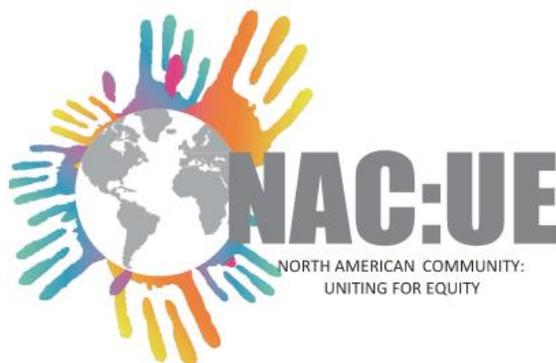


Pre-Service Teachers' Perceptions of Scientists: Stereotypes, Gender Bias or Media Influence?

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Abstract

This study investigates pre-service teachers' perceptions of scientists. Participants were asked on the first day of their elementary science teaching methods class to draw a scientist and to explain why they drew that scientist. Class discussion followed the activity. About 20% of the participants drew female scientists. The majority of the respondents demonstrated stereotypes and gender biases. Scientists were largely described as men with crazy hair in labs, wearing glasses and lab coats, doing scientific experiments. Participants indicated these perceptions came from the media. They indicated the roles of female scientists were never emphasized in science courses. It is recommended that 21st century educators review their instruction and include activities that improve the image of female scientists. Such a change could encourage more female participation in science and STEM related fields.

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The Draw-A-Scientist activity has been in use for decades in order to determine children's and adults' perception of scientists (Farland-Smith, Finson, Boone, & Yale, 2014; Finson, 2002; Milford & Tippett, 2013). The Draw-A-Scientist Test was developed by Chambers, 1983 (as cited in Scjoneco. 2006). Educational researchers have used this activity to determine the presence of stereotypes including gender, physical appearance, clothing and age of scientists (Schibeci, 2006). The findings of these studies indicate that both children and adults have a common perception of scientists. Scientists are viewed as intelligent, Caucasian men who work hard and spend their lives in labs exploring different things. This perception is reinforced by media in various ways such as children's shows and cartoons (Hoh, 2009). Even children's trade books portray scientists in the same manner (Rawson, & McCool, 2014). Research studies indicate the presence of both implicit and explicit stereotypes among people, both young and adult, and individuals from both genders. Other studies indicate that the presence of stereotypes and gender bias, even in subtle ways, can negatively affect female participation in STEM fields including science (Handley, Brown, Moss-Racusin, & Smith, 2015). Fields of science and math are traditionally connected with boys and men, while the humanities are related to girls and women. Presence of stereotypes not only affect career choices among girls and women, but also their performance in the field (Lane, Goh, & Driver-Linn, 2012). These stereotypes and media portrayals of scientists as crazy men with nerdy looks can discourage girls and women from choosing science as their career. They may feel like misfits in the STEM fields, as these areas are perceived as boys' fields. As a result, a large number of the females who enter the STEM related fields leave the STEM professions (Case, & Richley, 2013; Handley, Brown, Moss-Racusin, & Smith, 2015).

An activity similar to the Draw-A-Scientist process was carried out in this study to determine if these biased perceptions still exist in the second decade of 21st century. Participants were asked to draw a scientist. Instead of using the Draw-A-Scientist Test (Schibeci, 2006), the participants were asked to provide reasons for the depiction of the scientist they drew.

Objectives of the Study

- Identify participants' perception of a scientist through a drawing.
- Determine through written descriptions any stereotypes, biases and media influence among the 21st century pre-service teachers.

Design of Study and Procedure

This study was done in a science methods class at a mid-western regional university. The participants were pre-service teachers majoring in elementary, early childhood and special education. The data were collected over six semesters between fall 2012 and spring 2015. The participants were mostly traditional Caucasian female students (about 90% female population). However, no data were collected on gender, race or the age of the participants. Both qualitative and quantitative data were collected regarding the participants' drawings and reasoning processes.

On the first day of the class, participants were asked to draw a scientist on a piece of paper without discussing it with their peers or thinking too much about it. They were also asked to write a brief description of why they drew that person. The participants were then told to tape their drawings on a wall. For this reason, the participants were asked not to write their names on their drawings, to avoid any embarrassment because of their drawings. After the pictures were taped on the wall, the class moved together near the pictures to have a brief discussion about

each drawing. First the class identified how many participants drew female scientists. Then the class briefly discussed each drawing and the reasons for drawing.

Limitations of the Study

This study has several limitations. The sample was a sample of convenience and the study was done as a class assignment. Even though no data were collected on participants, the participants were mostly Caucasian females from rural areas who were majoring in elementary, early childhood or special education only. A broader study would help gather more generalizable data. In future studies, other ethnic groups such as African Americans should be included as it was noted in this study that most of the participants portrayed their scientists as Caucasian men.

Data Analysis and Findings

The data was analyzed both quantitatively and qualitatively. The quantitative analysis was done by simply counting how many participants drew female as their scientists each semester and calculating their percentages. The following table shows the number of participants each semester and the percentage of those who drew female scientists.

Table 1

Percentage of Participants who Drew Female Scientists

Semester	Total Number of Drawings	Drawings of Female Scientists (%)
Fall 2012	38	13
Spring 2013	55	22
Fall 2013	69	19
Spring 2014	49	22
Fall 2014	64	27
Spring 2015	64	19
Average	56.5	20.3

Table 1 clearly indicates that an average of 80% of the participants drew the scientists as man. The drawings of female scientists ranged from 13% to 27% across the six semesters. This pattern showed some bias and thus warranted a qualitative analysis of what influenced the participants' thinking.

The participants were asked to briefly describe the reason for the depiction of their scientist drawing. For the analysis of the qualitative responses, basic interpretive research methods were used (Ary, Jacobs, Sorensen, & Walker, 2014). Participants' responses were organized and reviewed across the six semesters. The data were classified into three main categories according to the research questions. The three broad categories were: stereotypes, gender bias, and media influence, even though there was some overlap in the descriptions. Table 2 shows examples of words and phrases participants used that relate to stereotypes, gender, and media influence.

Table 2

Qualitative Data Displaying Participants' Responses

Stereotypes	Gender	Media Influence
White lab coat	Male	Mad scientist
Crazy hair, fuzzy hair	Man	Dr. Frankenstein
Nerdy	His	Lab coat
Thin	He	Safety Goggles
Beaker and test tubes		Thin
Chemicals, fumes, smoke		
Smart, Intelligent		
Experimenting in a lab		
Safety goggles		
Pocket square		

The responses displayed several examples of stereotypes. Several participants included words such as lab coat, crazy hair nerdy, thin, smart and intelligent, beakers, test tubes, chemicals, fumes and smoke in their description of their scientists. One person commented that

“I drew a scientist with test tubes on the table and they are dissecting a rabbit.” Another person described the scientist as “My scientist has glasses and a pen because he is smart. I also drew hair sticking up because that is something I think of when I think of a scientist.” Another person described, “I have the scientist with glasses and fuzzy hair. I also gave the scientist a lab coat, skinny legs, ugly shoes and a test tube in his hand; they are generally skinny, nerdy with glasses and messy hair.” Another participant described their scientist “I imagine a scientist to be a bit crazy, very smart, and experimental.” All these descriptions indicate the stereotypes the participants had about the scientists.

Participants’ descriptions also displayed the gender stereotypes. They described their drawn scientist as a man, used the pronouns “he” and “his” in their descriptions. One participant commented, “When I think of a scientist, I imagine a man in a white lab coat, square glasses and spike white hair holding chemicals. He also has a crazy look in his eye.” This statement shows both gender bias and common physical stereotypes about scientists. A huge majority of the participants (about 80%), who were females, described their scientists as men or males. Only a few used female or feminine pronouns for their scientists. One of them said, “I drew a light bulb to show the scientist’s intelligence and creativity. The objects on the table are her science experiments.” As mentioned in previous studies, such as Moss-Racusin et al. (2012) and Handley et al. (2015), people of both genders display these subtle biases when they select one gender over the other.

Some of the responses by the participants showed mixture of both gender bias and the media influence. As one participant described the drawing of a scientist, “When I think of a scientist, I imagine a man in a white lab coat, square glasses and spiked white hair holding chemicals; he also has a crazy look in his eyes.” This statement clearly has both gender bias and

the influence of the media. Another participant described the scientist in a way that displayed media influence more clearly by saying, “My scientist has a lab coat on. He is wearing it because when I picture a scientist this is what they wear. I get this idea from movies and TV shows.” The participant repeatedly described the scientist as a “he” and the physical description of square glasses and the spiked hair indicates the media influence.

Reviewing the above responses from various participants, media influence was obviously affecting their thinking. A few participants described when they think of a scientist, they think of Bill Nye because they have watched his videos since grade school. As Bill Nye wears a lab coat and is seen holding beakers, test tubes and doing experiments in his videos, participants remembered those images and used them to describe their scientists. Some other participants described their scientists as Einstein, another legendary figure related to the field of science whose name and pictures are very commonly used in the media to portray science and scientists. As one participant described “I drew a picture of Albert Einstein. When I think of a scientist that is the first person that comes to mind.” Several participants show their media influence by describing their scientists as a “mad scientist”. One participant said “The mad scientist is what I always visualize when I think of science. Partly because science sometimes makes me feel crazy and these are the pictures that I usually see in books about scientists.” Another person said, “When I think of a scientist, I think of Dr. Frankenstein.” Yet another person said, “When I think of a scientist, I think of a nutty guy in glasses and a lab coat that explodes things often.” These descriptions also indicate media influence.

About 20% of participants drew female scientists. There was no data collected on who drew what type of scientist as there was no name on the drawings. The oral description during class discussion showed the reasoning behind the drawings of female scientists. One participant

said, “Scientists can be female, so I made her a girl. She needs safety glasses to protect her eyes, a badge for identification, and of course, a white lab coat to protect her clothes. Another participant described, “The scientist is working on an experiment. I drew her that way because scientists solve problems and work for solutions.”

Conclusion and Implications

The findings of this study are similar to previous studies related to the presence of stereotypes about scientists. This study was unique in its addition of descriptive responses. The data analysis presented above indicates that the participants in the Draw-A-Scientist activity displayed gender bias because only 20% of them drew female scientists. Most participants displayed various stereotypes in drawing those scientists as described in previous studies. The study participants displayed their stereotypical perceptions of scientists by describing them as nerdy men who were thin, had long crazy hair, wearing glasses and lab coats, and working with test tubes and beakers. Some of these perceptions were due to media influence (Rawson & McCool, 2014). The major media influence seemed to be that of a “mad scientists” which came from cartoons, children’s books and other TV shows. One person correctly identified these perceptions as stereotypes by saying, “I drew a guy because you often think of that as your stereotypical scientist. I drew the crazy hair because you think of things exploding and spiking their hair. I drew the beaker in his hands to show that he is actually participating in experiments.” This person not only identified stereotypes, but also gender bias and the media influence. During the discussion of the activity, the participants described that they had learned the information from different media sources, especially the visual media such as TV shows and movies.

Studies like this are important because there are still few women in the STEM related fields. About 70% of the STEM faculty members are men (Handlye et al. 2015). Women who start in the STEM related fields tend to drop out more than men (Kerkhoven, Russo, Land-Zandstra, Saxena, & Rodenburg, 2016). Moreover, finding the perception of pre-service teachers is also important as they will be teaching science to elementary students. If they continue to have these types of biased perceptions, it is likely that they may transfer these to their students, both intentionally and unintentionally (Buday, Stake, & Peterson, 2012). Studies also indicate that teachers' classroom attitudes and the role they play in their classrooms can affect children's attitudes toward science (Kerkhoven et. al, 2016). Other studies indicate that perceptions students have about scientists can affect their attitudes toward science and can also impact their career choices (Farland-Smith, finson, Boone, &Yale, 2014). We as teachers and teacher educators need to find out what is causing these perceptions and what we can do to eliminate or reduce them. During follow-up conversations, the study participants pointed out that some of them had all female professors in their college science classes. All participants had at least one female professor for their college science courses. However, they did not realize that those professors were actually scientists until our class discussion on that topic, probably because those science professors did not fit the media stereotypes. After realizing this, some of the participants suggested that the professors of their science classes should present themselves as scientists in front of their classes. That presentation may help reduce those stereotypes, gender bias, and media influences about scientists. Some participants suggested that presenting some notable female scientists' work in class would also help improve those perceptions. At the same time, we hope that these science faculty members do not have gender biases themselves. Some studies indicate that science faculty member, whether male or female, may perpetuate subtle and

unintentional gender biases. These include considering females as less competent or giving favorable consideration to the applications of candidates for science related fields with male names and giving unequal treatment to undergraduate female students (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman (2012). These treatments can also affect students' attitudes toward science and their choice of STEM related fields as their careers.

References

- Ary, D, Jacobs, L. C., Sorensen, C. K., & Walker, D. A. (2014). *Introduction to research in education (9th Ed.)* Belmont, CA, Wadsworth, Cengage Learning.
- Buday, S. K., Stake, J. E. & Peterson, Z. D. (2012). Gender and the choice of a science career; the impact of social support and possible selves. *Sex Roles, 66*, 197-209.
- Case, S. S., & Richley, B. A. (2013). Gendered institutional research cultures in science: The post-doc transition for women scientists. *Community, Work & Family, 16*(3), 327-349.
- Farland-Smith, D., Finson, K., Boone, W. J., & Yale, M. (2014). An investigation of media influences on elementary students' representations of scientists. *Journal of Science Teacher Education, 25*, 355-366.
- Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School Science and Mathematics, 102*(7), 335-345.
- Handley, I. M., Brown, E. R., Moss-Racusin, C. A., & Smith, J. L. (2015). Quality of evidence revealing subtle gender biases in science is in the eye of the beholder. *Proceedings of National Academy of Sciences, 112*(43), 13201-13206.

- Hoh, Y. K. (2009). Using biographies of outstanding women in bioengineering to dispel biology teachers' misperceptions of engineers. *The American Biology Teacher*, *71*(8), 458-460, 462-463.
- Kerkhoven, A. H., Russo, P., Land-Zandstra, A. M., Saxena, A., & Rodenburg, F. J. (2016, November). Gender stereotypes in science education resources: A visual content analysis. *PLOS ONE*.
- Lane, K. A., Goh, J. X., & Driver-Linn, E. (2012). Implicit science stereotypes mediate the relationship between gender and academic participation. *Sex Roles*, *66*, 220-236.
- Milford, T. M., & Tippett, C. D. (2013). Preservice teacher' images of scientists: Do prior science experiences make a difference? *Journal of Science Teacher Education*, *24*, 745-762.
- Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of National Academy of Sciences*, *109*(41), 16474-16479.
- Rawson, C. H., & McCool, M. A. (2014). Just like all the other humans? Analyzing images of scientists in children's trade books. *School Science and Mathematics*, *114*(1), 10-18.
- Schibeci, R. (2006). Student images of scientists: What are they? Do they matter? *Teaching Science*, *52*(2), 12-16.