Stereotypes of Scientists: 
Seeds of Progress and Recommendations for 
Elementary Teachers

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Abstract

Although policy makers have made gains in getting students to consider future careers in science, women and many minorities are still underrepresented in science fields. Here we describe research conducted with fifth grade students in a rural area of the southeastern U.S. that examined students’ concepts of scientists’ characteristics. The results showed that students still cling to stereotypical notions that scientists are White and male. However, when asked to predict from a diverse group of children who would grow up to be a scientist, students’ responses revealed promising potential. We build on these findings and discuss strategies that teachers can use to help students understand the diversity of people who work in science and science careers.

Keywords: elementary science, enclothed cognition, stereotypes

Teachers and researchers have long recognized that many students hold stereotypical images of scientists, and these stereotypes often hinder students’ abilities to personally identify with science or see themselves as pursuing careers in science (Cundiff, Vescio, Loken, & Lo, 2013; Gilbert & Yerrick, 2001; Schinske, Perkins, Snyder, & Wyer, 2016). The Draw a Scientist Test (DAST) has been used for decades as a measure of children’s and adults’ images of scientists (Chambers, 1983), and the results have consistently identified images of scientists as stereotypical white males, often with lab coats and crazy hair. Such stereotypes can discourage girls and boys from identifying as scientists when their gender, racial, or ethnic group identity differs from the stereotype (Archer, Dewitt, & Wong, 2014; Herbert & Stipek, 2005).

Interestingly, researchers have recently found a decrease in gender stereotypes as depicted in students’ DAST drawings.

A meta-analysis of over 20,000 pictures drawn by students age 5 to 18 over five decades revealed that, when asked to draw a scientist, school-age children in the United States over the decades are increasingly sketching women (Miller, Nola, Eagly, & Uttal, 2018). Yet, when looking across children’s ages, researchers in the U.S. (Miller et al., 2018) and internationally (Narayan, Park, Peker, & Suh, 2013) found that the proportion of the drawings of male scientists increased as children start high school, thus emphasizing that such gender stereotypes seem to be learned. Clearly, educators must work to directly address students’ stereotypes of scientists.

Miller and colleagues (2018) further compared data documenting the recent decades’ increase in drawings of female scientists with an increase in the percentage of women working in science fields. Expectancy-value research suggests that students need to be able to recognize the personal benefits of choosing a science career. Relatedly, student perceptions of scientists are likely to shape their career choices and impact their course-taking decisions (Wang & Degol, 2013; Wigfield & Eccles, 2000). Miller and colleagues (2018) further found that gender stereotypes of scientists were not present until children began school, emphasizing the importance of early educators’ roles in addressing science stereotypes. The present study is part of a larger study that examined efforts to promote elementary students’ visions of themselves.
doing science, and here we describe findings related to students’ stereotypes of scientists.

History of Science as a Profession

Images of scientists as professionals in Victorian and Edwardian literary novels over the 19th century (Russell, 2007) documented the transition of science as an intellectual hobby to a paid occupation. William Whewell, a Cambridge University historian and philosopher coined the term “scientist” in 1834 to describe experts in the study of nature. While stereotypical images of scientists developed over less than 200 years, there have been numerous attempts in the last 35 years to examine the role of stereotypes in Science, Technology, Engineering and Mathematics (STEM) courses and occupations (e.g., Barth, Kim, Eno, & Guidagno, 2018; Thébaud & Charles, 2018).

Scientists

The word scientist initially referred to white males such as Darwin, Faraday, and da Vinci (Markel, 2010), thus setting the stage for the white male stereotype. The attempts over the last 35 years to change the stereotypes of scientists have been met with limited success (e.g., Finson, 2002; Master, Cheryan, & Meltzoff, 2016). Teachers’ attention to students’ stereotypes of scientists is important as they strive to help all young learners envision themselves as potential scientists. As described in the Next Generation Science Standards (NGSS Lead States, 2013), “when provided with equitable learning opportunities, students from diverse backgrounds are capable of engaging in scientific practices and constructing meaning in both science classrooms and informal settings” (p. 1).

Consequently, it is important for educators to consider the role that students’ personal identities play in shaping career visions. Additionally, family and key mentors such as teachers can influence students’ career choices (Dee, 2007). Various media sources such as movies and literature have also been found to influence students’ images of scientists (Steinke et al., 2007), and these personal and cultural influences can serve either as support or as obstacles to students’ visions of themselves as scientists. Notably, clothing and accessories can also influence students’ images of themselves and others as described below.

Enclothed Cognition

Researchers have identified the role clothing plays on impressions of others. When shown images of high school students wearing dressy clothing, the students were rated by teachers and peers as more intelligent when compared to images of students wearing t-shirts and ragged jeans (Behling & Williams, 1991). Other researchers (Morris, Gorham, Cohen, & Huffman, 1996) examined the role of dress for teaching assistants. Those who dressed more formally were seen by students as more intelligent, though less interesting, than their casually dressed colleagues. Relatedly, studies have shown that physicians wearing white lab coats impact patients’ perceptions of their characteristics such as trustworthiness and possessing authority (Brase & Richmond, 2004). The potential that clothing may influence impressions of science and scientists is especially relevant for educators in the current U.S. and global stage, as students are frequently exposed to misrepresentations of scientists whose professional expertise is less valued and labeled as “elitist” and separate from common culture (Nichols, 2017). Given the impressions of clothing on others, researchers have begun to look at the impact of clothing on the wearer. Adam & Galinsky (2012) introduced the term enclothed cognition to identify the influence that wearing clothing has on one’s psychological processes. In their initial research, they examined the impact of wearing lab coats in science class on students’ performance on attention-related tasks, thus connecting the physical experience of wearing a lab coat with the symbolic meaning the coat represents. Their research revealed that wearing white lab coats increased students’ sustained attention when the lab coat was identified as a doctor’s coat but not when wearing a lab coat that was labeled a painter’s coat.

Here we present recent research findings that provide a snapshot of one U.S. rural community’s young learners’ views of scientists. We share recommendations for challenging students’ stereotypes and supporting students’ understandings of who scientists are and what they do.

Methods

This study was part of a larger study (Jones et al., 2019) that examined the impact of wearing lab coats during science class on grade 5 students’ science self-concept and their impressions of their classmates’ connections with science. The present study’s data were collected in follow-up interviews with students who participated in the larger study. The interviews were designed to help researchers and educators learn more about upper elementary students’ views of scientists. During interviews, we showed students images of a diverse group of adults, all dressed in similar attire, and we explored whether these students held any gender, racial, or ethnic stereotypes of scientists. Next, we showed students a similar group of photos but instead of the adult images, the second set of photos was a diverse group of children about their age (10-11 years old), and we asked the students about the potential of each to become a scientist.

Participants

The study was conducted at four elementary schools in rural communities in the southeastern United States. The schools were identified as low performing (an overall mean of 34% of students performing at grade level on the state’s achievement tests) and low income (a mean of 61% of the students eligible for free/reduced lunch). The student participants (n=73), identified as 36 Black (49%), 27 White (37%), 8 Hispanic
Data Collection and Analysis

Data for the present study focused on participants’ views of scientists. A semi-structured interview protocol for the full study was developed with questions that were designed by science education researchers and examined for validity by an expert panel composed of two science teachers, two researchers, and two university science teacher educators. For the present study the students were shown photos and asked the questions described below. Interviewers asked follow up questions to probe the meaning of student responses. Six of the coauthors, two science teacher educators and four science education research assistants, conducted one-on-one interviews with students. Each interview took approximately 20 minutes, and the interviewer transcribed student responses. As we interviewed students about their impressions of science and scientists, we provided them with stock photos of head shots of four adults about the same age that were smiling and each wearing various shirts. The images included a Black male, White female, White male, and Asian female. We asked the students, “Which of these people is a scientist? Why or why not?” Students were further asked to explain the reasoning for their choices. We then showed the students stock photos of head shots of six children about the age of the 5th grade participants (10-11 years old). The images included a Black female, Black male, White female, White male, Asian female, and Asian male. Each individual was smiling and wearing the same orange t-shirt. We asked the students “Which of these students will grow up to be a scientist?” We tallied the participant choices and determined the percentage of their photo selections. We further documented interview responses identifying participants’ reasons for both their adult and children’s image selections. Using an inductive approach for analyzing student responses (Glaser & Strauss, 1967; Strauss & Corbin, 1997; Thomas, 2006), interviews were coded for participant views using themes that emerged from their responses. Four of the researchers coded, discussed themes, and finalized coding criteria by comparing and developing common themes documented in the interviews. The primary themes that emerged from students’ reasoning behind their choice of a scientist or potential scientist were students’ descriptions of the person’s: gender, clothing, race, and general appearance. Two secondary themes that emerged were students’ rationales for the person’s career (either type of scientist or career other than scientist) or potential career for the children depicted in the photos and a general assessment of the person in the photo (e.g., “happy,” “smart,” “professional”). The research team organized students’ responses to both the adult and children’s photos and interview comments, discussed common themes and example quotes, and reached full agreement on the primary and secondary thematic coding frame. The researchers then conducted a second round of coding using the coding framework and organized the student comments related to the four adults and six children shown in the photos. In the section that follows, we present findings about the patterns of students’ images of scientists and the predictions for children’s potential as scientists.

Findings

This study was designed to examine elementary students’ images of scientists to provide teachers with data on student views as they work to 1) address student stereotypes of scientists and 2) help all students be able to see themselves participating in science and possibly choosing science careers. The findings from this portion of the study revealed clear stereotypes.

Photo Selections

The students’ selections and rationales for their identification of which of the adults in the photos was a scientist and which of the children in the photos would grow up to be scientist follow.

As seen in Table 1, 68% of the students interviewed chose the photo of the White male as the scientist, and the White female was selected as a distant second choice with 23%. The Black male was selected by 6% of the students, and only 3% of the students selected the photo of an Asian female as representative of a scientist. Looking further into these data (see Table 2), we compared the ethnicity and gender of the student participants related to their photo selections. Interestingly, we found that the White male stereotype pattern persists regardless of the students’ racial or gender identity.

Students were then shown photos of young males and females from various ethnic groups: White, Asian, and Black who appeared close to the age of the participants (10-11 years old). Students were asked to identify which of the children in the photos might grow up to become a scientist.

As seen in Table 3, when students were asked to predict which of the children would grow up to become a scientist, the patterns across gender and ethnicity were less distinct. Promisingly, nearly 18% responded that any of the children in the photos could potentially become a scientist. The percentages for White males (25%) and White females (23%) were similar, followed by Asian females (16%), and Asian males (11%). There were still areas of great concern; specifically, the low numbers of students who selected images of Black males (3%) or females (1%) as potential scientists.

Student Interviews

The reasons that the students gave for their photo selections shed light on their perceptions and provide valuable information about the beliefs the students held about scientists. Despite the fact that all

<table>
<thead>
<tr>
<th>Photo selection distribution (adult)</th>
<th>Total sum (out of 73)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black male</td>
<td>4.5</td>
<td>6.2%</td>
</tr>
<tr>
<td>White male</td>
<td>49.8</td>
<td>68.3%</td>
</tr>
<tr>
<td>White female</td>
<td>16.8</td>
<td>23.6%</td>
</tr>
<tr>
<td>Asian male</td>
<td>1.8</td>
<td>2.5%</td>
</tr>
<tr>
<td>* Students could select more than one choice as a response. When multiple photos were selected, answers were recorded as a fraction of a response. (For example, if a participant selected a White female and a Black male the response would be coded as .5 for each category).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of the males and females in the images were traditionally dressed, one of the common elements of the images that students considered in making their decisions related to the clothing worn by the adults in the photos. In describing their choices over half (56%) of the students mentioned the person in the image wore clothing appropriate for a scientist. Thirteen of the students (18%) chose an image as a scientist because they said the person looked “smart” or “accomplished,” and five students (7%) explained that they chose various images as the scientist because the person was smiling and looked “happy.” Below are sample quotations of the reasons the participants provided for their choice of a person as a potential scientist or their notions of alternative professions. Interestingly, each of the interviewers only asked students to explain their choices of who was a scientist and why or why not, so all of the students considered in making their decisions or weather.

Of the students who did not select the Black male as a scientist, many explained they imagined him in an alternative profession. Twenty-four (33%) of the students stated that the person in the photo of the Black male was in a sports profession or was a physical education teacher. One Black female said, “I think he would probably be a basketball player because he looks like he’s pretty tall.” While the photos were only headshots, seven other students also described him as “tall.”

Twenty-one of the students identified the Black male as a “singer,” “jazz musician,” or “entertainer.” One Black female student explained that she did not select him, “because he doesn’t look like someone who enjoys science.” Four of the students identified him as a dentist. Notably, none of the Black female students choose the photo of the Black male as a scientist.

**Adult White male scientist.** Many of the participants’ explanations for choosing the White male referenced the shirt he wore in the photograph or they referred to media images of scientists. One Black female who chose this photo explained, “He looks smarter because of the shirt he is wearing; makes him look more professional.” A White male participant also referenced the clothing as indicative of a scientist’s attire saying, “…because he’s wearing more fancy clothes and they make more money than an average person in an average job.” Four of the students who did not chose the photo of the White male as a scientist said he looked like a business person. Five of the students made media references such as this one from a Black female who said, “…he looks like Dr. Oz [on TV].” Four other students’ reasons mirrored the media source of her image as in this White female’s explanation that the White male was the scientist because “…he looks like Bill Nye the science guy. Looks very educated.”

**Adult White female scientist.** Many of the participants who chose the image of the White female also referenced clothing. One White female student explained that the White female was a scientist “because of the way she’s dressed and she looks like she went to college to be a scientist.” While only 23% of the students selected the White female as a scientist, four of the 16 students who selected her explained that they made the selection because she looked “nice.” One Black female explained, “She looks like she enjoys science because of her smile.” Four students specified that she was a meteorologist. Eight of the students who did not choose the White female made comments such as “She looks like she would probably be a teacher;” six thought she was in the medical field, either a doctor or counselor, and two described her as a “regular mom.”

### Table 2. Percentages of photo image selection by gender and racial/ethnic identity.

<table>
<thead>
<tr>
<th>Photo Image</th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
<td>White</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>(n=16)</td>
<td>(n=14)</td>
<td>(n=18)</td>
<td>(n=18)</td>
</tr>
<tr>
<td>Black Male</td>
<td>3.1%</td>
<td>0</td>
<td>12.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>White Male</td>
<td>56.3%</td>
<td>74.8%</td>
<td>87.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Asian Female</td>
<td>37.5%</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Asian Female</td>
<td>37.5%</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Black Male</td>
<td>1.3%</td>
<td>12.5%</td>
<td>8.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>White Male</td>
<td>69.6%</td>
<td>63.9%</td>
<td>83.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>White Female</td>
<td>12.5%</td>
<td>8.3%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Asian Female</td>
<td>5.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Asian Female</td>
<td>5.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
| **Students could select more than one choice as a response. When multiple photos were selected, answers were recorded as a fraction of a response. For example, if a participant selected a white female and a black male the response would be coded as .5 for each category.**

### Table 3. Frequency and percentage of participants’ photo selections of children.

<table>
<thead>
<tr>
<th>Photo Selected (children)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black male</td>
<td>2</td>
<td>2.7%</td>
</tr>
<tr>
<td>Black female</td>
<td>1</td>
<td>1.3%</td>
</tr>
<tr>
<td>White male</td>
<td>18</td>
<td>24.6%</td>
</tr>
<tr>
<td>White female</td>
<td>17</td>
<td>23.2%</td>
</tr>
<tr>
<td>Asian male</td>
<td>8</td>
<td>10.9%</td>
</tr>
<tr>
<td>Asian female</td>
<td>12</td>
<td>16.4%</td>
</tr>
<tr>
<td>All (can become a scientist)</td>
<td>13</td>
<td>17.8%</td>
</tr>
<tr>
<td>None (would become a scientist)</td>
<td>2</td>
<td>2.7%</td>
</tr>
</tbody>
</table>
Adult Asian female scientist. None of the students solely chose the image of the Asian female as a scientist. One female student who self-identified as Mixed race said that any of the images could be scientists, yet when describing the image of the Asian female she also offered a comment laced with stereotype imagery saying, “She looks like a person who likes to do nails.” Six students projected that she worked in fashion or as an artist or dancer, and five identified her as a teacher. Two students commented that she could not be a scientist because she was wearing lipstick.

Photos of children as potential scientists. When asked why the students selected one of the photos depicting a child as a potential scientist, many mentioned the appearance of the child in the photo and included comments such as they, “look like a scientist.” When asked to elaborate, many said the person in the photo “looks smart,” “looks happy,” or “they look like they like to do math.” When students chose either the Asian female or the White female child as a scientist, they specified that their future career would be on TV as a meteorologist.

Interestingly, when asked about the photos they did not choose, many projected potential careers for the child in the photo such as identifying the Asian female as a person who would work either in fashion or as a teacher. One responded that the Black male could have a future working “as a doctor,” yet many of the students’ projections followed the patterns of their responses about the photos of the adult Black male as an athlete, naming either a football or basketball player. Students also predicted that the Black female in the photos might become an athlete (e.g., naming gymnastics, tennis, basketball), and a number of students identified the Black female in a caring profession such as nursing or counselor. These data are especially relevant for educators as they encourage their students to identify as scientists and participate in school science.

Discussion

Findings from this study indicate that the majority students hold stereotypical images of science professionals (Cundiff et al., 2013; Master, Cheryan, & Meltzoff, 2016), and these images can have a variety of sources including media images which have been found to reinforce images of mad scientists and social outcasts (Steinke et al., 2007). Also media related, students in the present study identified examples of White male scientists from television such as Bill Nye and Dr. Oz. Unfortunately, there are limited media images in popular culture with Black or Latina women scientists, with Neil deGrasse Tyson being one of the few Black male scientists in the media.

The influence of gender, race, and ethnicity of the adult images in this study certainly influenced students’ decisions that aligned with their stereotypes, yet significantly over half of the students in this study commented on the clothing of the person in the photo as influencing their decisions. These data support the work of other researchers who reported the role of clothing influencing impressions of professionals and peers (Behling & Williams, 1991; Brase & Richmond, 2004). These findings reinforce the impact that clothing can have, and this information can support teachers as they address stereotypes of scientists. Images of marine or field biologists dressed for their outdoor “offices” may challenge some of the students’ stereotypes. Teachers can further capitalize on the role of clothing by considering Adam and Galinsky’s (2012) enclosed cognition research as they try to build students’ personal expectations by providing them with science data collection and analysis experiences while wearing lab coats and using tools of science to help students to envision themselves as potential scientists (Jones et al., 2019; Wang & Degol, 2013; Wigfield & Eccles, 2000).

One interesting finding from these data that seems to counter stereotypes of scientists as mad scientists or loners (Chambers, 1983; Steinke et al., 2007) were the number of students in the present study who commented about the images they chose as scientists “looking smart” or “friendly.” In addition, findings from the present study provide promise, as students were able to see diverse images of children with the potential to become scientists. Given these data, teachers can capitalize on the potential revealed in this study to help students envision themselves as scientists (Dee, 2007). Building on Miller and colleagues’ (2018) findings that stereotypes of scientists do not begin before children are of school age, addressing stereotypes of scientists in elementary school is critical as we prepare students to fully engage in science.

The shortage of qualified workers in STEM fields has been documented in the U.S. (US Joint Economic Committee, 2012) and internationally (Office of Chief Scientist, 2013). Despite women’s gains in earning science degrees, concerns persist regarding women working in science and especially in some STEM fields (Archer et al., 2014; Hamrick, 2019). Helping students see themselves working in a science profession begins with learning about the various professions that involve science knowledge and skills. Students cannot imagine themselves in STEM careers unless they are aware of various STEM careers (van Tuyl & van der Molen, 2015). Research on students’ selection of careers suggests that youth need to see themselves potentially working in the career in the future and this image of their future work is strengthened if others such as teachers or parents (Khattab, 2015) also support a future job in science (Wang & Degol, 2013). Holmes (2013) found that having a parent in a STEM field greatly influenced African-American female students’ aspirations for choosing a career in STEM.

For students without these examples, providing them with models is critical. For example, interactions with females in STEM professions have been found to increase students’ self-efficacy toward STEM careers (Cheryan, Siy, Vichayapai, Drury & Kim, 2011). Teachers can invite speakers from science professions and who share the same ethnic, racial, and gender with students to expose students to scientists who “look like me.” Exposing students to scientists from a range of scientific fields and including a diversity of scientists can launch efforts to help students begin see themselves in science careers.

The present study was conducted in a rural region of the U.S. and these
students may benefit from an expansion of how they value science knowledge and how traditional STEM careers are classified. For example, exposing students to the levels of science and mathematics knowledge used in careers in agriculture, industry, or health care require a high level of science knowledge and research; and exposing students to the scientists involved in such fields that may connect with students and their families.

Countering the public’s and students’ stereotypes of scientists will require concentrated efforts to provide examples of scientists from a range of gender, racial, and ethnic backgrounds. Teachers can unveil stereotypes of scientists in media and society with their students, and provide them with examples of science professions. Finally, building on expectancy value research (Wang & Degol, 2013; Wigfield & Eccles, 2000), teachers can help all students to envision themselves as smart, capable, and accomplished future scientists.

Conclusion

Despite the findings from this study that stereotypes persist in the sample of students studied, data from this study revealed that grade 5 students hold perceptions that children their age have potential to become scientists. These findings plant seeds of hope by providing teachers and teacher educators with strategies for expanding students’ visions of science professions and the diversity of persons who are professional scientists. These findings further expand our understanding of sources of stereotypes that teachers can address as they educate students and their families about expanding opportunities and visions of science literacy and science careers.

The authors wish to acknowledge BioGen Foundation for financial support and Emma Refvem for data analysis support.

References


