived from their study cannot be directly compared to the Harbison (2019) data shown in Figure 4. Data in Figure 4 are based on 32,908 books—the total number of children’s and teen/young adult books published in 2018—and furthermore, Harbison (2019) did not identify books using the NSF definition of STEM. Therefore, it is difficult to discern from Harbison (2019) what percentage of books were STEM-related. Despite the inability to compare percentages between these sources, they as well as the CCBC (2018) data collectively show that more work needs to be done to present youth with a more inclusive perception of people in STEM. Additionally, the percentages do not reveal if the characters of color within these books are portrayed in a negatively stereotypical light or if these books represent stereotypical beliefs regarding women and girls of color in STEM; this is important to note, considering that the NSTA has been said to use “rigorous” criteria to select books that are free “from gender, ethnic, and socioeconomic bias” (Falk, 2020, para. 4).

As such, I critically examine how women and girl protagonists of color are portrayed participating in STEM in children’s books, some of which were recommended by NSTA. As race is a social construct that “has become metaphorical . . . so completely embedded in daily discourse” and used as “a way of referring to and disguising forces, events, classes, and expressions of social decay and economic division” (Morrison, 1994, as cited in Ladson-Billings, 1998, p. 8), I will use CRT to shed light on power and inequalities around women and girl protagonists of color’s participation in STEM as it relates to the intersections of race and gender.

CRT History and Tenets

CRT centers race in its analysis and enables researchers to analyze the role race plays within education (Bell, 1995; Brooks, 2009). Since its debut in legal studies, CRT has been used to discuss various issues in education (e.g., school discipline and curriculum) and has expanded to children's books, as they too are brimming with dominant racial, gendered, classed ideology (Dixson et al., 2006; Hughes-Hassell et al., 2009; Ladson-Billings, 1998; Pérez Huber et al., 2020). Researchers have noted CRT allows them to understand that children's literature is contextualized within a socio-political construct and thus privy to racism, a cultural phenomenon (Schall et al., 2019). Within education studies, CRT uses knowledge from various areas such as gender studies, sociology, and history to contextualize and examine various cultural phenomena. The interdisciplinary perspective takes the approach that while CRT was born in legal studies, it is appropriate for other social and cultural contexts such as education and media (Schall et al., 2019). CRT scholars posit an examination of social, economic, and institutional structures to address White privilege and give voice to people of color who have historically been othered (DeCuir & Dixson, 2004; Hughes-Hassell et al., 2009).

The foundational premise of CRT is that race is embedded into our society and is intersected with other social constructs (Bell, 1995; Crenshaw, 1991). Race is found in our day-to-day interactions and thus appears to be a natural part of our lives (Bell, 1995). Moreover, racism intersects with other cultural phenomena such as classism, sexism, and nativism (Crenshaw, 1991). To describe the concept of race intersecting with other social constructs, Crenshaw (1991) coined the term "intersectionality," meaning the way a

person's various social identities intersect to present a perspective unique to that individual. For example, a Black woman from Cincinnati will have different perspectives and experiences than a Black man from Cincinnati. Although they share a similar race and nationality, they identify in different gender groups; this will influence how they engage within various communities. Similarly, the portrayal of women and girls of color in STEM may differ from the portrayal of men and boys of color in STEM, as the women and girls of color may be subject to racial and gendered stereotypes.

Another foundational tenet of CRT is challenging the dominant ideologies using counter-storytelling, also known as counternarratives, through the centrality of experiential knowledge. Counter-storytelling is defined as “a method of telling a story that aims to cast doubt on the validity of accepted premises or myths, especially ones held by the majority” (Delgado & Stefancic, 2001, p. 144). Counter-storying gives voice to persons of color who have historically been stripped of power and silenced. Bell (1995) wrote:

The narrative voice, the teller, is important to critical race theory in a way not understandable by those whose voices are tacitly deemed legitimate and authoritarian. The voice exposes, tells and retells, signals resistance and caring, and reiterates what kind of power is feared most—the power of commitment to change. (p. 907)

Counter-storytelling validates the lives and experiences of marginalized groups and thereby challenges the realities upheld by those in power (Hughes-Hassell et al., 2009). Additionally, counter-storytelling “has been a kind of medicine to heal the wounds of

pain caused by racial oppression” (Ladson-Billings & Tate, 1995, p. 53). It questions the dominant ideological depictions of people of color by bringing racism and institutional barriers, which are often overlooked, to the forefront (Brooks, 2009).

Although there are several tenets of CRT, which are subject to debate, the last tenet I will reference for my study is the commitment to social justice. CRT exposes oppression for its elimination and thus gives power to people of color, who have historically been oppressed (Pérez Huber et al., 2020). Likewise, my study aimed to reveal the potential forms of oppression within children’s multicultural literature that portrays women and girls of color participating in STEM to eliminate images that provide a distorted or negative view of women and girls of color in STEM.

Chapter Three

Research suggests a lack of representation in STEM-related children's literature for people of color (Farland-Smith et al., 2017; Kelly, 2018). While many researchers have explored the representation and misrepresentations of girls and people of color in children's literature, with particular attention to the portrayal of Blacks (Campbell et al., 2016; Gooden & Gooden, 2001; Yoo-Lee et al., 2014), little research has examined the intersectionality of the two, the representation of girls of color within children's literature (Brooks & McNair, 2015; Muhammad & Haddix, 2016). Moreover, most research that analyzes the representation of diverse characters participating in STEM in children's literature has been limited to the presence or lack of diverse characters and does not explore the portrayal of diverse characters participating in STEM. My search of educational research literature revealed no research-based examinations regarding the portrayal of girls of color participating in STEM in children's literature. Thus, utilizing a critical content analysis, my study examined the following research question: How are protagonists who are girls and women of color portrayed participating in STEM in children's picture storybooks intended for grades K-3?

Methodology

Content Analysis

"Content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004, p. 18). Thus, content analysis is an overarching term used to

describe a systematic research method that analyses and interprets societal artifacts (e.g., texts, pictures, videos) through the use of coding and thematic finds (Short, 2017, 2019; White & March, 2006). Historically, many of the content analyses done in children's literature have used a descriptive and objective approach that focuses on counting the presence of phenomena and cultural groups (Galda et al., 2000; Short, 2019) this has also been seen in studies that address STEM in children's literature (Farland-Smith et al., 2017; Kelly, 2018). However, to gain an accurate view of "what exists, what is important, what is right, and what is related to what," Signorielli (1981) posits that content analyses of mass media should contain the four following constructs: attention, emphasis, tendency, and structure (Signorielli, 1981, p. 102). Whereas "attention" focuses only on measuring the frequency of an instance, "emphasis" identifies instances that stand out amongst the data, "tendency" places judgment by determining if the messaging is positive or negative, and "structure" relates messages to the system as a whole. As such, more recent children's literature research, such as this study, has gone beyond counting to identifying instances of stereotyping and counternarratives through the examination of texts' social, cultural, and political aspects (Short, 2019).

Content analysis approaches vary based on researchers' needs (Short, 2017). They reflect an interpretive research stance, where the meaning is derived from the text and differs depending upon the researcher's interpretation of the text (Short, 2019). Content analysis may be directly connected to the literature and allow the researcher to use deductive reasoning to predict variables or identify relationships between variables (Hsieh & Shannon, 2005). It can be conventional, allowing themes to emerge from the

data instead of the pre-existing literature, and has a longstanding connection to communication studies (Hsieh & Shannon, 2005). Meanwhile, a summative approach to content analysis does not involve inferencing. Rather, the approach quantifies data to gain an understanding of the content and context (Hsieh & Shannon, 2005). Researchers who have examined diverse representation in STEM-related children's books have used the summative approach of content analysis, quantifying the frequency of women, Black, Latinx, Asian, and Indigenous characters within children's literature (Farland-Smith et al., 2017; Kelly, 2018). For this study, I expanded upon the work of Farland-Smith et al. (2017) and Kelly (2018) to conduct an interpretive content analysis of STEM-related children's books already identified as containing women and girl characters of color. When conducting a content analysis, researchers are not limited to one stance; they may choose to also take on a critical stance (Short, 2019), as I did within this study, through the critical examination of power and inequalities as they relate to the intersections of race and gender.

Critical Content Analysis

Within a critical content analysis, the researcher takes on a political stance, utilizing a critical lens to analyze communication artifacts. Critical theory is based on the premise that the world we live in and the artifacts we create are socially constructed (Freire, 1970; Short, 2017). Therefore, communication artifacts are created from a particular perspective that reflects an individual's understanding of the world around them (Freire & Macedo, 1987; Short, 2017). Moreover, a person's interpretation of

artifacts is colored by their personal experiences, values, and cultural understandings (Rosenblatt, 1938; Short, 2017; Vasquez, 2012).

By taking on a critical stance in content analysis, researchers are concerned with examining issues relating to power and identifying, understanding, and addressing issues relating to inequity (Rogers, 2004; Short, 2019). In literature, this may translate to who has access, who does not have access, what is accessible, which voices are heard, which stories are told, and which voices are silenced (Short, 2019). In critical content analysis, the focus is on deconstruction (i.e., critically examining issues relating to stereotypes and misrepresentations) and reconstruction (i.e., recognizing counternarratives, challenging stereotypes through narratives; Freire, 1970; Short, 2019). Children's literature has particularly benefited from critical content analysis (Reynolds, 2011; Short 2019), as it acknowledges that "all literature is a cultural and historical product, revealing how power relations of class, race, and gender work together in text and image in society" (Botelho & Rudman, 2009, as cited in Short, 2019, p. 153). As such, literature is never neutral; rather, books are representative of hegemonic beliefs regarding people and their varying socially constructed identities.

I utilized critical content analysis to deconstruct racial and gendered stereotypes and reconstruct through the identification of narratives that challenge dominant ideology about women and girl protagonists of color who participate in STEM. This was done by examining the illustrations and text within each book, whereby each book was considered one unit of analysis and every girl and woman protagonist of color was considered another unit of analysis. For example, if one book consisted of 30 pages, all pages were

examined. Should all 30 pages within the book contain illustrations and text, both the illustrations and texts were included within the analysis to examine the portrayal of the characters within each book. Likewise, if the 30-page book had one main character, the text and illustrations about the main character were included within the analysis.

Specifically for this study, I examined main characters within the stories about women or girls of color. To analyze the text, I used Pérez Huber et al.'s (2020) framework of critical race content analysis, combining the tenets of CRT with elements of critical content analyses to examine race, gender, class, and other intersectionalities about characters of color in children's literature.

In referencing Pérez Huber et al.'s (2020) framework, I used their analytical questions for the purposes of my study (Table 1). Because my dissertation focused only on protagonist girls and women of color, thereby making them central to the story, I removed the question "What roles do Characters of Color play (i.e., central, tangential, hierarchical)?" (Pérez Huber et al., 2020, p. 5).

As my study focused explicitly on protagonist girls and women of color in STEM (as operationalized by makeup foundation shades) but did not identify the ethnic groups of the protagonists, I did not examine cultural authenticity. Thus, I adapted the question "How are the realities and/or experiences of people of color represented, or not (cultural authenticity vs. generalizations, simplifications)?" to "How are the realities and/or experiences of girls and women of color in STEM represented, or not?"

In summary, to answer the research question of how women and girl protagonists of color are portrayed participating in STEM in children's picture storybooks intended for grades K-3, I examined the illustrations and texts as follows:

1. Book illustrations, where the book was the unit of analysis.
2. Protagonists' illustrations, where the protagonist was the unit of analysis.
3. Protagonists' texts, where the protagonist was the unit of analysis.
4. Questions from the adapted elements of critical race content analysis, where the book was the unit of analysis.

Table 1*Adapted Elements of a Critical Race Content Analysis*

Tenets of CRT in education	Elements of a critical content analysis	Critical race content analysis	Analytical question prompts
The centrality of race and racism and their intersectionality with other forms of subordination	A critical examination and critique of how power and agency operate within a text.	Centralizes racism and intersecting forms of oppression in the storylines of books about people of color	What identities or characteristics are assigned to girls and women of color by race, class, gender, immigration status, language, etc.? In what ways does the story become raced, or not?
The challenge to dominant ideology	To uncover and challenge how texts reflect dominant ideologies that sustain social inequities.	Uncovers ideologies of White supremacy that underlie racist storylines and literacy practices.	What are the dominant ideologies and how do they operate (e.g., White supremacy, patriarchy, cultural deficits, other forms of power)?
The centrality of experiential knowledge	Significance of human experience in words and images. Texts are reflections of lived realities.	Centralizes culturally authentic experiences of people of color in texts/ images.	How are the realities and/or experiences of girls and women of color in STEM represented, or not?
The interdisciplinary perspective	Consideration of historical, social, cultural, political, and	Use of interdisciplinary knowledge to consider the socio-historical, cultural,	Is there a context to situate race and/or its intersections (historical, political, social,

Tenets of CRT in education	Elements of a critical content analysis	Critical race content analysis	Analytical question prompts
	economic contexts of the text	political, and economic contexts of the text.	geographic, temporal, etc.), or not?
The commitment to social justice	Concerned with locating power in order to challenge and transform inequity.	Committed to social justice by challenging and transforming inequity in stories for children.	How is focalization of the story constructed? How does power operate within the narrative devices of the story (i.e., vantage point, story closure, assumptions)? Who has power? Who has agency? What are the dominant ideologies/deficit perspectives and how are they challenged? How does resistance emerge?

Note. CRT = critical race theory; STEM = science, technology, engineering, and math. Adapted from “Theorizing a Critical Race Content Analysis for Children’s Literature About People of Color” by L. Pérez Huber, L. Camargo Gonzalez, and D. G. Solórzano, 2020, *Urban Education*, 0042085920963713.

Data Collection

Using underpinnings from Farland-Smith et al. (2017) and Kelly (2018), I identified books using convenience sampling by referencing STEM-related professional associations. As Farland-Smith et al. and Kelly specifically referenced books from the Outstanding Science Trade Books (OST) for Students K-12 list, developed by the NSTA, I did the same. Additionally, I referenced the Best STEM Booklist (BTB), as it is a collaborative project with the National Science Teachers Association, the American Society for Engineering Education, the International Technology and Engineering Educators Association, the Society of Elementary Presidential Awardees, and the Children's Book Council (CBC). To check the reliability of my book search on professional associations, I also referenced parent and teacher blogs that identified children's multicultural STEM picture books (Colours of Us, 2017; Teaching Books, 2021). My selection criteria consisted of the following:

- Published 2016-2020
- STEM-related
- Intended for grades K-3
- Picture books
- Girls or women of color illustrated in the foreground on the front cover of the book

The selection criteria led to a total of 26 children's picture books to examine, which are listed in Table 2. Of the 26 books, two were identified from the Colours of Us

list, 19 were identified from the OST list, and four were identified from the BTB. It is of note that many of the books appeared on more than one book list.

Table 2

Books Identified for Study

Books identified for study
Ahmed, R. (2018). <i>Mae among the stars</i> (S. Burrington, Illus.). Harper.
Arnold, M. D. (2018). <i>Galápagos girl/Galapagueña</i> (A., Dominguez, Illus.). Children's Book Press.
Averbeck, J. (2018). <i>Two problems for Sophia</i> (Y. Ismail, Illus.). Margaret K. McElderry Books.
Beaty, A. (2016). <i>Ada Twist, scientist</i> (D. Roberts, Illus.). Abrams Books for Young Readers.
Becker, H. (2018). <i>Counting on Katherine: How Katherine Johnson saved Apollo 13</i> (D. Phumiruk, Illus.). Christy Ottaviano Books.
Derting, K., & Johannes, S. R. (2019a). <i>Cece loves science</i> (V. Harrison, Illus.). Greenwillow Books.
Derting, K., & Johannes, S. R. (2019b). <i>Cece loves science and adventure</i> (V. Harrison, Illus.). Greenwillow Books.
Derting, K., & Johannes, S. R. (2020a). <i>Cece loves science: Push and pull</i> (V. Harrison, Illus.). Greenwillow Books.
Derting, K., & Johannes, S. R. (2020b). <i>Libby loves science</i> (J. Murray, Illus.). Greenwillow Books.
Funk, J. (2018). <i>How to code a sandcastle</i> (S. Palacios, Illus.). Viking.
Funk, J. (2019). <i>How to code a rollercoaster</i> (S. Palacios, Illus.). Viking.
Harvey, J. W. (2017). <i>Maya Lin: Artist-architect of light and lines</i> (D. Phumiruk, Illus.). Christy Ottaviano Books.
Jones, P. (2017). <i>Izzy Gizmo</i> (S. Ogilvie, Illus.). Simon and Schuster.
Keating, J. (2017). <i>Shark lady: The true story of how Eugenie Clark became the ocean's most fearless scientist</i> (M. Á. Miguéns, Illus.). Sourcebooks Jabberwocky.
Lecocq, M., & Archambault, N. (2018). <i>Rox's secret code</i> (J. V. Innerebner, Illus.). POW!
Maier, B. (2018). <i>The little red fort</i> (S. Sánchez, Illus.). Scholastic Press.
Mosca, J. F. (2018). <i>The girl with a mind for math: The story of Raye Montague</i> (D. Rieley, Illus.). The Innovation Press.
Mosca, J. F. (2017). <i>The doctor with an eye for eyes: The story of Dr. Patricia Bath</i> (D. Rieley, Illus.). The Innovation Press.

Books identified for study

- Persico, Z. (2019). *Georgia's terrific, colorific experiment* (Z. Persico, Illus.). Running Press Kids.
- Shetterly, M. L., & Conkling, W. (2018). *Hidden figures: The true story of four Black women and the space race* (L. Freeman, Illus.). Harper.
- Shipp, B. N. (2016). *The meteorologist in me* (R. Boyer, Illus.). The Power of Love Books.
- Simon, A. (2018) *Abby invents unbreakable crayons* (D. Necsulescu, Illus.). Abby Invents.
- Slade, S. (2019). *A computer called Katherine: How Katherine Johnson helped put America on the moon* (V. M. Jamison, Illus.). Little, Brown and Company.
- Smith, K. (2020). *Boxitects* (K. Smith, Illus.). Clarion Books.
- Spires, A. (2019). *Fairy science* (A. Spires, Illus.). Random House Children's Books.
- Winter, J. (2017). *The world is not a rectangle: A portrait of architect Zaha Hadid* (J. Winter, Illus.). Beach Lane Books.
-

Operationalizing Terms

Picture Books. Picture books are books in which illustrations are collectively integral to telling the story (Kümmerling-Meibauer et al., 2015). Specifically, illustrations within picture books can function as a mirror rendition of the text, to elaborate upon the text, or as a form of storytelling that does not have text (i.e., wordless picture books; Kümmerling-Meibauer et al., 2015; Lynch-Brown & Tomlinson, 1999). As such, picture books generally have illustrations on every page of the story, are typically 32 pages in length, and may appear in various fiction or nonfiction genres (Creany, 1993). For this reason, chapter books and graphic novels were delimited from this study.

There are several types of picture books (e.g., concept books, wordless books, and picture storybooks; Lynch-Brown & Tomlinson, 1999). Concept books are used to explain a particular idea. Examples of concept books are alphabet and counting books, which explain ideas to readers (Lynch-Brown & Tomlinson, 1999). As the name states,

wordless picture books are meant to tell a story exclusively through illustrations, with no accompanying text (Lynch-Brown & Tomlinson, 1999). Lastly, picture storybooks are books in which texts and illustrations appear with equal frequency, and both share an equal role in telling the story (Lynch-Brown & Tomlinson, 1999). Instead of addressing a particular idea, as concept books do, the purpose of a picture storybook is to tell a story. Picture storybooks are frequently used as read-alouds by teachers and parents during the early stages of children's literacy development (Caswell & Duke, 1998; Creany, 1993; Lynch-Brown & Tomlinson, 1999). For the purposes of this study, I analyzed picture storybooks, as relational meaning may be derived from a combination of the images and text.

STEM Picture Storybooks. The purpose of this study was to examine how women and girl protagonists of color were described in children's literature when participating in STEM. As such, picture storybooks that contained all five story components (character, setting, plot, conflict, resolution) with a character engaging in science, technology, engineering, or mathematics activities were selected.

Intended Audience. Although there are picture books with adults as the primary audience, picture books are typically intended for primary-age youth. I referenced Lynch-Brown and Tomlinson's (1999) definition of primary age youth, identifying books intended for audiences ages 5–8 (i.e., kindergarten to third grade). I derived information regarding the intended audience from the book details supplied by the publishers.

Publication Year. Farland-Smith et al. (2017) and Kelly (2018) are the most recent studies that have examined STEM representation in children's literature. Kelly

examined books published in 2016, and Farland-Smith et al. focused on children's literature from 2014–2016. My study sought to expand upon both studies by analyzing children's literature published from 2016–2020. Although Farland-Smith et al. and Kelly suggested that STEM-related children's literature lacks diversity, neither study explored how characters of color are described when participating in STEM, as I did in this study.

Protagonists of Color. Kelly (2018) stated,

Recording race proved highly problematic with many photographs and illustrations not clearly suggesting the scientist's racial background. With scholars acknowledging race as a fluid social construct rather than a biological reality, many have questioned its use as an analytical tool. This project bore out the difficulties of employing race as a lens to classify pictures and illustrations, but I suggest it was still a worthwhile consideration because school children make quick judgments about whether the people in their schoolbooks are like them or not. (p. 1196)

People of color are defined as individuals who have historically been marginalized within their society. Recognizing the complexity of categorizing books based on race, I used foundation shades from the makeup brand Pür (Figure 5) to operationalize protagonists of color for my study. Protagonists (i.e., identified in the foreground of the book cover) whose complexions fell within the “Light” or “Medium” category of the foundation shades were delimited from this study. Protagonists whose complexions fell within the “Dark” or “Deep” categories were immediately added to the study. Protagonists whose complexions fell within the “Tan” category required the following additional steps to

determine the racial/ethnic background: (a) reviewing the synopsis of the book to determine if the author clearly identified the racial/ethnic background of the protagonist; (b) if the information was not in the synopsis and the book was based on a true story, research the individual whose life the story was based on to determine their race/ethnicity; (c) if the information was not in the synopsis and the protagonist was fictional, reference the CCBC (2018) book search, which contained “diversity subjects” that could be used to help determine the ethnicity of the protagonist. Table 2 provides an overview of books added to the study whose main characters did not fall under the “Dark” or “Deep” categories of the foundation shades. Supporting characters (e.g., characters illustrated in the background of a story) were delimited from the analysis.

Gender. As this study was particularly examining women and girls of color, I identified the protagonists’ gender by the pronouns she/her/hers. Books whose synopsis referred to the story’s protagonist (e.g., the character illustrated in the foreground of the book cover) as a woman or girl were included in the study. Supporting characters (e.g., characters illustrated in the background of a story) were delimited from the analysis.

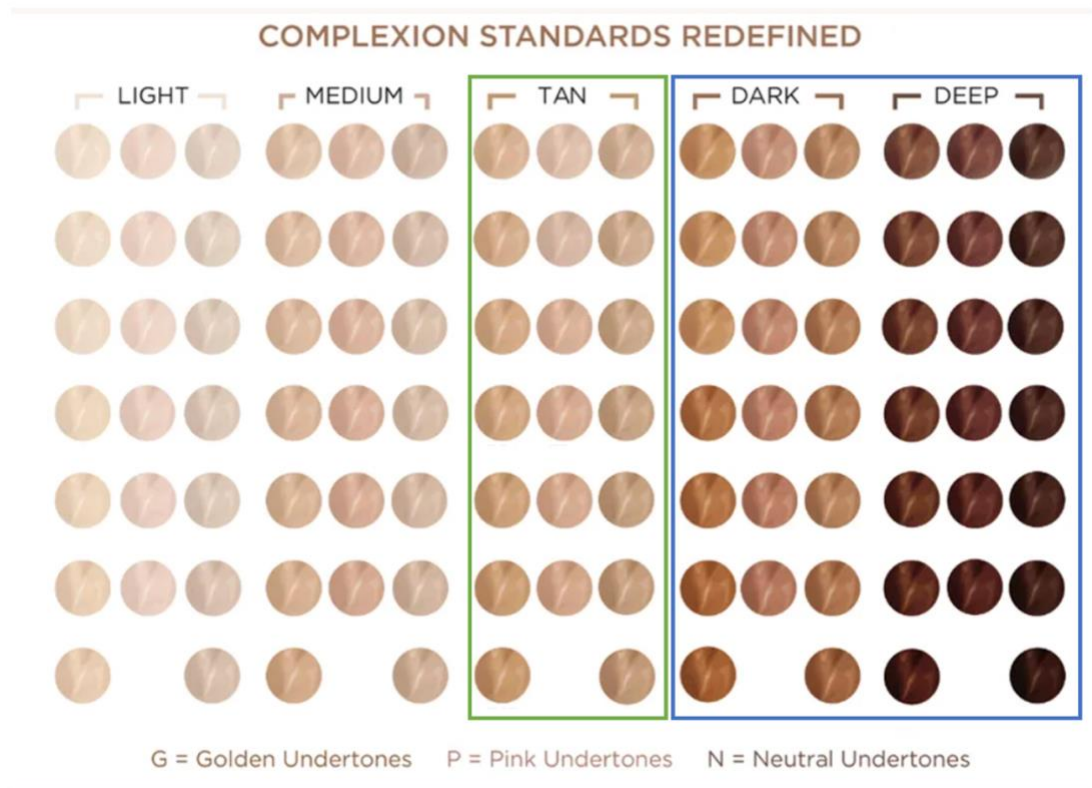


Figure 5. Categories of skin complexions. From “Pür’s Love Your Selfie Foundation-Concealer Hybrid Comes in 100 Shades: The Foundation Shade Gauntlet Has Been Thrown” (Pür, Illus.), by K. Hoshikawa, 2019, *Allure*, <https://www.allure.com/story/pur-love-your-selfie-foundation-100-shades>. Copyright 2022 by Pür.

Table 3*Ethnic Validation Check of Children's Picture Books*

Book	Race/ethnicity of main character	Validation check
Keating, J. (2017). <i>Shark lady: The true story of how Eugenie Clark became the ocean's most fearless scientist</i> (M. Á. Miguéns, Illus.). Sourcebooks Jabberwocky.	Japanese-American	Based on a true story (National Oceanic and Atmospheric Administration, 2015)
Harvey, J. W. (2017). <i>Maya Lin: Artist-architect of light and lines</i> (D. Phumiruk, Illus.). Christy Ottaviano Books.	Chinese-American	Based on a true story (Public Affairs Television, 2003)
Arnold, M. D. (2018). <i>Galápagos girl/Galapagueña</i> (A., Dominguez, Illus.). Children's Book Press.	Galapagueña	Book synopsis
Maier, B. (2018). <i>The little red fort</i> (S. Sánchez, Illus.). Scholastic Press.	Latina	CCBC (2018)
Winter, J. (2017). <i>The world is not a rectangle: A portrait of architect Zaha Hadid</i> . Beach Lane Books.	British-Iraqi	Based on a true story (Zukowsky, n.d.)

Coding

I used two units of analysis to code: protagonists and books. Using an Excel workbook, I examined four areas within these two units of analysis. The first three were (a) protagonists' bodily illustrations, (b) protagonist descriptors in text, and (c) books' illustration of protagonists' environment and interactions. The fourth area was referred to as books using analytical question prompts; it combined text and illustrations to understand how the books reflected Huber-Pérez's (2020) framework for critical race

content analysis. I divided the Excel book into four sheets based on the aforementioned areas. For internal validity and reliability purposes, I investigated the four identified areas separately per book. For example, using protagonists as the unit of analysis, I coded the illustrations of all 26 books, and only after coding all 26 books did I code the text using protagonists as the unit of analysis. Tracking the book titles and page numbers were additional ways in which I ensured internal validity and reliability.

Unit of Analysis: Protagonist

Protagonists' Bodily Illustrations. I examined the illustrations and used short phrases or words to describe the protagonists' hair textures (i.e., straight, curly, wavy, coiled), hairstyles (i.e., Afro puffs, hair loosely hanging, pigtail/ponytail, braids), skin complexion (i.e., tan, dark, deep), and age (i.e., adult or youth). Data were organized within an Excel sheet with the following columns: book title, page number, protagonist's name, age, hair texture, hairstyle, and skin complexion.

Protagonist Descriptors in Text. To adequately answer how girls and women of color participating in STEM were described in text, I used "characterization (i.e., gender, ethnicity, physical description, personality, status, motivation, change/transformation)," a form of interpretive narrative subcoding (Saldaña, 2016, p. 158). Data were gathered by compiling quotes relating to protagonists' characterization. For example, the quotes from Winter (2017) "dreams of designing her own cities" (p. 5) and "I can't stop thinking" (p. 32) were pulled from the text and assigned the subcode "dreamers," as in both cases the protagonist was portrayed dreaming about various possibilities. Data were organized

within an Excel sheet with columns listed as follows: book title, page number, and quotes. I assigned a color to each code and color-coded the quotes.

Unit of Analysis: Book

Books' Illustration of Protagonists' Environment and Interactions.

Interpretive narrative coding was used to examine illustrations, where the book was the unit of analysis (Saldaña, 2016). To examine the illustrations, I added descriptions of the illustrations into Excel. For example, I described illustrations from Beaty (2016) as “protagonist of deep complexion frowning at toys with back turned away from other characters of deep complexion who are frowning towards protagonist from a separate page.” I then coded the description as “division,” as there was a physical division (i.e., other characters were on a separate page from the protagonist) and a metaphorical division where the protagonist was portrayed as focusing only on the toys in front of her, mentally in a separate place from other characters. Here, data were also organized within an Excel sheet with the following columns: book title, page number, and quotes. I assigned a color to each code and color-coded the quotes.

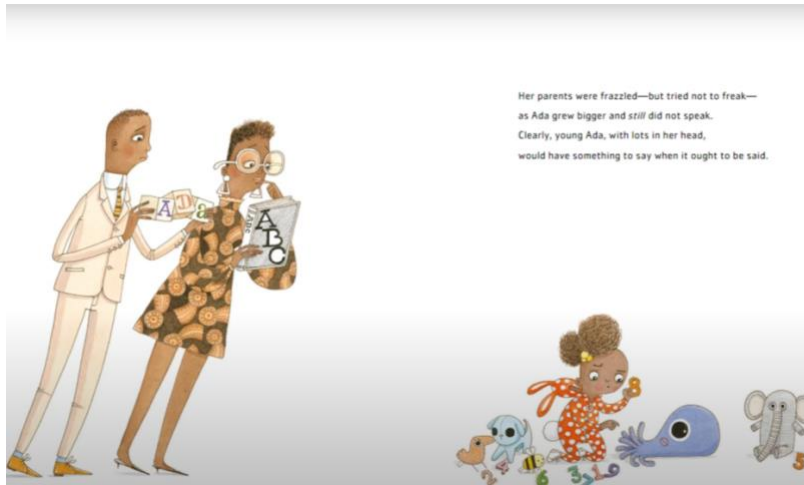


Figure 6. Illustration from Beaty, 2016. From *Ada Twist, Scientist* (D. Roberts, Illus.; pp. 3-4), by A. Beaty, 2016, Abrams Books for Young Readers. Copyright 2016 by D. Roberts.

Adapted Pérez Huber et al.’s (2020) Analytical Question Prompts. Although descriptive and narrative coding enabled me to examine the books’ content, using adapted analytical question prompts helped me to incorporate a critical race lens to examine stereotypes of women and girls of color as well as identify counternarratives. Therefore, in this fourth area of the units of analysis, I used adapted analytical question prompts from Pérez Huber et al.’s (2020) Elements of a Critical Race Analysis chart (see Table 1). I answered the question prompts for each book deducing from a collection of texts and illustrations. In the fourth sheet of the Excel book, in addition to adding a column for the book title, columns were created corresponding to these questions:

- “Is there a context to situate race and/or its intersections (historical, political, social, geographic, temporal, etc.), or not?”

- “How does power operate within the narrative devices of the story (i.e., vantage point, story closure, assumptions)?”
- “Who has power?”
- “Who has agency?”
- “What are the dominant ideologies/deficit perspectives and how are they challenged?”
- “How does resistance emerge?”

After adding the information in the aforementioned columns, I identified patterns by assigning color to the text. For example, under the “Who has power” column, each time I noticed a character of light complexion was in a position of power, I colored the text orange. Additional questions from Pérez Huber et al.’s (2020) Elements of a Critical Race Analysis chart were not included, as answers to the questions were derived from analyzing protagonists’ text and book illustrations.

Formation of Themes

A total of seven codes emerged from the data as identified by their frequency of occurrence. Table 4 provides a breakdown of the codes that led to the formation of three out of four themes (outcast, brilliance, and resistance). Codes were created by identifying reoccurring patterns within the data. The number in parentheses beside each code in Table 4 represents the number of occurrences of that code within the data. Theme “brings meaning and identity to a recurrent experience and its variant manifestations. As such, a theme captures and unifies the nature or basis of the experience into a meaningful whole” (DeSantis & Ugarriza, 2000, as cited in Saldaña, 2016, p. 199). Thus, to create the

themes, I looked for patterns related to protagonists' identity and experiences in STEM. The codes "division," "alone," and "ridiculed/misunderstood" were all in reference to the way protagonists were shown to be at the fringes of society and therefore related to protagonists' role of outcast. "Dreamers/curious," "smart/creative," and "sharing of knowledge or resources" were all related to protagonists' exceptionality and the contributions they made to their community, thus leading to the formation of the theme "brilliance." The code "patience/perseverance" was related to the way in which resistance emerged, if at all. The fourth theme not shown within Table 4, the monolithic view of protagonists' experiences, was derived from an overview of the statistical analyses, which will be described in detail in Chapter 4.

Table 4

Emergence of Themes from Codes

	Themes		
	Outcast	Brilliance	Resistance
Codes	Division (65)	Dreamers/curious (28)	Patience/perseverance (17)
	Alone (72)	Smart/creative (28)	
	Ridiculed/misunderstood (19)	Sharing of knowledge or resource (13)	

Chapter Four

To answer the research question “How are protagonists who are girls and women of color portrayed participating in STEM in children’s picture storybooks intended for grades K–3?” I provide descriptive analyses and identify themes that emerged from data gathered from books published in 2016–2020. The descriptive analyses provide an overview of data gathered from protagonists’ illustrations and text. Thematic analysis was used to identify patterns that emerged across the 26 picture storybooks, using a collection of illustrations and texts.

Prior to explaining themes, Chapter 4 begins with statistical analyses that include an overview of the protagonists’ skin complexions, hair textures, hairstyles, ages, and types of STEM interaction (i.e., alone or collaborative), and an analysis of who the characters were. In essence, I use descriptive analyses to determine how protagonists who were girls and women of color were portrayed to look and participate in STEM by examining the protagonists’ physical appearance and the nature of their participation in STEM.

Descriptive Analyses

Protagonists’ Complexions

While there was some diversity of complexions in the chosen books, the categories of complexion were not evenly distributed. As shown in Figure 7, of the 26 books featuring girls and women of color as the protagonist(s) participating in STEM, 43%, 37%, and 20% were of deep, dark, and tan complexion respectively.

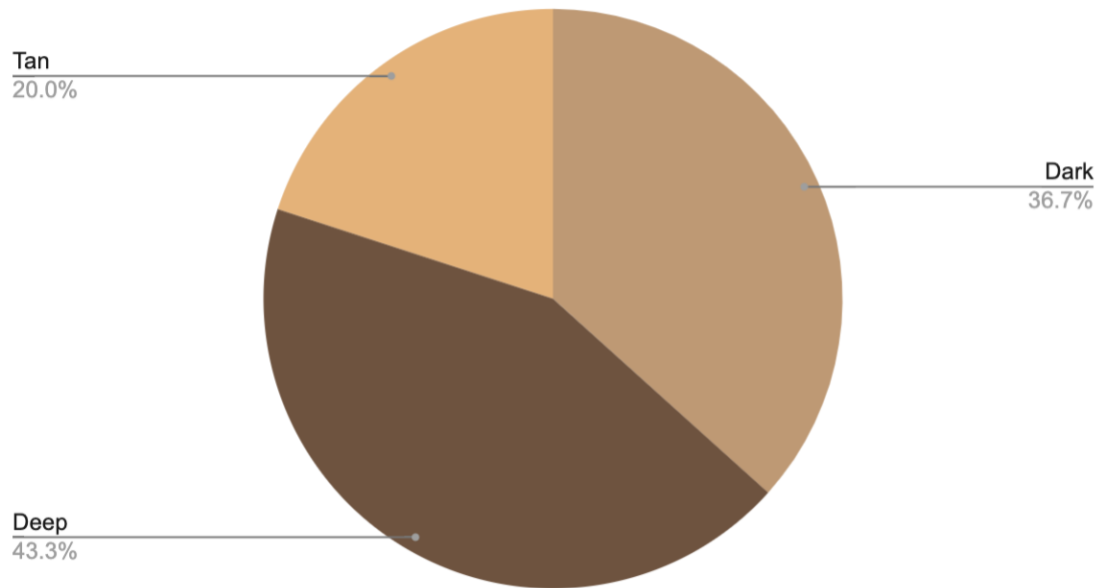


Figure 7. Percentages of protagonists' complexions.

Protagonists' Hair Textures

Hair textures were defined by referring to Figure 8, a texture chart created by L'Oréal, a French cosmetics company. Because coiled, curly, and wavy hair textures were difficult to differentiate within the illustrations, I created two categories by grouping coiled, curly, and wavy together and keeping straight hair as a separate group.

Figure 9 shows the percentages of protagonists' hair textures illustrated across the 26 picture storybooks. Findings show 90% of the protagonists had curly, coiled, or wavy hair, while 10% had straight hair.

I also examined the connection between skin complexions and hair textures. Findings indicate the protagonists' complexions varied, with protagonists of deep, tan,

and dark complexion having curly, coiled, or wavy hair, while only protagonists of tan complexion had straight hair (i.e., no protagonists of deep or dark complexion were portrayed with straight hair).



Figure 8. Categorization of hair textures. From “Texture Chart: How to Figure out Your Natural Hair Type” by J. A. Rosa, n.d., Hair.com by L’Oreal, <https://www.hair.com/types-of-natural-hair.html>.

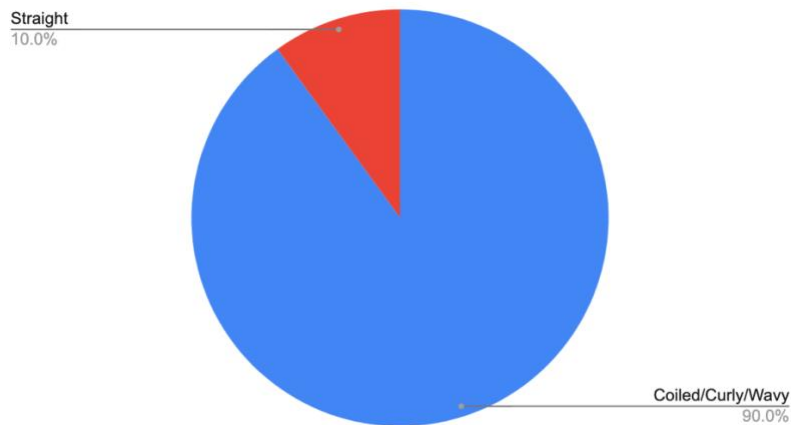


Figure 9. Percentages of protagonists' hair textures.

Protagonists' Hairstyles

In the books examined within this study, only four types of hairstyles emerged: Afro puffs, braids, pigtail/ponytail, and hair loosely hanging, examples of which are illustrated within Figure 10. As indicated by the pie chart (Figure 11), more than half of the protagonists (53%) were illustrated with their hair loosely hanging; 23%, 20%, and 3% were portrayed with their hair styled in Afro puffs, pigtails/ponytails, and braids respectively. Skin complexions varied for characters whose hair was styled as pigtail/ponytail or hair loosely hanging. However, only one protagonist, a character of deep complexion, was portrayed to have braids. Similarly, only protagonists of deep complexion and one protagonist of dark complexion were illustrated with Afro puffs.

Examples of Protagonists' Hairstyles			
Braids		Pigtail/ponytail	
 <i>Libby Loves Science</i>		 <i>The Girl with a Mind for Math: The Story of Raye Montague</i>	 <i>Fairy Science</i>
Afro puffs		Hair loosely hanging	
 <i>Two Problems for Sophia</i>	 <i>Izzy Gizmo</i>	 <i>Galápagos Girl/Galapagueña</i>	

Figure 10. Examples of protagonists' hairstyles. From *Libby Loves Science* (J. Murray, Illus.; cover), by K. Derting and S. R. Johannes, 2020, Greenwillow Books, copyright 2020 by J. Murray; *The Girl with a Mind for Math: The Story of Raye Montague* (D. Rieley, Illus.; cover), by J. F. Mosca, 2018, The Innovation Press, copyright 2018 by The Innovation Press; *Fairy Science* (A. Spires, Illus.; cover), by A. Spires, 2019, Random House Children's Books. Copyright 2019 by A. Spires; *Two Problems for Sophia* (Y. Ismail, Illus.; p. 2), by J. Averbeck, 2018, Margaret K. McElderry Books, copyright 2018 by Y. Ismail; *Izzy Gizmo* (S. Ogilvie, Illus.; cover), by P. Jones, 2017, Simon and Schuster, copyright 2017 by S. Ogilvie; *Galápagos Girl/Galapagueña* (A., Dominguez, Illus.; cover), by M. D. Arnold, 2018, Children's Book Press, copyright by A., Dominguez.

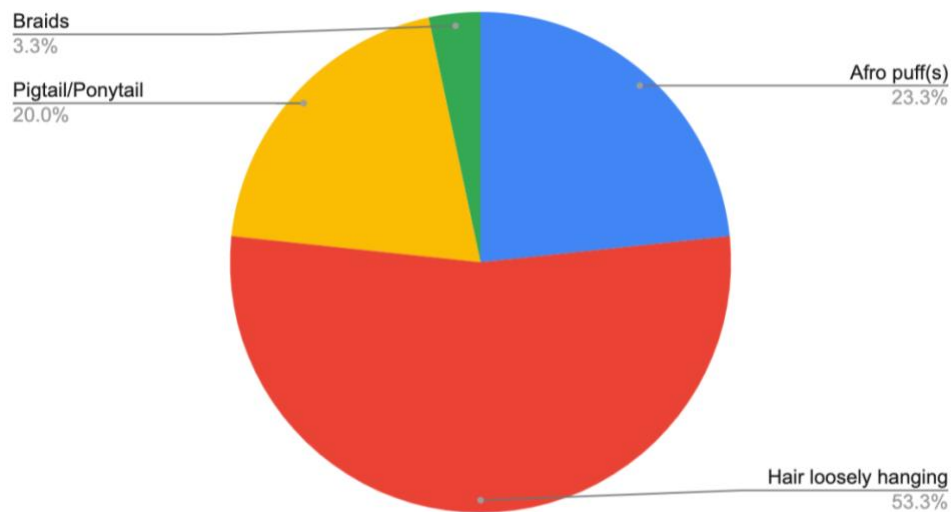


Figure 11. Percentages of protagonists' hairstyles.

Protagonists' STEM Interactions (Alone or Collaborative)

Of the 26 books used within this study, 85% contained multiple instances of women and girl protagonists of color participating in STEM alone (see Figure 12). Specifically, a total of 82 instances of protagonists participating in STEM alone were identified. Examples of protagonists participating in STEM alone included solving mathematical problems, reading or studying STEM books, drawing a design, or developing code for a computer (Becker, 2018; Keating, 2017; Lecocq & Archambault, 2018; Palacios, 2018; Shetterly & Conkling, 2018; Slade, 2019; Winter, 2017). In contrast, only 15% of books within the study contained instances of the protagonists participating in STEM collaboratively. One or two instances of protagonists participating in STEM collaboratively with others were not included because these instances did not reflect the pattern that emerged within the book. For example, when a protagonist spent

the majority of the book working alone but worked collaboratively with the other characters within the last few pages of the book, I categorized the STEM interaction of this protagonist as predominantly alone. Instances of the protagonists working collaboratively included exploring nature with friends and participating in science projects with classmates (Derting & Johannes, 2019a, 2019b, 2020a, 2020b).

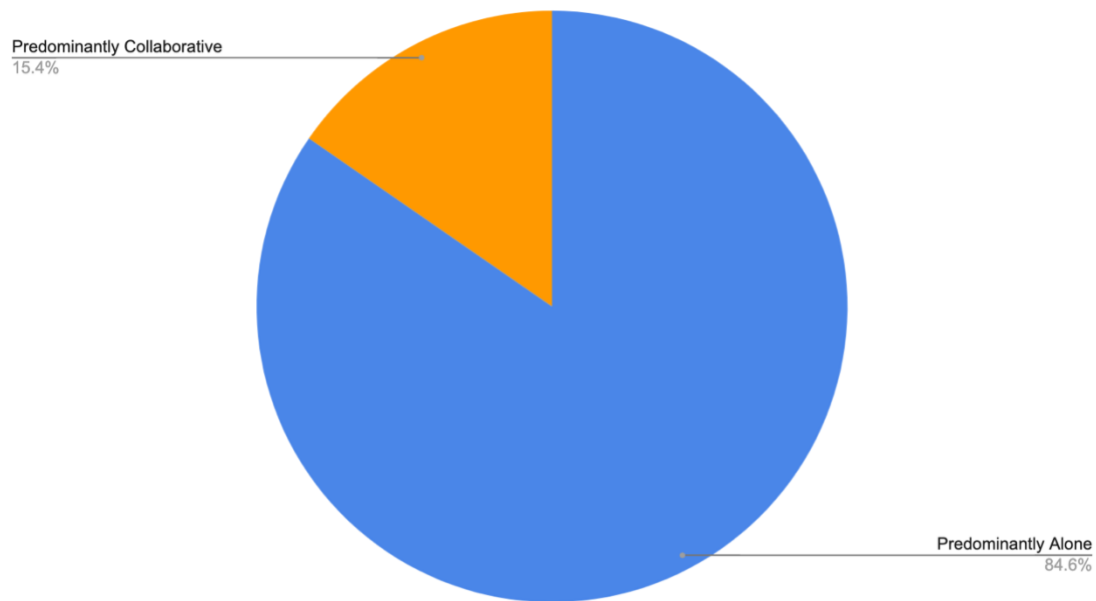


Figure 12. Percentages of protagonists' STEM interactions (alone or collaborative).

Protagonists' Ages

Although the exact ages of the protagonists could not be determined from the picture storybooks, evidence suggested that 35% (see Figure 13) of the protagonists participated in STEM through a career (e.g., architect, engineer, physician, and scientist)

and were therefore adults, while 65% of the books only portrayed the protagonists participating in STEM as youth (i.e., the stories did not include instances of the youth growing into adults). Of the 35% that portrayed the protagonists participating in STEM as adults, all were based on true stories, specifics of which will be discussed in the Historical Figures section.

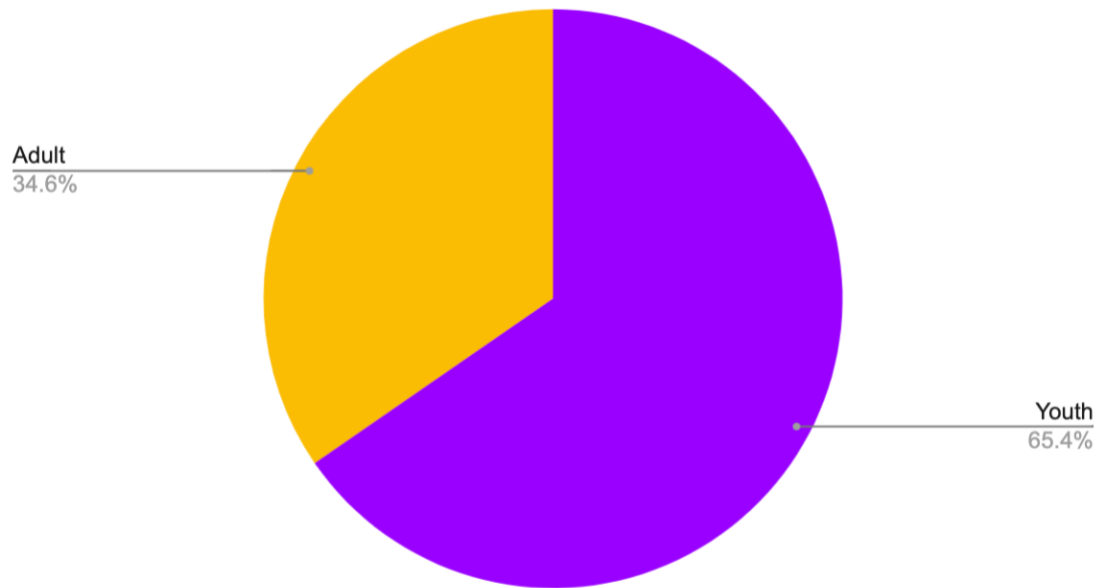


Figure 13. Percentages of protagonists' ages.

Historical Figures

Of the 26 books used in this study, eight were based on the lived experiences of women of color born in the United States as early as 1910 and as late as 1959. Two books were based on the lives of women born outside the United States: (a) Zaha Hadid, a

woman of color born in 1950 in Iran who later immigrated to Great Britain (Winter, 2017), and (b) Valentina Cruz, a woman of color born in 1971 in Floreana, a Galápagos Island (Arnold, 2018). Table 5 provides a list of these books and the corresponding people in history portrayed.

Table 5

Historical Figures Identified

Book title	Historical person and occupation
Ahmed, R. (2018). <i>Mae among the stars</i> (S. Burrington, Illus.). Harper.	Mae Jamison (engineer, physician, astronaut)
Arnold, M. D. (2018). <i>Galápagos girl/Galapagueña</i> (A. Dominguez, Illus.). Children's Book Press.	Valentina Cruz (biologist, naturalist guide)
Becker, H. (2018). <i>Counting on Katherine: How Katherine Johnson saved Apollo 13</i> (D. Phumiruk, Illus.). Christy Ottaviano Books.	Katherine Johnson (mathematician)
Harvey, J. W. (2017). <i>Maya Lin: Artist-architect of light and lines</i> (D. Phumiruk, Illus.). Christy Ottaviano Books.	Maya Lin (architect)
Keating, J. (2017). <i>Shark lady: The true story of how Eugenie Clark became the ocean's most fearless scientist</i> (M. Á. Miguéns, Illus.). Sourcebooks Jabberwocky.	Eugenie Clark (ichthyologist)

Book title	Historical person and occupation
Mosca, J. F. (2018). <i>The girl with a mind for math: The story of Raye Montague</i> (D. Rieley, Illus.). The Innovation Press.	Raye Montague (engineer)
Mosca, J. F. (2017). <i>The doctor with an eye for eyes: The story of Dr. Patricia Bath</i> (D. Rieley, Illus.). The Innovation Press.	Patricia Bath (optometrist)
Shetterly, M. L., & Conkling, W. (2018). <i>Hidden figures: The true story of four Black women and the space race</i> (F. Freeman, Illus.). Harper.	Katherine Johnson (mathematician), Dorothy Vaughan (mathematician), Mary Jackson (engineer), Christine Darden (mechanical engineer)
Slade, S. (2019). <i>A computer called Katherine: How Katherine Johnson helped put America on the moon</i> (V. M. Jamison, Illus.). Little, Brown and Company.	Katherine Johnson (mathematician)
Winter, J. (2017). <i>The world is not a rectangle: A portrait of architect Zaha Hadid</i> . Beach Lane Books.	Zaha Hadid (architect)

Power

Across the 26 books used, women and girl protagonists of color were portrayed as powerless 88% of the time. Using a combination of feminist and anti-racist scholars' work, I operationalized power as authority over resources or people (Johnson et al., 2000; Kloos et al., 2012; Rowlands, 1997). Within this study, I identified characters as having power based on their authority over the resources within the stories (e.g., knowledge and technology) and their authority over people (e.g., competition judges, parents, teachers,

supervisors). For example, teachers had authority over knowledge and their students, parents and guardians had authority over their dependents and the resources they provided, and one protagonist had control over technology (a robot). Only unique instances of protagonists and non-protagonists (other characters within the story who were not protagonists) with power were recorded. For example, if a family member was shown within the book multiple times, I only recorded the first unique instance; the other recurring instances were not recorded.

There were only three unique instances of the protagonists having power. Two of the instances appeared in books written by the same author about a girl using her robot to code (Funk, 2018, 2019): she had power over her robot, which was used to process various codes. The third unique instance where a protagonist had power was in Maier's (2018) book, where the protagonist built a treehouse and used her power to refuse her brothers' entry until they contributed in some way.

As shown in Figure 14, in comparison to non-protagonists of light complexion, non-protagonists of color were rarely shown to be in positions of power outside the family household. Data in Figure 14 indicate that non-protagonists of light complexion were often portrayed as having power in society, as identified by their authority over laws and policies that governed people (i.e., government/institution), authority over students within classrooms (i.e., teachers), and authority over people within the workplace (i.e., supervisor). The category "other" was used to address additional instances of power, such as competition judges and characters the protagonists went to for help (i.e., tourists and veterinarians/doctors).

As shown in Figure 14, there were few depictions of characters of color in power outside the family household. Outside the household, non-protagonists of color were only portrayed as having authority over a classroom as teachers; there were no instances of non-protagonists of color having authority over laws that govern people or authority over colleagues in the workplace. Moreover, protagonists were only portrayed with power in their youth; there were no instances of women protagonists of color in power.

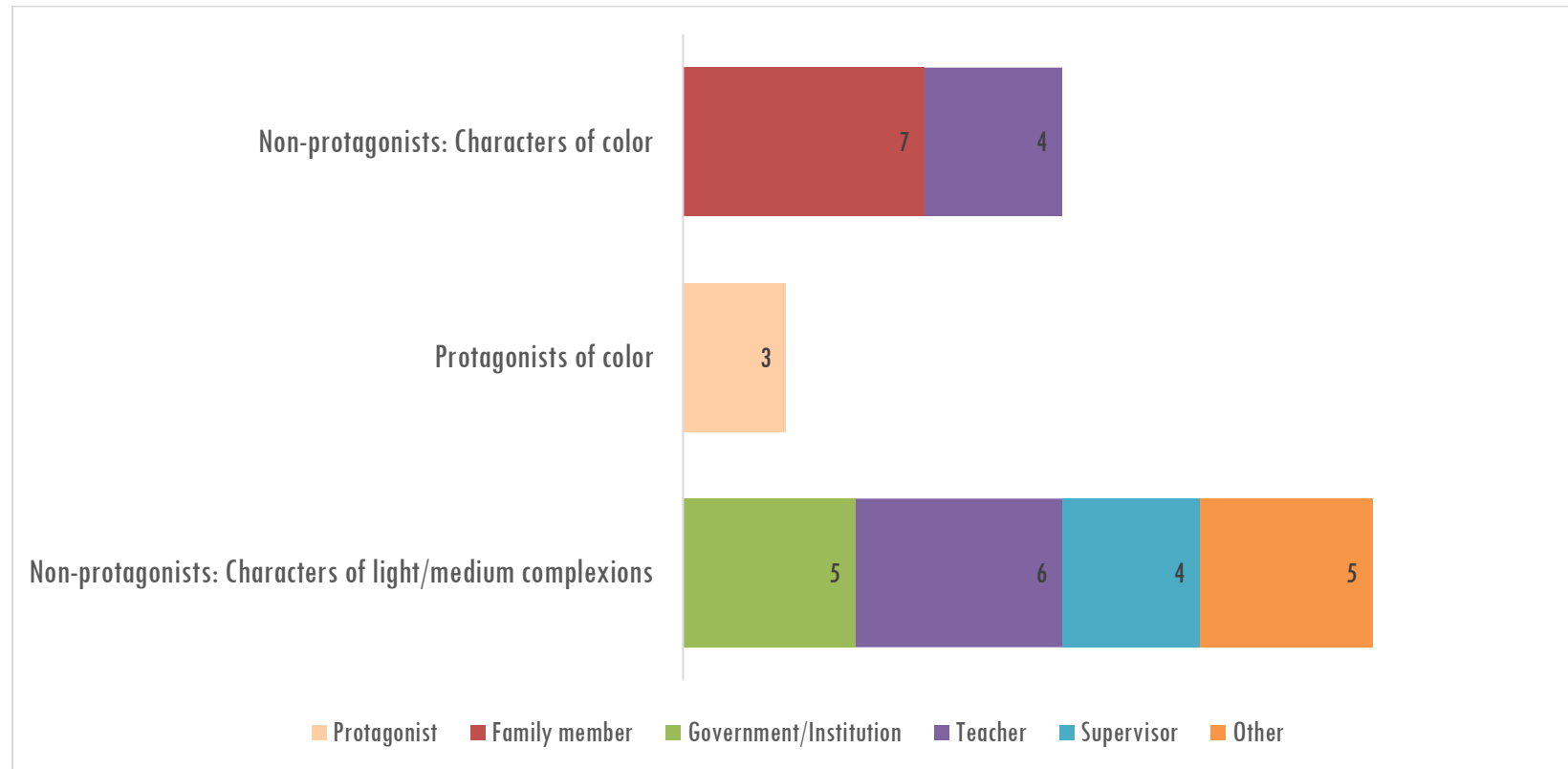


Figure 14. Skin complexions of protagonists and non-protagonists in power.

Summary of Descriptive Analyses

Overall, findings from the descriptive analyses of the 26 books revealed that while some diversity existed in protagonists' complexions, there was a lack of diversity regarding hair. Only protagonists of tan complexion were portrayed to have straight hair. Additionally, there was only one instance of a protagonist participating in STEM who wore her hair in braids. While most characters of deep complexion were shown to have Afro puffs, only one protagonist of dark complexion and no protagonists of tan complexion were illustrated with Afro puffs. The lack of diversity surrounding the representation of hairstyles fails to exemplify how symbolic hair is within various communities. Hair can act as a form of self-expression and can have spiritual and religious connotations associated with it as well (Johnson & Bankhead, 2014). Moreover, with the exception of afros, many other hairstyles involving a person of color's natural hair texture (e.g., braids, Bantu knots, twists, cornrows, and locs) may be banned in the workplace or schools (Powell, 2018). As such, the lack of diversity associated with hairstyles in children's literature risks perpetuating dominant ideologies related to what society deems as acceptable hair for girls and women of color participating in STEM.

The descriptive analyses also revealed that protagonists of color's experiences participating in STEM were portrayed through a limited view. The protagonists participating in STEM were predominantly alone and often portrayed as powerless. There were few instances of women and girl protagonists of color participating collaboratively, a skillset that has been identified as necessary in STEM fields (Jang, 2016). The portrayal of participating in STEM in isolation also contradicts collaborative learning, which has

been encouraged within classrooms to help foster the skills students need to be global contributors to society (Geisinger, 2016; Kennedy & Odell, 2014).

The protagonists' experiences participating in STEM were further examined by identifying themes in a collection of texts and illustrations.

Themes

In addition to using descriptive analyses to examine the portrayal of women and girl protagonists of color participating in STEM in children's picture storybooks, I identified four themes from the data. As picture storybooks use a combination of text and illustrations to narrate a tale, I found evidence of the identified themes in both text and illustrations. The four themes to be discussed in this section are as follows:

- *Outcasts.* Women and girl protagonists of color were frequently assigned the role of outcast, often portrayed working alone while being laughed at or misunderstood by those around them.
- *Spotlighted Brilliance.* Women and girl protagonists of color were often portrayed as brilliant individuals who had innovative ideas, were creative, and paved the way for others with their accomplishments.
- *Monolithic View of Characters' Experiences.* Women and girl protagonists of color participating in STEM were often portrayed as individuals who were native to their land (i.e., were not immigrants or born to immigrant families) and from families with resources who lived in rural or suburban locations.
- *Resistance.* Women and girl protagonists of color were frequently portrayed as resisting the dominant ideologies through their perseverance.

Outcast

There were a total of 156 instances of women and girl protagonists of color portrayed as outcasts within the stories, participating in STEM activities or careers alone while other characters collaborated with one another, excluding the protagonist of color.

As shown in excerpts by Ahmed (2018) and Slade (2019), at times the role of outcast stemmed from systematic oppression. Ahmed's book tells a rendition of the story of Mae Jamison, the first Black woman to become an astronaut in the United States. It reads,

“What do you want to be and what do you want to do when you grow up? Who wants to go first?”

“... I want to go to space.”

“I want to be an astronaut.”

All the kids started laughing.

Miss Bell asked, “Mae, are you sure you don't want to be a nurse? Nursing would be a good profession for someone like you.” (Ahmed, 2018, pp. 21–23)



Figure 15. Illustration from Ahmed, 2018. From *Mae Among the Stars* (S. Burrington, Illus.; pp. 21–22), by R. Ahmed, 2018, Harper. Copyright 2018 by R. Ahmed.

The protagonist in the story shares with the class that she would like to become an astronaut when she becomes an adult. However, as identified in the excerpt from Ahmed (2018), aspiring to become an astronaut was not in line with the role society deemed fit for a girl protagonist of color. The protagonist's role as an outcast is evidenced by the laughter from the students and the suggestion from the teacher to choose a different career, all of whom are characters of lighter complexion than she is, as seen in Figure 15. Moreover, the field the teacher suggests she aspire toward is nursing, which has historically been portrayed as an occupation for women (Cvencek et al., 2011; McLaughlin et al., 2010), whereas societal perception of an astronaut was not aligned with the image of the girl protagonist of color.

Similar to Ahmed (2018) is an excerpt from Slade (2019), which is based on the experiences of Katherine Johnson, a Black woman whose mathematical contributions led to the successful launch of Apollo 13. The excerpt states, “Then she discovered that women weren’t allowed to attend the group’s meetings” (Slade, 2019, p. 13).



Figure 16. Illustration from Slade, 2019. From *A Computer Called Katherine: How Katherine Johnson Helped Put America on the Moon* (V. M. Jamison, Illus.; pp. 13–14), by S. Slade, 2019, Little, Brown and Company. Copyright 2019 by V. M. Jamison.

As shown in the excerpt from Slade (2019), the protagonist participated in STEM via her career, yet her participation was limited due to the institutional laws and policies preventing her from attending a group meeting with colleagues, all characters of light complexion, as pictured in Figure 16. The division between the protagonist and the characters of light complexion is further iterated through the protagonist being drawn alone on one page, while the characters of light complexion are drawn in close proximity to one another on a separate page. As shown through the excerpts and illustrations from

Slade (2019) and Ahmed (2018), these two protagonists were assigned the role of outcast due to hegemonic beliefs about what they could achieve as a woman and girl of color.

Excerpts from Spires (2019) and Maier (2018) provide examples of outcast protagonists whose stories are not based on actual lived experiences of women of color. An excerpt from Spires (2019) states, “She is the only fairy in Pixieville who believes in science . . . Unfortunately, the only thing they teach in fairy school is magic. Class is very frustrating for Ester. And for Ms. Pelly Petal” (pp. 3–6).



Figure 17. Illustration from Spires, 2019. From *Fairy Science* (A. Spires, Illus.; pp. 5–6), by A. Spires, 2019, Random House Children’s Books. Copyright 2019 by A. Spires.

The story tells the tale of a fairy who is the only one who believes in science, contradicting the dominant ideology that all fairies believe in magic. The protagonist finds her experience in fairy school to be frustrating, as the dominant ideology is constantly relayed to her by her teacher and classmates. The protagonist’s frustration is

highlighted by her frown when the fairy teacher speaks of magic (see Figure 17). The excerpt further explains that her feelings of frustration are echoed by the fairy teacher, of light complexion, who is illustrated in Figure 17 to have a frown on her face when the protagonist speaks of science.

The protagonist is also assigned an outcast role in the following excerpt from Maier (2018):

One day, she found some old boards.

“Who wants to help me build something?” she asked her brothers.

Oscar Lee pretended not to hear her.

Rodrigo gave her a look that could melt Popsicles.

José almost fell off the fence.

“You don’t know how to build anything,” they said. (Maier, 2018, pp. 3–6)

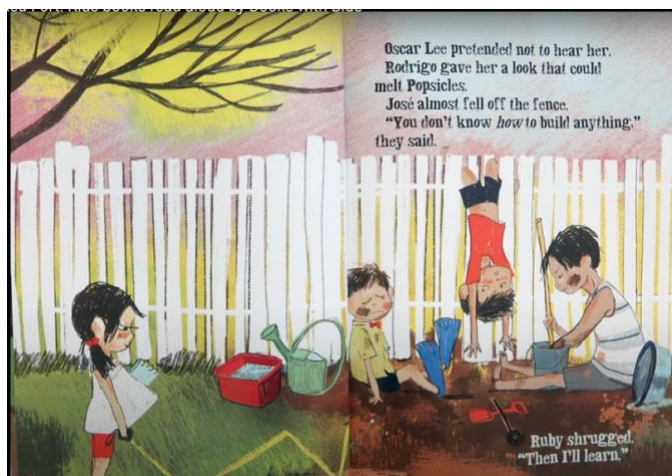


Figure 18. Illustration from Maier, 2018. From *The Little Red Fort* (S. Sánchez, Illus.; pp. 5–6), by B. Maier, 2018, Scholastic Press. Copyright 2018 by S. Sánchez.

The story describes a girl who wants help from her brothers to build what the reader later learns is a treehouse. However, the dominant ideology within this book is that a girl protagonist of color is not capable of building anything. This ideology is relayed from the brothers to the sister, thus creating a gendered division between the siblings. The separation between the sister and her brothers is further evident in the division of the characters on the pages, as shown in Figure 18, with the sister standing alone on one page while the brothers are illustrated together on a separate page.

Each of the four excerpts above highlights a thematic example of a girl or woman protagonist of color being assigned the role of outcast. The excerpts and illustrations from Slade (2019), Ahmed (2018), Spires (2019), and Maier (2018) show women and girl protagonists of color participating in STEM in isolation, judged by the supporting characters, instead of working collaboratively with them. Racial and gender identities of the protagonists were central to understanding the dominant ideologies and their experiences portrayed across the 26 stories.

Spotlighted Brilliance

Another overarching theme that emerged from the stories was of women and girl protagonists of color doing extraordinary things in STEM; in 69 instances they were, in essence, portrayed to be brilliant. In these 69 instances, protagonists were portrayed as individuals who made remarkable discoveries, paved the way by being the first or the only one to accomplish a feat, or made brilliant contributions to their classroom or society. Moreover, the protagonists were described as individuals who thought of different possibilities for themselves or the world around them and sought to make those

possibilities realities. Their new ideas might be in reference to a product, such as the creation of an unbreakable crayon (Simon, 2018), or a different possibility, such as protecting an island of animals (Arnold, 2018).

The following excerpt from Lecocq and Archambault (2018) is from a story about a girl protagonist of color who creates a robot that later destroys her town:

Her latest robot masterpiece was ready to lead the PrinCentaur revolution! You see, Rox had a superpower. She could make any toy she imagined come to life.

Rox was a coder. She knew how to write instructions on her computer called code that told robots what to do. (pp. 1–3)



Figure 19. Illustration from Lecocq and Archambault, 2018. From *Rox's Secret Code* (J. V. Innerebner, Illus.; pp. 11–12), by M. Lecocq and N. Archambault, 2018, POW! Copyright 2018 by J. V. Innerebner.

The girl then works to stop her robot. Within the Lecocq and Archambault excerpt, the ability to code is deemed a superpower, an ability to be marveled over, as pictured within

Figure 19, which shows Rox's coding ability succeed when she gives life to her robot. Coding is not portrayed as a skillset accessible to all, but highlighted as a remarkable ability or sign of brilliance.

The idea of the protagonist having remarkable abilities is echoed within the following K. Smith (2020) excerpt:

Meg was a boxitect. She loved to make things out of boxes. She loved making tiny houses, tall towers, and twisty tunnels. And she made marvelous things no one had ever seen before! Meg was proud of her work. She could make boxes into anything. Meg's mother was proud too. She thought Meg was brilliant and creative. (pp. 1–5)



Figure 20. Illustration from K. Smith, 2020. From *Boxitects* (K. Smith, Illus.; pp. 3–4), by K. Smith, 2020, Clarion Books. Copyright 2020 by K. Smith.

The words “brilliant and creative” are explicitly used to describe Meg’s maker ability. Her creative designs are illustrated in Figure 20. Here again a precedent has been set where the protagonist’s ability is shown to be awe-inspiring and not possessed by everyone.

The brilliance of the protagonists was highlighted not only through description of their abilities, but also through their achievements, as evident from the works of Simon (2018), K. Smith (2020), Mosca (2017), and Winter (2017). Simon (2018) tells the story of a girl protagonist of color who invents an unbreakable crayon: “Then, she had a brilliant idea. I will make the first Unbreakable Crayons. Miss Pilar smiled. You are a problem solver. You are an Inventor. You solve problems, big and small, because you have great ideas” (pp. 7–8). This excerpt explicitly showcases Abby’s “brilliant idea” (Simon, 2018, p. 8), making note that she will be the first to invent an unbreakable crayon, her achievement illustrated in Figure 21.



Figure 21. Illustration from Simon, 2018. From *Abby Invent's Unbreakable Crayons* (D. Necsulescu, Illus.; pp. 31–32), by A. Simon, 2018, Abby Invent's. Copyright 2018 by A. Simon.

The highlighting of brilliance through description of notable feats was further reinforced in the following excerpt from Mosca (2017):

Then she hit a GRAND SLAM, when she started an eye doctor training program. She would LEAD it for years, and what makes that so sweet? She'd be the FIRST WOMAN to achieve such a feat! . . . And because of her work, those without sight for years (like fifteen or twenty or THIRTY more years) . . . They could finally SEE! We should give THREE CHEERS. HOORAY, Dr. Bath! HOORAY, Dr. Bath!! HOORAY, Dr. Bath!!! But WAIT! She did more. She CREATED a place . . . A place to bring HOPE to the whole human race. Its motto is this: Rich or poor, black or white, healthy vision's important. It's everyone's RIGHT! (pp. 20–28)

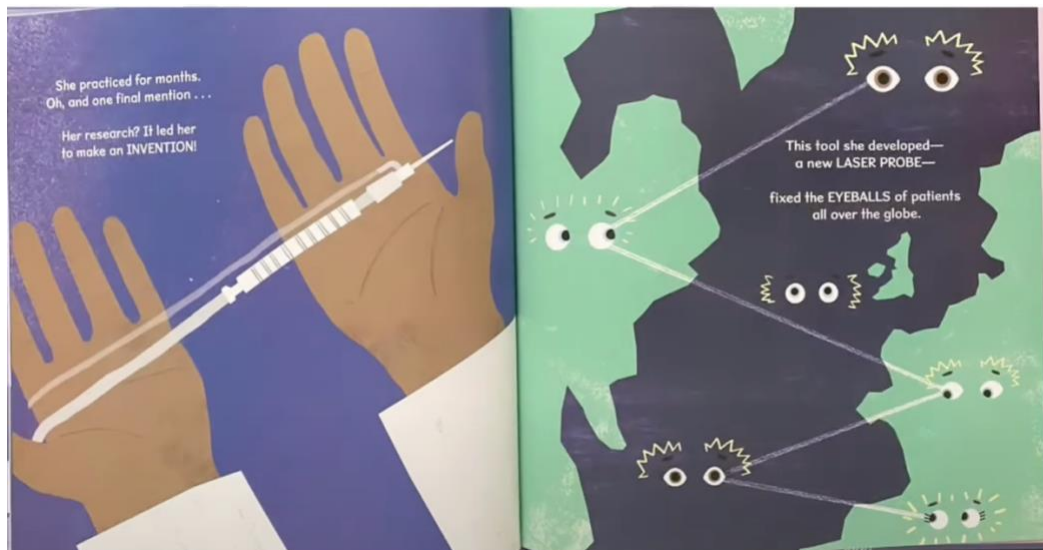


Figure 22. Illustration from Mosca, 2017. From *The Doctor with an Eye for Eyes: The Story of Dr. Patricia Bath* (D. Rieley, Illus.; pp. 23–24), by J. F. Mosca, 2017, The Innovation Press. Copyright 2017 by The Innovation Press.

Mosca tells the story of Dr. Patricia Bath and how she grew up to become an optometrist with various accomplishments. This is another example of spotlighted brilliance, as it shines light on Dr. Bath’s global feats of being the first woman to lead an eye doctor training program and the first to invent a way to treat eye cataracts, as alluded to in Figure 22.

The global feats of an individual are also spotlighted in Winter (2017): “Zaha’s designs don’t look like other designs. Her buildings swoosh and zoom and flow and fly” (p. 15). This book tells the story of Zaha Hadid, an architect whose unique designs were used across the world, further illustrated in Figure 23. Winter spotlighted how different and, again, remarkable Zaha’s architecture designs were.



Figure 23. Illustration from Winter, 2017. From *The World Is Not a Rectangle: A Portrait of Architect Zaha Hadid* (J. Winter, Illus.; pp. 15–16), by J. Winter, 2017, Beach Lane Books. Copyright 2017 by J. Winter.

The examples presented within this section show a consistent theme of women and girl protagonists of color having their brilliance spotlighted, whether through remarkable abilities (e.g., Rox’s ability to bring anything to life with her coding skills, Meg’s ability to make anything out of boxes) or contributions (e.g., Abby’s invention of the unbreakable crayon, Dr. Patricia Bath’s invention of the eye cataract treatment, and Zaha Hadid’s unique architecture designs).

Women and girl protagonists of color participating in STEM through everyday activities were only shown in four out of the 26 books, and these four books were all written by the same authors (Derting & Johannes, 2019a, 2019b, 2020a, 2020b).

Monolithic View of Protagonists' Experiences

Little diversity of the protagonists' identities was portrayed within the books; rather, monolithic views of protagonists' familial background and experiences in STEM were prominent across the 26 books. Women and girl protagonists of color living in rural/suburban areas were often presented. Figure 24 provides a percentage breakdown of the 26 books' geographic contexts. Only 7% of the books were set within urban areas: two books referenced London and Harlem, NY, while additional evidence of an urban setting was seen through a reference to public trains used to attend school and the presence of tall buildings and little greenery. Suburban/rural areas were the setting for 33% of the books, as evidenced by houses on large pieces of land, often accompanied by a nearby forest or treehouse. Eleven percent of the books were set in either an amusement park, forest, or beach. There was no identifiable geographic location for 48% of the books, which provided no evidence of either tall buildings or ample space for greenery.

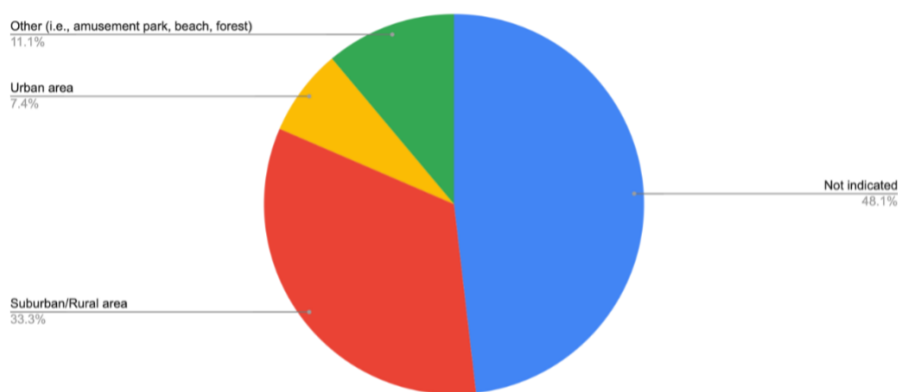


Figure 24. Books' geographic contexts.

When comparing the infrequent occurrences of protagonists raised in urban areas with the multiple instances of protagonists living in suburban or rural areas, a message emerges that women and girl protagonists of color who participate in STEM are from certain types of neighborhoods (i.e., rarely do they live in urban areas). Additionally, the stories portrayed protagonists' families as having the resources to build treehouses, travel the world, own robots, or even own telescopes (Ahmed, 2018; Derting & Johannes, 2019a, 2019b; Funk, 2018, 2019; Winter, 2017), revealing a perceived socioeconomic status of women and girl protagonists of color participating in STEM. Moreover, only two books, Winter (2017) and Harvey (2017), referred to their protagonists as being immigrants or coming from a family of immigrants; in both instances, the protagonists were of Asian descent.

While 67% of the books used in this study did not indicate specific historical contexts, when women and girl protagonists of color were shown participating in STEM careers, it was commonly shown to occur during the Jim Crow era. Of the 26 books used in this study, 33% were set during the Jim Crow era, a time when segregation was legal in the United States. The historical context was evident from the books' references to (a) segregated schools where the protagonists could not attend school with characters of light complexion; (b) segregated classrooms where protagonists were not allowed to sit in the front with the men; and (c) segregated departments where protagonists could not study engineering at their university. Reference to the Jim Crow era was further supported by the fact that this 33% of books identified were all based on the lives of actual people. Thus, additional information regarding the years in which the characters were born was

taken into consideration. The book by Arnold (2018), which told the story of Valentina Cruz and her work conserving the Galápagos Islands, was the only book about a real person whose accomplishments occurred in the 21st century.

Resistance

There were 17 instances where resistance emerged through the countering of dominant ideology, and in each of these instances, resistance was portrayed through protagonists' perseverance through tough situations regardless of the circumstance. In these 17 instances, protagonists were commonly described as determined or staying focused and not changing their minds regardless of the obstacles that came their way. And, in every instance where the women and girl protagonists of color persevered, they achieved their goal. For example, see the following excerpt:

Yet Raye kept her cool—gave her best every day, and in time all her skills were applauded. Hooray! People learned of her work. Who's this Raye? They'd demand. When they met her, they stared. They expected a man! Yes, that happened a lot. Many could not believe that a woman of color did all she'd achieved. Some even thought Raye was a maid (sad, but true). When they ordered a drink, she'd say, Bring me one too! All her humor and wit served her well through the years, as she battled the hard times with laughs and not tears. And that boss in the Navy who'd been so unkind . . . Made Raye the first woman to lead ship design! More honors would follow. Her fame picked up steam. And finally, at last, she accomplished her dream. That title she'd worked for—an engineer! Scorrre!! Now the world knows her feats. She is hidden no more. So, the lesson

to all is don't ever give in. Take a chance. Rock the boat. If it sinks, you can swim. When the storm comes your way, hold your course, and don't stress. Never quit, and like Raye, propel straight to success! (Mosca, 2018, pp. 25–31)



Figure 25. Illustration from Mosca, 2018. From *The Girl with a Mind for Math: The Story of Raye Montague* (D. Rieley, Illus.; pp. 23–24), by J. F. Mosca, 2018, The Innovation Press. Copyright 2018 by The Innovation Press.

The book by Mosca (2018) told the story of Raye Montague, who become an engineer and the first woman to lead a ship design. She could not pursue a career in engineering because her college said, “Engineering’s not taught to black students” (Mosca, 2018, p. 12). The excerpt shows the character resisting society’s limitation on her career choice, by battling “the hard times with laughs and not tears” (Mosca, 2018, p. 29). One way the character battled tough times was that when “the whole staff got the flu. Raye did all of her work . . . and the engineers’ too!” (Mosca, 2018, p. 17). The character’s perseverance

resulted in her accomplishment of becoming the “first woman to lead ship design,” as illustrated in Figure 25 (Mosca, 2018, p. 29).

Resistance to dominant ideology is also shown in this excerpt from Persico (2019):

But then an idea strikes! How does my family get creative? She wonders.

Georgia tries something new—something that’s not from her library. It feels odd for her at first, but with every colorful beaker she fills and each new shape she draws, her excitement grows. (pp. 23–24)



Figure 26. Illustration from Persico, 2019. From *Georgia’s Terrific, Colorific Experiment* (Z. Persico, Illus.; cover), by Z. Persico, 2019, Running Press Kids. Copyright 2019 by Z. Persico.

In this story, the protagonist, Georgia, is the only scientist born in a family of artists. She wants to create an experiment, but thinks that her family’s artistic experience will be of no help to her. The protagonist’s beliefs are in line with a once dominant

ideology that the natures of science and art cannot be combined (Braund & Reiss, 2019; Driver et al., 1996). So, the character pushes her family's help away. However, through perseverance, she achieves self-discovery, as illustrated in Figure 26. Georgia pushes against that ideology by tapping into the knowledge and abilities of her family members with artistic abilities.

Resistance to dominant ideology through perseverance was also alluded to by Shipp (2016): "April Showers [a TV meteorologist]: Tonight we have a SPECIAL weather guest helping with the forecast. If she keeps studying, she'll become a future TV meteorologist! Welcome Summer Winters" (p. 22). In this story, the protagonist, Summer, dreams of becoming a television meteorologist, but is constantly discouraged by her family, classmates, and friends: "HA HA HA!!! Yeah right. We love you Summer, but you don't know enough about the weather to be a weather woman says Storm" (Shipp, 2016, p. 6); "Oh Summer! You are too shy for that. I think that would be too hard for you" (Shipp, 2016, p. 13); "You can't be on TV, HA HA HA! You'll get too nervous! Scream all the students in a burst of laughter" (Shipp, 2016, p. 18). Resistance to the dominant ideologies that a girl protagonist of color does not know enough or is perceived as not having a suitable personality emerges when the TV meteorologist, a character of color, brings Summer on television with her (Figure 27), leaving words of encouragement that Summer can one day have her dream come true if she perseveres and studies enough.



Figure 27. Illustration from Shipp, 2016. From *The Meteorologist in Me* (R. Boyer, Illus.; cover), by B. Shipp, 2016, The Power of Love Books. Copyright 2016 by B. Shipp.

The theme of resisting the dominant ideologies through perseverance was further highlighted by Keating (2017):

As she grew older, many were still telling Eugenie what to do. Forget those sharks. Be a secretary! Be a housewife! Eugenie wanted to study zoology, but some of her professors thought women weren't smart enough to be scientists or brave enough to explore the oceans. And they said sharks were mindless monsters. Eugenie knew better. (p. 12)

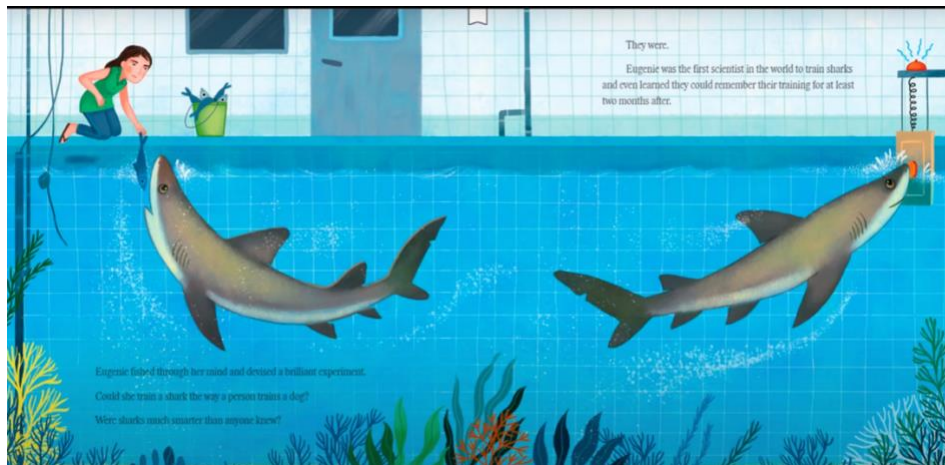


Figure 28. Illustration from Keating, 2017. From *Shark Lady: The True Story of How Eugenie Clark became the Ocean's Most Fearless Scientist* (M. Á. Miguéns, Illus.; pp. 22–23), by J. Keating, 2017, Sourcebooks Jabberwocky. Copyright 2017 by M. Á. Miguéns.

The story describes the life of Eugenie Clark, who became a zoologist and discovered sharks were not mindless. Within this excerpt, the dominant ideology is that women cannot be scientists or explore the ocean. Eugenie resisted by pursuing her dream of becoming a zoologist and proving that sharks were not mindless by successfully training “a shark the way a person trains a dog” (Keating, 2017, p. 22), as illustrated in Figure 28.

The various excerpts show evidence of the characters' resistance to dominant ideology through perseverance. The dominant ideologies the characters resisted were beliefs that girls and women of color could not achieve in STEM or that the natures of science and art could not mix. Regardless of the dominant ideologies, women and girl protagonists of color were portrayed as challenging it by persevering.

Summary of Results

To answer the question, “How are protagonists who are girls and women of color portrayed participating in STEM in children’s picture storybooks intended for grades K–3?” I identified four themes and analyzed data using descriptive statistics. Findings indicated that in these books published between 2016-2020, women and girl protagonists of color were portrayed with varying skin complexions, although not evenly distributed, including tan, deep, and dark. Hair textures and styles of protagonists were limited, with only those of tan complexions illustrated with straight hair, one protagonist of dark complexion illustrated with Afro puffs, and only four hairstyles used across the 26 picture storybooks. Women and girl protagonists of color were portrayed monolithically, with many protagonists portrayed as native to their land, from families with resources, and raised in rural/suburban areas. When women protagonists of color were portrayed as participating in STEM careers, all but one of the stories were based on the lived experiences of women born during the Jim Crow era; there was only one instance of a woman pursuing a STEM career in the 21st century. Additionally, many of the books portrayed protagonists as powerless and isolated, exhibiting signs of brilliance while often shouldering the role of an outcast and burdened with countering the dominant ideologies through perseverance.

Chapter Five

The purpose of this study was to examine how women and girl protagonists of color were portrayed participating in STEM. Using CRT as my theoretical framework, I applied critical content analysis to examine how forms of racism and oppression emerged in the representation of girls and women of color in children's literature. Findings from this study suggest that in children's literature published from 2016 to 2020, little diversity existed regarding the appearances of women and girl protagonists of color (i.e., skin complexions, hair texture, and hairstyles). The lack of diversity around hair is of note, given the discrimination women and girls of color experience in schools and workplaces because of the way they choose to style or cover their hair (Banks & Landau, 2021; Greene, 2012). Findings also indicated a lack of diversity relating to protagonists' STEM experiences, with many portrayed as outcasts exhibiting signs of brilliance while overcoming oppression from dominant ideology through their perseverance.

To maintain a critical perspective throughout the analysis of my findings, I begin this chapter by discussing the connection and implications of my themes (outcast, brilliance, monolithic view of protagonists' experiences, and resistance) as they relate to CRT. The CRT tenets I use are (a) the centrality of race and racism and their intersectionality with other forms of subordination, (b) the centrality of experiential knowledge, (c) the interdisciplinary perspective, and (d) the commitment to social justice. At the end of this chapter, I discuss limitations and suggestions for future research.

Connections to CRT

“Outcast” as It Relates to the Centrality of Race and Racism and Their

Intersectionality with Other Forms of Subordination

The premise of this tenet is that racism is so embedded within our society that it is commonplace in our everyday lives and used to explain and disguise various events (Morrison, 1994; Ladson-Billings, 1998). Acknowledging that racism permeates our society “suggests that racist hierarchical structures govern all political, economic, and social domains. Such structures allocate the privileging of Whites and the subsequent Othering of people of color in all areas, including education” (Bell, 1995, as cited in DeCuir & Dixson, 2004, p. 26). Findings from this study revealed that this tenet and “subsequent othering of People of Color” (DeCuir & Dixson, 2004, p. 26) hold true within the children’s picture storybooks examined. One theme that emerged from the data was the assignment of the role of outcast to women and girl protagonists of color. Having the label “outcast” associated with the characters was central to their gender and racial identities. There were instances where protagonists’ racial and gender identities were explicitly central to their experiences and others where this was implied.

Racism and sexism were explicitly factors of protagonists’ experience in several overt examples of systemic oppression:

- Protagonists were excluded from attending meetings with their colleagues.
- Protagonists were not allowed to attend the same school or university department as their peers of light complexion.

- Protagonists' participation in STEM was met with criticism and skepticism because of their racial or gender identity; comments such "She's an Arab!" were identified as the reason for not accepting one protagonist's work (Winter, 2017, p. 19).
- Protagonists were encouraged to leave their STEM career aspirations behind in favor of careers historically portrayed as fields for women, such as teacher, secretary, housewife, or nurse.

There were also times when racism and sexism were implicit within the children's picture storybooks. There were multiple instances where the protagonists were portrayed participating in STEM alone while characters of lighter complexion, and in some cases boys or men, were portrayed working or playing collaboratively with one another, implying a racial or gendered division between the other characters and the protagonists (Ahmed, 2018; Becker, 2018; Keating, 2017; Maier, 2018; Mosca, 2017, 2018; Shetterly & Conkling, 2018; Shipp, 2016; Slade, 2019; K. Smith, 2020; Spires, 2019). Whether explicit or implicit, racism and sexism were central to the protagonists' divisive roles in their STEM participation experiences.

Implications. Messages about protagonists being othered because of their racial and gender identity perpetuate dominant ideology rather than acting as counternarratives. It shows that even if women and girls of color participate in STEM, their experiences are not ideal, as they may be cast aside, misunderstood, and subjected to various forms of systemic oppression.

Systemic oppression is still present in society today, as evident from

Black children hav[ing] lower achievement performance (as measured by standardized tests) . . . [being] more likely to have less experienced or under-prepared teachers, suffer[ing] disproportionately from school discipline policies, hav[ing] less access to advanced courses . . . [being] less likely to be selected for gifted and talented classes, be[ing] assigned to special education, and experience[ing] grade level retention. (Shores et al., 2020, as cited in Ladson-Billings, 2021, p. 2)

Recognizing that youth of today will grow into adults of tomorrow, who will have a hand in shaping the hegemonic beliefs of our society, it is imperative that youth be provided with media examples that showcase an ideology whereby anyone can participate and belongs in STEM.

“Brilliance” and “Monolithic View of Protagonists’ Experiences” as They Relate to the Centrality of Experiential Knowledge and the Interdisciplinary Perspective

The premise of this tenet is that to challenge dominant ideology, the experiences of people of color must be central to the narrative (Ladson-Billings, 2013). Narratives that challenge hegemonic beliefs by voicing the experiential knowledge of oppressed people of color are known as counternarratives (Ladson-Billings, 2013). By acknowledging that identities are social constructs that intersect to create unique experiences for people within and across ethnic groups, CRT scholars likewise acknowledge that reality is also socially constructed (Crenshaw, 1991; Ladson-Billings & Tate, 1995) with “truths only exist[ing] for this person in this predicament at this time in history” (Delgado, 1991, p. 11). The experiences of people of color vary, so their

narratives should also reflect the complexities in their realities; while there are commonalities, no two people's experiences are the same. However, a theme that emerged from the data was the constant retelling of women and girl protagonists of color as being brilliant. STEM knowledge and skills can be learned by people of any identity, yet books within this study often portrayed them as only accessible to those who exhibited brilliance. Additionally, commonalities existed with regard to the protagonists' geographic and historical contexts and socioeconomic status. In addition to there being only one mention of protagonists' experiences within the 21st century while 33% of the stories were set during the Jim Crow era, stories portrayed protagonists as being of similar socioeconomic statuses.

Implications. Representing little diversity in the experiences of people of color oversimplifies the realities of girls and women of color's participation in STEM, thereby making their experiences appear one-dimensional. Sharing stories that predominantly focus on the brilliance of women and girl characters of color participating in STEM reinforces a common sentiment told to many women and girls of color that they must "work twice as hard to get half as much" or that they "must be twice as good to get noticed for the work you do and three times as good to get ahead" (Cirincione-Ulezi, 2020, p. 722). It sends the message to girls of color reading the books that if they want to participate in STEM, they will need to be able to perform exceptionally well. This notion of working twice as hard was evident when a protagonist "did all of her work . . . and the engineers' too" when the engineers, all of whom were of light complexion, within her office got sick (Mosca, 2018, p. 17). The story ended with the protagonist becoming the

first woman to be the leader of a ship design. From the example, “working twice as hard” and becoming the first to make a notable contribution to society highlights brilliance as being associated with performing better than characters of light complexion.

Stories only focusing on the protagonists’ contributions are not new:

Women are presented as exceptional, having defied convention to make it in a man’s world . . . Physicist and historian Brush (1985) calls this the *Marie Curie syndrome* [italics added] in which the scientist, regardless of her abilities to be intuitive, imaginative, and creative, and a leader in her field, is presented as someone who painstakingly carried out tedious observational experimental work.

(Milne, 1998, p. 182)

The notion of exceptionality was further emphasized by the stories of girls and women protagonists of color who were systemically burdened with overcoming obstacles associated with their gender and race. Stories that only highlight the brilliant and exceptional skills of girls and women of color in STEM “help to reinforce the notion of scientific knowledge as a privileged form of knowledge” (Milne, 1998, p. 181), placing STEM participation on a pedestal for the privileged few. Further, one-dimensional stories decrease the opportunity for youth to see mirrors of themselves or see and experience cultures different from their own (Bishop, 1990). Having stories that “focus on the struggles of scientists as well as on their successes might help students who have struggles in their own lives to identify more closely with the great scientists [or others who participate in STEM]” (Milne, 1998, p. 184). Thus, providing access to counternarratives that express the diverse realities of girls and women of color creates

more opportunities for girls of color to connect the stories with their own experiences and increase their enjoyment of the books (Hefflin & Barksdale-Ladd, 2001; Hughes-Hassell et al., 2009).

“Resistance” as It Relates to the Commitment to Social Justice

The premise of this tenet is that forms of oppression should be identified and deconstructed. It recognizes the “limits of the current multicultural paradigm . . . seeking to underscore the difficulty (indeed, impossibility) of maintaining the spirit and intent of justice for the oppressed while simultaneously permitting the hegemonic rule of the oppressor” (Ladson-Billings & Tate, 1995, p. 25). One of the ways I identified oppression within this study was examining who was in positions of power. There were multiple instances across the books where the women and girl protagonists of color were portrayed as not being in positions of power. Examples of protagonists’ powerlessness included the following:

- In classrooms, teachers of light complexion either did not encourage protagonists in STEM or neglected to discourage classmates from ridiculing the protagonists.
- In workplaces, supervisors of light complexion used their power to limit protagonists’ STEM participation (e.g., by not allowing the protagonists to attend staff meetings).
- The government used its power to oppress protagonists (e.g., refusing to allow the protagonist to apply to the engineering department at their university); in

these cases, characters of light complexion represented the “face” of the government.

- Protagonists turned to characters of light complexion for help they needed (e.g., an Indigenous protagonist asking characters of light complexion to help them save the animals on their island), thereby presenting the notion that people of color are powerless without the assistance of settlers (Datta, 2016, 2020; L. T. Smith, 1999) instead of acknowledging that “numerous Indigenous communities experience the colonial perspective as a form of violence, exploitation, and discrimination towards their land, culture, and knowledge” (Datta, 2020, p. 18).

These instances send subliminal messages that girls and women of color are not in positions of power and, therefore, their experiences in STEM will be contingent upon the interests of Whites.

Implications. CRT scholars refer to the alignment of Whites’ interests with the interests of people of color as “interest convergence,” which posits that Whites are only prompted to pursue racial equity when they can also benefit (Bell, 1980; Ladson-Billings, 2013). Thus, a story sending the message that girls and women of color will be oppressed and powerless to change anything without converging with the interests of Whites perpetuates dominant ideology, negating the story’s ability to act as a counternarrative.

Moreover, having perseverance constantly shown as the only form of resistance to oppression paints an incomplete picture.

Yes, it [grit] is needed, but to insist that dark children need, do not have, and can function on those characteristics alone is misleading, naïve, and dangerous.

Measuring dark students' grit while removing no institutional barriers is education's version of *The Hunger Games*. It is adults overseeing which dark children can beat the odds, odds put in place and maintained by an oppressive system. (Love, 2019, p. 73)

The narrative that if women and girls of color just persevere in the face of oppression, they too will be able to garner success in STEM sustains a notion that girls and women of color should focus on the tasks at hand “so that nothing could supersede White economic demands for labor” (Love, 2019, p. 77). As such, the portrayal of resistance in STEM participation should reflect examples of systemic changes as well as individual instances of resistance.

Limitations of the Study

I identified three limitations of my study: reliance on frequency of instances instead of significance in data analyses, a repetition of stories about the women who contributed to the launch of Apollo 13, and a repetition of authors that emerged due to the nature of my selection criteria. Given increased attention to the representation of people of color in books (Rodríguez & Vickery, 2020; Woodson, 2013; Yorio, 2018), I focused on the frequency of instances for the formation of the themes; no weight was given to the significance of an event within a story. For example, if a story portrayed a protagonist as participating in STEM predominantly alone, but on the last page of the story the protagonist was portrayed as collaborating with others, no weight was given to the

significance of that resolution. Future research could examine the importance of plot structure (i.e., the story climax or resolution) as it relates to the portrayal of women and girl protagonists of color's participation in STEM.

One source of repetition was the reoccurrence of stories about characters from the movie *Hidden Figures*, which premiered at the end of 2016 (Mendelson, 2017). *Hidden Figures* is a historical drama based on the lived experiences of Katherine Johnson, Dorothy Vaughan, Mary Jackson, and Christine Darden, women who contributed to the launch of Apollo 13. Considering the movie's \$200 million success at the worldwide box office (Mendelson, 2017), it comes as little surprise that this success was translated into the book publishing industry, leading to three books about these women (Becker, 2018; Shetterly & Conkling, 2018; Slade, 2019) meeting my selection criteria and thus appearing within my study. As the stories of Katherine Johnson, Dorothy Vaughan, Mary Jackson, and Christine Darden took place during the Jim Crow era, having three books about their experiences within my study may have impacted the analysis.

Additionally, there were several authors who appeared more than once within the study because their writing styles and publication dates aligned with my selection criteria. There were two books by Mosca (2017, 2018), two by Funk (2018, 2019), and four by Derting and Johannes (2019a, 2019b, 2020a, 2020b). Having authors' work appear multiple times within my study meant their perceptions of women and girl protagonists of color were represented more than once, perhaps leading to an increase in the frequencies of certain codes.

The books written by Derting and Johannes (2019a, 2019b, 2020a, 2020b), as shown in Table 6, were notable because they were often exceptions to the themes identified within this study. Aside from their protagonists of color being from families with resources, which aligns with the pattern that emerged across the 26 books, the girls in the stories (a) were *not* outcasts—they participated in STEM collaboratively with their classmates and friends, and (b) were *not* exceptionally brilliant—they were portrayed as girls who loved science and put into practice lessons learned from class. A review of the authors and illustrators revealed that one of the authors and both illustrators were people of color. This suggests more research should be done to examine the relationship between narratives of people of color in STEM and the authors’ and illustrators’ connection to that community.

Table 6

Books Written by Kimberly Derting and Shelli R. Johannes

Book title	Illustrator
<i>Libby Loves Science</i>	Joelle Murray
<i>Cece Loves Science</i>	Vashti Harrison
<i>Cece Loves Science—Push and Pull</i>	Vashti Harrison
<i>Cece Loves Science and Adventure</i>	Vashti Harrison

Conclusion

Having books that portray women and girl protagonists of color participating in STEM is essential; however, representation alone is not enough. Findings from my study revealed that the messaging in children's literature that portrays women and girl protagonists of color participating in STEM should be taken into deeper consideration. As such, authors, illustrators, and publishers should make more concerted efforts to create and publish STEM-related multicultural children's literature featuring women and girl protagonists of color that acts as counternarratives.

Findings also suggest that more work should be done to critically examine the portrayal of women and characters of color in children's literature. As such, the STEM community must take on a more abolitionist lens, one where they interrogate the messages of children's literature by examining the "author positionality and perspective when selecting books for classroom use" (Rodríguez & Vickery, 2020, pp. 112–113). Thorough interrogation is essential in identifying whose voices are being heard and what narrative authors wish to portray. Having the diverse voices of people of color who have been historically oppressed is central to counternarratives that challenge dominant ideology (Ladson-Billings, 2013). Thus, we need more research that scrutinizes the messaging of multicultural children's literature through critical examinations of power and inequalities as it relates to race and its intersections. Additionally, professional associations (e.g., NSTA, American Society for Engineering Education, International Technology and Engineering Educators Association), educators, and librarians should

reassess children's books featuring protagonists of color that they recommend and allow within their classrooms and libraries.

Stakeholders such as administrators and teacher educators also have a role to play. In addition to providing resources for teachers and librarians to access counternarratives, administrators should hold their schools accountable for creating and maintaining an inclusive environment for the students whereby students have access to stories that reflect authentic and diverse experiences of people of color participating in STEM. Likewise, teacher educators should incorporate strategies for identifying stereotypes and counternarratives in children's literature in their curriculum. Providing our youth, both those now and in the future, with counternarratives are steps we, within the STEM community, can take towards ensuring everyone feels as though STEM is an area in which they are accepted and belong.

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Biography

Talisa J. Jackson is a Black woman born and raised in the south in a middle-class, two-parent household with one younger sibling. She received her Bachelor of Science from East Carolina University in Elementary Education. Prior to attaining her doctorate, she was employed as a teacher in Charlotte-Mecklenburg Schools and Fairfax Country Public Schools. Talisa received her Master of Education in Reading Education from the University of North Carolina-Charlotte. While pursuing her doctoral degree, Talisa was employed at George Mason University, where she lectured pre-service teachers, advised undergraduate students, and conducted education research. Talisa's passions for education and equity propelled her to non-profits like the National Geographic Society and federal agencies such as the National Science Foundation, where she worked to increase the percentage of people of color who received educational funding and pursued a career in STEM. As Talisa continues to pursue her passions, she hopes to do her part in increasing the representation of people who have been historically marginalized in STEM and is excited about where the journey takes her.