ABSTRACT

GENDER REPRESENTATIONS IN SCIENCE CHILDREN’S LITERATURE: A REVIEW OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION’S OUTSTANDING SCIENCE TRADE BOOKS FOR STUDENTS K-12: 2014

by Jessica Rae Robertson

Despite extensive research regarding the gender gap within the science, technology, engineering and math (STEM) fields, little progress has been made in closing this gap. This study takes a fresh approach by examining gender representations in science children’s literature. Images and content from the fifty-five books on the National Science Teachers Association’s Outstanding Science Trade Books for Students K–12: 2014 list were examined for gender distributions. Results reveal that while female scientists were pictured more often than male scientists, male non-scientists and male nouns and pronouns were used more often than their female counterparts. Gender-neutral characters such as animals were pictured more often than both male and female characters regardless of whether or not they were depicted as scientists. Additionally, books with a focus in life science were categorized as female-oriented more often than expected. No other variables had significant differences by category. Implications for schools, educators, and parents are discussed.
A Thesis

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Dedication

I would like to dedicate my work to my father, Jack Robertson. Thank you for always believing in me, teaching me to think critically, and instilling a passion for education within my soul.
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I would like to acknowledge my parents, friends and family for their support and encouragement during the completion of this project. Additionally, I would like to thank Amity Noltemeyer for her continued guidance, advice and support in helping me complete my research. Lastly, I would like to thank Jordan Metzger for her help and patience in collecting data. This project wouldn’t have been possible without all of your help.
Introduction

“Leadership matters. In order to innovate new solutions to the toughest problems we face, diverse leadership matters the most” (Lennon, 2013, p. 7). The gender gap within the fields of math and science is a highly contested topic among scholars. Although enrollment in math and science classes and achievement on math and science tests is roughly equal between genders all the way through high school, women are receiving an overwhelming minority of post-secondary degrees in science, technology, engineering, and mathematics (STEM) fields (Carr, 2013; Office of Civil Rights, 2012). Reasons for this gap are difficult to pin down, and are more than likely multi-faceted. Many avenues have been explored including stereotype threat, differences in spatial ability, and lack of role models. Additionally, research shows that girls’ interest in math and science decreases steadily as they progress through elementary school (Jacobs & Bleeker, 2004), and by middle school, boys and girls tend to have different attitudes toward math and science (Jones et al., 2000). This, combined with other factors, likely facilitates future class and career choices as well as goals and aspirations. Many ideas regarding the gender gap in the STEM filed have been researched, however one source that warrants further research is science children’s literature.

Historically, women have been underrepresented in children’s literature, including children’s literature regarding science (Gooden & Gooden, 2001; Holbrook, Panozza & Prieto, 2009; Mattix & Sobolak, 2014; Nilsen, 1971; Owens, 2009; Rawson & McCool, 2014). Historically, the women who are present are often portrayed in limited traditional roles whereas men are shown engaging in a much wider variety of activities and professions (Gooden & Gooden, 2001; Nilsen, 1971). Children’s books have the potential to change children’s perceptions of society and, a majority of the time, are the most frequent opportunity that children are given to see how others should interact (Gooden & Gooden, 2001). Therefore, the way gender is portrayed in children’s literature is critical to the process of developing a sense of self and identity (Mattix & Sobolak, 2014; Peterson & Lach, 1990; Serafini & Moses, 2014). In looking specifically at math and science children’s literature, the research is minimal. In the literature that does exist, researchers have examined illustrations of scientists (Rawson & McCool, 2014), portrayals of engineers (Holbrook et al., 2009), and biographies about scientists (Owens, 2009). In all of these studies, the trend continues—women are underrepresented. The
aim of this paper is to reveal the distribution of gender portrayal in current science children’s literature.

Women in STEM Fields

Most people have probably heard the stereotype that boys are better at math and science and girls are better at language arts. However, when looking at enrollment and achievement statistics of school-age children, it becomes evident that this stereotype is far from true. Higher percentages of girls are enrolled in Algebra I in grades 7 and 8 as compared to their male counterparts (Office for Civil Rights, 2012). Additionally, those students who take Algebra I at an earlier age tend to pass the course at higher rates as compared to those who wait to take the course (Office for Civil Rights, 2012). Across races, girls are performing better in Algebra I than boys of the same age (Office for Civil Rights, 2012). As these children reach high school, they are still equal in terms of enrollment as compared to the boys in their class. Boys only slightly outweigh girls in enrollment for science classes (51% to 49%), and girls actually outnumber boys taking chemistry classes (52% to 48%; Office for Civil Rights, 2012). Similar results emerge when looking at gender and math classes. Enrollment is nearly equal in calculus, geometry, and Algebra II classes (Office for Civil Rights, 2012). Even when considering course enrollment across disciplines at the college level, gender distributions are roughly equal (Bettinger & Long, 2005). The distinction comes in looking at students who actually chose to major in the science disciplines at the post-secondary level (Bettinger & Long, 2005). When considering degrees in physics, women only obtain 21.8% of bachelor’s degrees, 25.2% of master’s degrees and a mere 15.5% of doctoral degrees (Halpern et al., 2007). In fact, the only field of science or math in which women outnumber men in doctoral degrees is Psychology (67.3%; Halpern et al., 2007). Despite the fact that women’s status in these fields has progressed, these numbers indicate that there is still reason for concern (Carr, 2013).

Why the Gap?

Pinpointing exactly why there is such discrepancy of gender within the STEM fields is a difficult task; likely a multitude of factors are at play. As Sonnert and Holton (1995) state, science careers appear to be influenced by many individual characteristics and personal events that seem insignificant when considered individually, but become powerful once considered as a whole. Nonetheless, many different ideas and theories have been analyzed. Despite the immense amount of attention this issue has been given, there are still many debates about how
much, if any, each variable actually accounts for the disproportional representation of genders (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011; Verdine et al., 2014). Most likely, a combination of factors contributes to the gap including, but not limited to, stereotype and signaling threat, differing levels of interest, differences in spatial ability, and a lack of female role models.

All kinds of misconceptions exist about men and women. Some, such as the notion that women’s brains are comparable to those of gorillas’, may seem absurd today (Blickenstaff, 2006); however, some of these misconceptions have repercussions that are still evident today. For example, researchers have broken down intelligence tests by subtests to look for differences by gender, and found differences that suggest men have the advantage in mathematical and spatial ability whereas women have greater verbal ability (Blickenstaff, 2006). However, these advantages seem to have no leverage, according to current enrollment and achievement statistics. As mentioned previously, there are virtually no differences between enrollment and achievement rates among boys and girls between the elementary to high school levels. Yet, regardless of these statistics, many have been able to show that simply believing, or being aware of a certain stereotype can negatively effect women’s performance and self-concept (Murphy, Steele & Gross, 2007; Nguyen & Ryan, 2008; Schmader, Johns, & Forbes, 2008; Shapiro & Williams, 2012; Spencer, Steele & Quinn, 2008).

The idea that performance can change relative to a person’s beliefs and knowledge about a certain stereotype is referred to stereotype threat, or “a disruptive apprehension about the possibility that one might confirm a negative stereotype about one’s group” (Steele, Spencer & Aronson, 2002, as cited by Taylor & Walton, 2011, p. 1055). These types of threats can approach girls from all angles including parents and teachers (Shapiro & Williams, 2012). This type of consequence has been shown to take effect as early as middle school (Halpern et al., 2007), and can influence performance, course selection, and ultimately career choice (Gunderson, Ramirez, Levine, & Beilock, 2011). Although there may not be significant negative effects on performance taking place at the elementary level, the stereotype is still well known (Blickenstaff, 2006; Finson, 2002; Halpern et al. 2007). Halpern et al. (2007) state that when elementary girls are asked about math and science abilities, they reply that men are better than women, but boys and girls are equally as good at math and science. However, children’s actions tend to speak differently than their words. In a 1983 study by Chambers, 4,807 elementary
students were asked to draw a scientist (Finson, 2002). Of those 4,807 children, only 28
students’ drawings featured a female scientist (Finson, 2002). This means that women were
represented in less than one percent of the children’s drawings (Finson, 2002). Again,
pinpointing exactly where children get the notion that men are better than women at science is
difficult, but one factor to consider is the stereotype that our society perpetuates, and how that
stereotype effects our perceptions of the environments and of ourselves. For example, in one
study by Murphy et al. (2007), researchers found that women who were exposed to an imbalance
of gender at a math and science conference showed more cognitive and physiological alertness
and reported a lesser sense of belonging and desire to participate than did those females who
were exposed to an equal amount of each gender (Murphy et al., 2007). Additionally, men were
not affected by the gender imbalance (Murphy et al., 2007). A second example, given by Jacobs
and Bleeker (2004), demonstrates that parents’ math and science purchases (books, toys, games,
etc.), activities they do with their children, math modeling, perceptions of their child’s math
ability, as well as the value they place on math have significant effects on their children’s math
and science activities and interests later in life. Mothers were more likely to purchase math and
science items for their boys independent of the child’s grade level (Jacobs & Bleeker, 2004).
This gives boys more, and different opportunities to explore math and science, and may
ultimately provide them with different knowledge, skills, experiences and expectations later in
life (Jacobs & Bleeker, 2004). Additionally, parents were more likely to facilitate their
daughters’ math and science activities, which could potentially send the message that girls need
more help in this domain, and may have negative effects on self-efficacy (Jacobs & Bleeker,
2004). Further, mothers’ math modeling behaviors were a significant predictor in their child’s
math involvement two years later, and mothers’ math and science purchases as well as
involvement in activities were significant predictors in the child’s interests six years later (Jacobs
& Bleeker, 2004). Ultimately, both attitudes and actions of parents play a role in shaping their
children’s academic preferences (Jacobs & Bleeker, 2004).

A second explanation to consider is that boys and girls may simply differ in their
interests. Research has shown that even in elementary school, and despite being outperformed by
girls, boys tend to have more positive attitudes in science (Blickenstaff, 2006; Jones, Howe &
Rua, 2000). By middle school and throughout high school, this trend becomes even more salient
(Jones et al. 2000). According to Jacobs and Bleeker (2004), children’s perceptions of the
usefulness and importance of math decrease as they advance grade levels. Girls tend to say that science fails to capture their attention, and is all about memorization (Jones et al., 2000). Qualitative reports have shown that while girls find interest in science classes, they do not see themselves pursuing a career in science-related fields (Blickenstaff, 2006; Jones et al., 2000). Instead, they report finding much more interest in other career paths (Blickenstaff, 2006; Jones et al., 2000). For many girls who do want to pursue a career in a STEM field, they have made the clarification that there are many different kinds of scientists such as scientists that work with rockets, and scientists that work with animals (Blickenstaff, 2006). Many girls prefer the latter for the humanistic aspects of the field such as helping people or animals, rather than the formal aspects of the natural sciences (Blickenstaff, 2006; Jones, et al., 2000). Perhaps, these differences in interests were fostered by differing childhood and personal experiences. Boys tend to report their personal experiences related to science much differently than girls (Jones et al. 2000). For example, boys tend to have more experiences with visiting factories, weather stations and other similar science-related places out of school during their childhoods (Jones et al. 2000). Boys also report reading more science-related articles, watching more science television shows and conducting their own science experiments (Jones et al. 2000). Even when exposed to the same science lesson in the classroom, girls and boys report having very different experiences (Jones et al. 2000). According to Jones et al. (2000), boys were given more scientific opportunities such as completing experiences and using equipment. These results are important to consider because more positive attitudes have been correlated with higher science achievement (Weinburgh, 1995, as cited by Blickenstaff, 2006).

As previously stated, researchers who dissected intelligence test results looking for gender discrepancies found that males tend to outperform women on tests of spatial ability. Spatial ability is important for many reasons, one of which is its crucial role in developing and improving upon mathematical skills (Verdine et al., 2014). According to Verdine et al. (2014), engaging in more spatial play (such as playing with blocks) and using more spatial language can improve performance on tests of spatial ability. Though several research studies have looked further into this possibility, the results have been inconclusive (Coluccia & Louse, 2004; Geary, Saults, Liu & Hoard, 2000; Verdine et al., 2014). Some argue that males have the advantage in many different mathematical categories such as speed and fluency and the male advantage can be seen as early as first grade (Geary et al., 2000). In their study, Geary et al. (2000) found that
the male advantage in mathematics is facilitated by the male advantages in both computational fluency and spatial cognition. Similarly, a recent meta-analysis summarizing studies surrounding the Purdue Spatial Visualization Tests shows that males tend to outperform females, especially when time constraints were added (Maeda & Yoon Yoon, 2013). Conversely, in a recent study by Verdie et al. (2014) in which preschoolers were asked to assemble blocks in various ways, no differences by gender were observed. The effect of age in the results of these studies is still in question. In a study by Geiser, Lehmann, and Eid (2008), which examined gender differences in spatial ability across 15 age groups (9-23), differences by gender were present in every age group. However, there is still a gap in the research in looking at gender differences in spatial ability between preschool and second grade.

Others have inquired about the possibility that women perceive science as a male field because that is how it appears. In other words, girls have fewer role models to look up to and become inspired by (Jones et al. 2000). Possibly, this sends the message to girls that women do not belong in STEM fields, and they should do their best to avoid them (Blickenstaff, 2006). Additionally, although this view assumes even more gender stereotypes to be true, it could be that there are few examples of women becoming successful scientists while still managing to raise a family; perhaps this turns off girls even further (Blickenstaff, 2006). Bettinger and Long (2005) decided to measure the effects of same-gender faculty members on students, and found compelling results for both genders. When looking at the influence of female faculty members on female students, the researchers found that faculty members do have the power to increase student course selection and choice of major (Bettinger & Long, 2005). Effects were particularly strong in the areas of math, statistics and geology (Bettinger & Long, 2005); however, results were insignificant for the fields of physics and computer science. That being said, it should be noted that the proportion of female faculty in these disciplines was very small which made estimating effects difficult (Bettinger & Long, 2005). Perhaps, if percentages of female faculty in these areas increased, female faculty members would be able to influence their students more strongly. Similarly, when studying girls’ implicit attitudes toward science and gender stereotypes about science, researchers found that women tend to identify with female professors that are seen as positive role models and as a result tend to see science as a feminine field rather than a masculine one (Young, Rudman, Buettner, & McLean, 2013). Further, when professors are considered to be positive role models, students tend to have more science-oriented career goals.
and more positive attitudes about science regardless of gender (Young et al., 2013). This supports the idea that women can benefit from having role models of the same gender with whom they can identify by reducing negative stereotypes about women in science (Young et al., 2013).

However, not everyone thinks that the gender of the role model is the most important contributing factor. According to Cheryan et al. (2011), role model gender did not influence participants’ perceived projected success. Instead, the researchers claimed that participants’ “perceived dissimilarity from stereotypical role models” impacted results (Cheryan et al., 2011, p. 1). Participants either interacted with someone who possessed “stereotypical” STEM qualities or someone who resembled an average college student (Cheryan et al., 2011). Female participants’ perceived anticipated success differed depending on the type of role model that they were given, but not depending on gender; however, males did not show this type of difference (Cheryan et al., 2011).

**Reading and Development**

Children can learn a great deal about the world from reading (Mattix & Sobolak, 2014; Peterson & Lach, 1990; Serafini & Moses, 2014). As stated by Serafini & Moses (2014), “…children’s literature can foster an understanding of narrative structures and the role visual images play in storytelling, help develop comprehension abilities, expand vocabularies, and expose young readers to new concepts and ideas” (p. 1). Additionally, researchers describe literature as a way for children to become acquainted with the world in which they live and learn about societal standards and values (Mattix & Sobolak, 2014; Peterson & Lach, 1990; Serafini & Moses, 2014). “Readers learn from a good story what is expected of children and come to realize the accepted standards of right and wrong within the complexity of their gender” (Peterson & Lach, 1990, “Effects of Picture Books on Child Development,” para. 4) This is why we must be so cognizant of the ways in which we choose to represent the world through children’s literature. Reading is a constructive process, and what is taken away from the text depends directly upon what knowledge and experiences the reader has brought with them (Peterson & Lach, 1990). Gender role stereotypes effect how children view themselves (Narahara, 1998, as cited by Gooden & Gooden, 2001; Peterson & Lach, 1990; Steyer, 2014). According to Steyer (2014), the way that each gender has been portrayed has given boys a sense of entitlement whereas girls’ self-confidence and future aspirations are negatively affected.
Additionally, once a stereotype has been learned, children have a difficult time letting that stereotype go (Gooden & Gooden, 2001; Peterson & Lach, 1990). These stereotypes portrayed in children’s literature have many different effects on outcomes for children including the ways in which they relate to themselves and others as well as the ways in which they expect others to behave (Gooden & Gooden, 2001; Peterson & Lach, 1990). Further, girls may have difficulty realizing their full potential due to a lack of variety of female role models (Steyer, 2014). Being exposed to such gender roles at a critical point in development can negatively affect the ways in which children grow and develop (Steyer, 2014). In one study, 4th grade girls were asked to rate traditionally male jobs and characteristics after being read either a story with women in traditional or nontraditional roles (Ashby & Wittmaier, 1978). Not surprisingly, the girls who were read the nontraditional story were more likely to rate traditional male jobs and characteristics as being acceptable for females (Ashby & Wittmaier, 1978). These findings further underline the importance of having a variety of women in a variety of different roles and positions for the mindsets and development of girls’ self-concept. Further, Peterson and Lach (1990) explain that reading materials in which genders are portrayed equally can help boost memory and story recall.

**Women in Children’s Literature**

Children’s books have been around since the 16th century, and have been a consistent medium for which children can learn about the world and themselves (Gooden & Gooden, 2001; Serafini & Moses, 2014). In the late 1800’s, authors began to target their books to either gender, and the messages to each were quite different (Peterson & Lach, 1990). Boys were subtly told to go out into the world, take action and become a leader where girls were meant to help them succeed in the private sector (Peterson & Lach, 1990). After a strong wave of feminism, women started questioning women’s representation in various aspects of life and began demanding different, more equal treatment (Gooden & Gooden, 2001). In such investigations, researchers have found discrepancies in the ways in which gender is portrayed through literature across all ages (Gooden & Gooden, 2001; Mattix & Sobolak, 2014; Nilsen, 1971). Although some claim that women are beginning to increasingly appear in children’s literature, others debate that there is still a substantial underrepresentation of women (Steyer, 2014). Nonetheless, the representation of women in children’s literature remains an issue today.
These underrepresentations speak a great deal about women’s worth in our society and can impact both girls and boys (Steyer, 2014). The representation of gender in children’s literature has been a topic of interest for at least the past four decades. However, the results seem to be static—women are still underrepresented and shown in mostly traditional roles whereas men are seen more often and in a larger variety of roles and professions. In Nilsen’s (1971) review of gender representations in literature she found that women were critically underrepresented in titles, and as characters. In fact, in four books, female characters were completely absent, compared to at least one male character being present in every single book (Nilsen, 1971). Often, when female characters were mentioned, they were in stereotypical roles and environments such as mother, or in the kitchen, cleaning or cooking (Diekman & Murnen, 2004). A multitude of studies similar to that of Nilsen’s have been completed over time, yet the results are nearly the same (Crabb & Marciano, 2011; Crisp & Hiller, 20011; Diekman & Murnen, 2004; Hamilton, Anderson, Broaddus, & Young, 2006; Kolbe & LaVoie, 1981; Kortenhaus& Demarest, 1993; Paynter, 2006; Taber & Woloshyn, 2011a; Taber & Woloshyn, 2011b; Taylor, 2003). Poarch and Monk-Turner (2001), Hendricks et al. (2010), and Mattix and Sobolak (2014) look at representations of gender in children’s literature in award winning books, books about various occupations and even New York Times Best Illustrated Books for Children, and all find that women are underrepresented and are most often seen in traditional household or caregiving roles.

Science Children’s Literature

Could an underrepresentation of girls and women in children’s literature possibly be contributing to the gender gap within the STEM fields? When looking at children’s literature that is science-specific, the results are quite similar to studies looking at general children’s books. Children learn a great deal about their worlds through the stories they read and listen to in their books. Often, the very first place that children hear about science and learn about difference scientists and their work is through literature (Owens, 2009). When studying science, it would make sense that the main focus of the story is science rather than other outside factors. However, this does not always seem to be the case. In looking at books written about science for children, gender seems to play a crucial role (Owens, 2009; Rawson & McCool, 2014). Researchers have studied biographies of scientists of both genders, general images of scientists, and specific fields such as engineering (Owens, 2009; Holbrook et al., 2009; Rawson & McCool,
In 2009, Owens explored the ways in which gender is present in stories about the well-known scientists, Madame Curie and Albert Einstein. Researchers claim that though science biographies have seemed to change the ways in which each story is told, gender is still crucial to the ways in which the characters are embodied (Owens, 2009). For example, many of the early books surrounding Curie’s work mention that she was at the top of her class due to hard work, but fail to mention all of the hurdles she had to overcome to get there in her position as a woman (Owens, 2009). In doing so, authors have insinuated that many other women were simply not hard workers (Owens, 2009). Later authors attempted to empower girls by making a point to say that Curie was making great strides for women, but fail to mention the historical context (Owens, 2009). Up through the most recent publication of a Marie Curie biography, gender was central to the story whether it be concerning one woman’s great accomplishments, or about the barriers women face (Owens, 2009).

In biographies about Albert Einstein, many children’s authors talk a great deal about his relationship with his wife Mileva (Owens, 2009). Many of the stories seem to wrongfully credit Mileva for her divorce from Einstein, and fail to mention that she, too, was a scientist (Owens, 2009). Some authors portray his second wife, Elsa, in a much more positive light claiming that she was able to be much more attentive and caring (Owens, 2009). It is not until 2002 that Mileva is pictured in such a way that recognizes her work as a scientist as well (Owens, 2009).

Additionally, these biographies send implicit messages about gender and education (Owens, 2009). Curie is often portrayed unrealistically as the perfect student and emphasizes her hard work and playing by the rules (Owens, 2009). Conversely, Einstein is perceived as a rebellious bad boy that does not want to go to school (Owens, 2009). Owens (2009) points out that both characters reacted similarly to their schooling yet are portrayed on complete opposite ends of the spectrum.

Also in 2009, Holbrook et al. studied the ways in which engineering is portrayed through 71 children’s books geared toward children ages 8 through 12. In examining the types of characters portrayed in these books, researchers found that 46.5% could be considered “eccentric or nerdy” as well as “unpopular or solitary” (Holbrook et al., 2009, p. 733). Further, 74% of all the central characters were male (Holbrook et al., 2009). The researchers noted that there are few activities that girls may find directly appealing (Holbrook et al., 2009, p. 735).
More recently in 2014, Rawson and McCool examined 1,117 images of scientists in 104 children’s books. The researchers examined the sample using a system developed by previous researchers that indicated 15 major stereotypes of scientists including: “Lab coat, Eyeglasses, Facial hair, Symbols of research, Symbols of knowledge, Technology, Relevant captions Male, Caucasian, Indications of danger, Presence of light bulbs, Mythic stereotypes, indications of secrecy, Scientists doing work indoors, and Middle aged or elderly” (Rawson & McCool, 2014, p. 11, 12). Results indicated that the mean score was 3.4, which means that drawings had roughly 3 of the qualities from the list (Rawson & McCool, 2014). Of the indicators, just two were present over half the time: male and Caucasian; however, doing work indoors was present nearly half the time (Rawson & McCool, 2014). Rawson and McCool (2014) put further emphasis on the misrepresentation of images of scientists by pointing out that 60% are Asian.

**Present Study**

Are women underrepresented as scientists in children’s books? Is science portrayed as male dominated fields that should be avoided by women? Perhaps these books are simply trying to paint a picture of reality, but this may have harmful side effects that feed the vicious circle of exclusion. Could these factors play into the perpetuation of gender stereotypes and perhaps thus the gender gap in the STEM fields? Further research is needed in order to be able to begin to answer these questions.

One area that has not yet been researched is the intersection of all of these factors. Researchers have examined the gender gap in the STEM fields, tackled the question of gender representation in children’s literature and begun to look at the ways in which gender is portrayed in science children’s literature. The question still remains as to how each gender is represented through children’s literature surrounding all content areas of science. Unlike Owen’s (2009) study, the proposed study aims to look at a list of science children’s books containing both fiction and non-fiction. Additionally, unlike Holbrook et al., (2009), this study intends to look at a wide sample of areas of science as opposed to just engineering. Lastly, the current research proposes to examine the text and titles in addition to Rawson and McCool’s (2014) work of studying images in children’s books.

The current study aims to measure the ways in which gender is portrayed through science children’s literature by completing a content analysis of The National Science Teachers’ Association’s (NSTA) list of Outstanding Science Trade Books for Student’s K-12: 2014. This
list contains 55 books for children grades pre-K through seven from differing content areas that have been approved for accuracy by science teachers and mentors. The books were analyzed quantitatively based on language used (use of nouns and pronouns) and illustrations, as well as qualitatively for stereotypical roles and other information. Based on previous research, hypotheses include: (1) Male nouns and pronouns, (names, he, him, his) will be used more often than female nouns and pronouns (names, she, her), (2) There will be more illustrations of males than females, (3) There will be more male oriented books than female oriented books, or gender balanced books, and more gender balanced books than there will be female oriented books. (4) No differences in gender representations will be seen between books targeted at different age groups., and (5) Gender representations will be equal in books with a focus on Life sciences, but not in those with a focus on Physical or Earth sciences.

Research Design

Materials

A content analysis of books included on The National Science Teachers’ Association’s (NSTA) list of Outstanding Science Trade Books for Student’s K-12: 2014 was completed. This is a collection of 55 science children’s books that have been reviewed and approved for content accuracy by science teachers and mentors (see Appendix A). Books on this list range widely in topic including, but not limited to, animals, volcanoes, insects, the ocean, the environment, scientists, anatomy, the solar system, engineering, nutrition, and plants. While books ranged in the age for which they were written, all books were designed for school-aged children. All books were obtained through Miami University libraries, Lane Public libraries, and both libraries’ inter-library loan systems.

Measurements

A coding manual created for this study was used to quantify gender representations in the selected books (See Appendix B). This coding manual included 25 items on which researchers were to evaluate for each book. The first 10 items asked researchers to examine general information about the book such as authors and illustrators and their respective genders, year of publication, title, content area and age range. The next five items required researchers to look at the cover page of the book in order to examine nouns and pronouns used in the title as well as gendered (or neutral) pictures on the front of the book. For the next two items, the content of the
book was examined for the frequency of male and female nouns and pronouns (he, she, him, her, his, names). Items 18-23 examine the images throughout the books content. These items are divided into “scientist,” “non-scientist,” and “neutral” images. Scientists can be either male or female and were considered to be those characters in science-related roles appearing in the content of the book. This generally included whatever scientific action the book was describing. Similarly, non-scientists can be of either gender and are those characters in non-science related roles. Gender neutral images are those of characters whose gender cannot be determined or animal characters. Item 24 assess equitability of roles given to male and female characters despite the frequency of male and female characters. Finally, item 25 allows for researchers to take notes and provide explanations of why they scored item 24 the way that they did.

After completing the above steps, the percentage of male (male words + male pictures), female (female words + female pictures) and neutral (neutral pictures) opportunities for each book were calculated based on the total number of opportunities (total male + total female + total neutral words and pictures) in that book. Then, each book was coded into one of three categories depending on the result of the frequency counts: Male Oriented (1.5 times more male than female), Female Oriented (1.5 times more female than male), Gender-Balanced (1.5 times greater neutral). Categories were determined to be male oriented, female oriented or gender-balanced strictly on the number of gendered (or neutral) images nouns and pronouns used in each book. Books were not considered to be male or female oriented based upon societal standards of gender roles.

Procedures

Each book listed on the NSTA Outstanding Trade Books list was obtained through Miami University Libraries, Lane Public Libraries, and each library’s inter-library loan system. Prior to beginning the analysis, the primary researcher trained a research assistant (an undergraduate student) on how to use the coding manual. Training consisted of the primary researcher explaining the coding manual to the assistant. Then, researchers jointly used the coding manual to analyze three children’s books that are not on the NSTA list in order to provide an opportunity for practice with the aim of enhancing inter-rater reliability. Next, five science children’s books were selected from Miami University’s library. Researchers coded each book independently using the coding manual, and then all discrepancies were discussed until
researchers reached an agreement. Finally, the research assistant examined approximately 33% of the NSTA Outstanding Trade Books independently in order to obtain inter-rater reliability. Each book was assigned a number, and then a random number generator was used to select 20 books from the list. Once all books were obtained, the primary researcher and the research assistant independently read and coded each book using the coding manual described previously.

**Results**

The data were analyzed using percent agreement to determine inter-rater reliability, descriptive statistics to summarize the data, and chi square tests to determine significant differences between categories (male, female balanced). The original list of books contained 55 children’s books (See Appendix A). Due to lack of specificity in the coding manual that led to inaccurate coding and thus skewed data, one book was eliminated. The final list analyzed therefore contained 54 books.

**Inter-Rater Agreement**

Inter-rater agreement was based on a selection of 20 books chosen randomly from the NSTA trade list containing 55 total books. It was determined that roughly 33% of the books should be coded by both raters to obtain inter-rater agreement. Therefore, the research assistant and the primary researcher both coded 20 of the same books. The remaining 35 books were coded independently by the primary researcher.

Percent agreement was used to determine inter-rater reliability (see Table 1). Although this statistic does have limitations, McHugh (2012) stated, “if researchers are well trained, and little guessing is likely to exist, the researcher may safely rely on percent agreement” (p. 282). Because both researchers were trained in the use of a coding manual, the use of percent agreement can be justified. Cohen’s Kappa was also considered, but rejected due to the nature of the data. McHugh (2012) states that, for Cohen’s Kappa, sample size should not be less than 30 cases in order to find significant results. Due to the small number of books coded by both researchers, obtaining significance using Cohen’s Kappa is unrealistic even in cases with near perfect agreement (see Table 1). When considering interrater reliability, typically 70% agreement or higher is considered to be acceptable (Barrett, 2001, as cited by Stemler, 2004). Interrater reliability was achieved for all variables with the exception of “equitable representations” and “targeted age range.” For this reason, these variables were excluded from data analysis.
Descriptive Statistics

Overall, males were more present in children’s literature, with the exception of images of scientists. The gender-balanced category contained the most books including 37 books and making up 68.5% of the list. Male oriented books represented 24.1% of the list and included 13 books, while there were only 4 female oriented books making up 7.4% of the total list (see Table 2 for descriptive data). On average, there were 15.9 (SD= 77.9) female scientists pictured as compared to 12.9 (SD=29.6) male scientists pictured per book. However, there were an average of 131.1 (SD= 249.9) male words per book in the books’ content as compared to only 93.5 (SD=199.8) female words per book. Additionally, male non-scientists outnumbered female non-scientists 21.4 (SD=65.0) to 11.7 (SD= 18.5). Gender-neutral pictures greatly outnumbered male and female images with 142.7 (SD= 336.3) per book. The majority of authors were female (69.1%), whereas illustrator gender was roughly equal (29.1% male, 30.9% female). Most books had a focus in life science (80%) while only 18.2% had a focus on physical science, and 16.4% had a focus on earth science. Just over half (54.5%) of the books were targeted at children ages preschool through 3rd grade while 43.6% were targeted for children in grades 4-9.

Chi Square Tests

Finally, chi square tests were completed in order to determine if significant differences exist between the categorical data (see Table 3). Chi square tests were completed to see if (a) the gender classification (male-oriented, female-oriented, balanced) is independent of author/illustrator gender, (b) the gender classification is independent of the content area of the book (earth, physical or life science), and (c) gender classification is independent of the targeted age range of the book. The only significant difference was found between gender classification and the focus area of life science ($\chi^2 (2, N = 53) = 12.98, p <.01$). Review of the observed and expected cross tabulation values suggests that books with a life science focus were categorized as male-oriented or female-oriented less often than expected, and were categorized as gender balanced more often than expected.

Discussion

This study sought to reveal gender distributions and gender roles within children’s books about science. The hypotheses were confirmed or denied as follows. The first hypothesis that Male nouns and pronouns (names, he, him, his) will be used more often than female nouns and pronouns (names, she, her) was confirmed. The second hypothesis, that there will be more
illustrations of males than females, was inconclusive as there were more female scientists, but more male non-scientists. Third, the hypothesis that there will be more male-oriented books than female-oriented books, or gender balanced books, and more gender balanced books than there will be female-oriented books had mixed results. There were the most gender-balanced books, but more male-oriented books than female books. Lastly, the fourth and fifth hypotheses regarding age range and equitable representations could not be analyzed due to unreliability in the data surrounding these categories. Chi-square tests revealed that gender classifications were affected by books with a focus in life sciences differently than expected. Life science books were categorized as gender-balanced more often than expected and categories as male-oriented or female-oriented less often than expected.

Overall, it would seem that although females are still not recognized individually as capable scientists as men once were, they are beginning to be included in the conversation. Though men were overwhelmingly portrayed more as non-scientists, were talked about much more, and had more books targeted toward their gender, women were in fact portrayed as scientists more often. However, these results are not without limitations and qualifications.

**Interpretations**

Generally, findings in this study are comparable to conclusions from prior research. This topic has been discussed since 1971, yet women are still underrepresented more than 40 years later. In Nilsen’s (1971) study of gender representations in children’s books, women were well underrepresented. Since then, award winning children’s books and New York Times Best Sellers books have been examined for gender representations and found that men are portrayed more often than women. A content analysis of the National Science Teachers Associations choice of science trade books seems to be following the same trend.

Previously, children’s books about science have favored men and boys. For example, Owens (2009) found that gender was crucial to the ways in which Einstein and Curie’s stories are told. Holbrook et al. (2009) found that engineers are portrayed almost exclusively as male. Rawson and McCool (2014) also found that scientists are portrayed as male a majority of the time. Though women were portrayed more often than men as scientists in this study, men outnumbered women as non-scientists and in nouns and pronouns indicating that it may still be easier for boys to identify with the science fields than girls. Overall, books generally geared towards girls made up only 7% of the total list while books geared towards boys made up 24% of
Though some progress may have been made, as there were 4 books oriented solely towards girls, there is still a great deal of ground to be gained.

**Limitations**

Though female scientists were portrayed more often than male scientists, this discrepancy could in part be due to an outlier book. One book was a comic-like picture book about the lives of three female primatologists. Therefore, many female scientists were pictured—more so than the average book. When this book was eliminated from the data, the average number of female scientists decreased by 10 images which also made the average number of female scientists roughly four less than the average number of male scientists.

Another limitation is the nature of the list of books selected. Because the list of books chosen was reviewed and approved by science teachers, it is possible that the reviewers tried to select a more diverse pool of books. While gender distribution was not a criterion for the books to appear on the NSTA list, because the list of books was reviewed and approved, other factors could have been taken into consideration.

This is the first known study in which children’s science books were analyzed using a coding manual and two examiners. This leaves room for error in using the manual and coding the books. Although researchers were trained on how to use the manual and ensured agreement on all items before beginning to code the NSTA books, practice books were often very different from target books, which left room for interpretation. Additionally, the coding manual was ambiguous on what was defined as “scientific action” which led to coding difficulty, specifically when the book had a focus on the lives of animals. Further, the manual left room to count animals as scientists as they were completing the action being described in the text, which may paint an inaccurate picture of the distribution of scientists and non-scientists.

Lastly, the interrater reliability analysis is a limitation of this study. The sample used by researchers to ensure interrater reliability was 20 books. In order to be able to achieve significance using Cohen’s Kappa, the sample must be at least 30. For this reason, percent agreement was utilized, though this method does not account for the possible error in coding.

**Future Research**

Although this study has shed some light on how gender is represented in children’s science literature, there are still many questions left to answer. Possibilities for future research include replications with the same manual or manual updates, replications with books that have
not been reviewed, examining race or other factors besides gender, and looking at how these
gender distributions affect children. These findings need to be replicated to ensure the accuracy
of the manual as well as to determine the effect of the NSTA approved book list. Additionally,
there are other disparities, such as race, within the STEM fields that could be explored. Further,
it would be interesting to determine how these gender distributions affect real students. Are girls
discouraged by what they read and see in science books, or are they unfazed? Additionally,
research should explore which books students actually have access to, such as those in a teacher
library, and examine the gender distributions in these books.

Implications

The results of this study have several implications for education and learning. Overall,
the underlying message portrayed through children’s literature is beginning to change. Girls are
beginning to be portrayed as equals in the realm of science and there are many more books
aimed toward boys and girls as opposed to just boys. However, there are still few books solely
about women and girls in science while there are a great deal more about men and boys in
science. Additionally, while female scientists are being depicted at a much higher rate, they are
still being talked about far less than their male counterparts. Nonetheless, girls are gaining more
opportunity to learn about women in science-related roles, and have many more characters and
role models to which they can compare themselves. Though we cannot say that all children’s
literature is improving, there is some improvement in books being promoted by experts in their
field. Authors, illustrators, editors and publishers must consider these findings when producing
future books and aim to include more equitable distributions of gender in future publications to
help ensure that everyone is represented in the STEM fields.

Additionally, these findings have implications for parents and educators. Are adults
providing girls with enough appropriate materials for them to identify with the field of science?
Classrooms and school libraries need to ensure that girls have access to books that promote
science to girls if not both genders equally. We must ensure that the books on our shelves
include strong female scientists in addition to the already well-known male scientists. Science
lessons should include women who have contributed to the field as well as men. If we cannot
say these things to be true, we must find other ways to incorporate female scientists into
classroom discussions. For example, educators and parents can seek out additional resources
such as women who are already working in the STEM fields to act as role models for female
students. Educators and parents can also encourage girls to take science courses and assume leadership roles in classroom science experiments alongside of their male peers. Are adults acting as critical consumers of literature and thinking about the implications of the books we buy for our students and children? Parents and educators must carefully read and analyze the books that we choose to buy to ensure that women are not only represented, but are fulfilling critical science roles, not only supporting roles, within these books. It is our duty as educators to provide our students with equal opportunity and encourage all students to pursue a variety of subjects. The gap within the STEM fields will not close if we do not facilitate a passion for science education within our students, regardless of their gender.
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Appendix A

List of NSTA Outstanding Science Trade Books for Student’s K-12: 2014

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animals Upside Down.</td>
<td>Steve Jenkins and Robin Page</td>
</tr>
<tr>
<td>Best Foot Forward.</td>
<td>Ingo Arndt.</td>
</tr>
<tr>
<td>Beyond the Solar System.</td>
<td>Mary Kay Carson.</td>
</tr>
<tr>
<td>Cougar.</td>
<td>Stephen Person.</td>
</tr>
<tr>
<td>The Dolphins of Shark Bay.</td>
<td>Pamela S. Turner.</td>
</tr>
<tr>
<td>The Eagles Are Back.</td>
<td>Jean Craighead George.</td>
</tr>
<tr>
<td>Eat Like a Bear.</td>
<td>April Pulley Sayre.</td>
</tr>
<tr>
<td>Eight Dolphins of Katrina.</td>
<td>Janet Wyman Coleman</td>
</tr>
<tr>
<td>Electrical Wizard.</td>
<td>Elizabeth Rusch.</td>
</tr>
<tr>
<td>Eruption!</td>
<td>Elizabeth Rusch.</td>
</tr>
<tr>
<td>Ferdinand Fox's First Summer.</td>
<td>Mary Holland.</td>
</tr>
<tr>
<td>Frog Song.</td>
<td>Brenda Z. Guiberson.</td>
</tr>
<tr>
<td>Giant Pacific Octopus.</td>
<td>Leon Gray.</td>
</tr>
<tr>
<td>Here Come the Humpback Whales!</td>
<td>April Pulley Sayre.</td>
</tr>
<tr>
<td>Lifetime.</td>
<td>Lola M. Schaefer.</td>
</tr>
<tr>
<td>Lives of Scientists.</td>
<td>Kathleen Krull.</td>
</tr>
<tr>
<td>National Geographic Kids First Big Book of the Ocean.</td>
<td>Catherine D. Hughes.</td>
</tr>
<tr>
<td>Next Time You See a Firefly.</td>
<td>Emily Morgan</td>
</tr>
<tr>
<td>Next Time You See a Pill Bug.</td>
<td>Emily Morgan</td>
</tr>
<tr>
<td>Next Time You See a Sunset.</td>
<td>Emily Morgan</td>
</tr>
<tr>
<td>No Monkeys, No Chocolate.</td>
<td>Melissa Stewart and Allen Young.</td>
</tr>
<tr>
<td>Ocean Counting.</td>
<td>Janet Lawler.</td>
</tr>
<tr>
<td>On the Move.</td>
<td>Scotti Cohn.</td>
</tr>
<tr>
<td>One Minute Mysteries.</td>
<td>Eric Yoder and Natalie Yoder.</td>
</tr>
<tr>
<td>Papa’s Mechanical Fish.</td>
<td>Candace Fleming.</td>
</tr>
<tr>
<td>A Place for Turtles.</td>
<td>Melissa Stewart.</td>
</tr>
<tr>
<td>Primates.</td>
<td>Jim Ottaviani.</td>
</tr>
<tr>
<td>Title</td>
<td>Author</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Roseate Spoonbill.</td>
<td>Stephen Person.</td>
</tr>
<tr>
<td>Scaly Spotted Feathered Frilled.</td>
<td>Catherine Thimmesh.</td>
</tr>
<tr>
<td>See What a Seal Can Do.</td>
<td>Chris Butterworth.</td>
</tr>
<tr>
<td>Seymour Simon’s Extreme Oceans.</td>
<td>Seymour Simon.</td>
</tr>
<tr>
<td>Snow School.</td>
<td>Sandra Markle.</td>
</tr>
<tr>
<td>Something Stinks.</td>
<td>Gail Hedrick.</td>
</tr>
<tr>
<td>Stripes of All Types.</td>
<td>Susan Stockdale.</td>
</tr>
<tr>
<td>Stronger Than Steel.</td>
<td>Bridget Heos.</td>
</tr>
<tr>
<td>The Tapir Scientist.</td>
<td>Sy Montgomery.</td>
</tr>
<tr>
<td>Things That Float and Things That Don’t.</td>
<td>David A. Adler.</td>
</tr>
<tr>
<td>Too Hot? Too Cold?</td>
<td>Caroline Arnold.</td>
</tr>
<tr>
<td>Tracking Tyrannosaurs.</td>
<td>Christopher Sloan.</td>
</tr>
<tr>
<td>Ultimate Bugopedia.</td>
<td>Darlyne Murawski and Nancy Honovich.</td>
</tr>
<tr>
<td>Up, Up in a Balloon.</td>
<td>Lawrence F. Lowery.</td>
</tr>
<tr>
<td>Volcano Rising.</td>
<td>Elizabeth Rusch.</td>
</tr>
<tr>
<td>What If You Had Animal Teeth!?</td>
<td>Sandra Markle.</td>
</tr>
<tr>
<td>What’s In There?</td>
<td>Robie H. Harris.</td>
</tr>
<tr>
<td>When Rivers Burned.</td>
<td>Linda Crotta Brennan.</td>
</tr>
<tr>
<td>Yummy!</td>
<td>Shelley Rotner and Sheila M. Kelly.</td>
</tr>
</tbody>
</table>

Note: Flight of the Honey Bee was removed from all statistical analyses
Appendix B
Coding manual for Content Analysis of Science Children’s Literature

This manual contains detailed instructions for coding each of the variables from the books included in the content analysis. Each bold term corresponds to the variable names in the SPSS database (these are listed in the same order).

1. Authors- write the names of the authors as they would appear in a reference list (e.g., “Mcloughlin, C.S., & Noltemeyer, A.L.”)

Variable: String

2. Authors’ Gender(s)- Is the author male, female, a combination of males and females or neither male nor female?

Variable: Nominal
Category: 1= Male
         2= Female
         3= Both
         4= Neither

3. Illustrator(s)- write the names of the illustrators as they would appear in a reference list (e.g., “Mcloughlin, C.S., & Noltemeyer, A.L.”)

Variable: String

4. Illustrator(s) Gender(s) - Is the illustrator male, female, a combination of males and females or neither male nor female?

Variable: Nominal
Category: 1= Male
         2= Female
         3= Both
         4= Neither

5. Year- Write the date of publication

Variable: Scale

6. Title- Write the full title of the publication

Variable: String

7. Content Area: Physical Sciences- Does the book have a focus within the Physical Sciences (e.g. chemistry, physics, engineering)?
8. **Content Area: Earth Sciences**- Does the book have a focus within the Earth Sciences (e.g. astronomy, oceanography, geology)?

Variable: Nominal
Category: 1 = Yes
2 = No

9. **Content Area: Life Sciences**- Does the book have a focus within the Life Sciences (e.g. biology, zoology, paleontology, botany)?

Variable: Nominal
Category: 1 = Yes
2 = No

10. **Age Level**- Write the number associated with the targeted age range of each book. If the age range spans both ranges listed below (e.g., grades 1-4) select the one that overlaps most with that age range (e.g., for grades 1-4, select “1”).

Variable: Nominal
Categories: 1 = Preschool-3
2 = 4-9

11. **Male oriented nouns and pronouns in the title**- Write the total number of male oriented pronouns occurring in the title (e.g. names, he, his, or him).

Variable: Scale

12. **Female oriented nouns and pronouns in the title**- Write the number female oriented pronouns occurring in the title (e.g. names, she, or her)

Variable: Scale

13. **Group oriented pronouns in the title**- Write the number of group oriented pronouns occurring in the title (e.g. we, they or them).

Variable: Scale
14. **Male illustrations on the cover page** - Write the number of images of males appearing on the cover page of the book (only include images of animals if they are distinctly male judging by clothing or identified by name).

Variable: Scale

15. **Female illustrations on the cover page**– Write the number of images of females appearing on the cover page of the book (only include images of animals if they are distinctly female judging by clothing or identified by name).

Variable: Scale

16. **Gender neutral character illustrations on the cover page**- Write the number of images of gender neutral characters appearing on the cover page of the book (non-gendered animals, or other characters).

Variable: Scale

17. **Male oriented nouns and pronouns in book content**– Write the number of male oriented nouns and pronouns that occur within the content of the book (e.g. names, he, him, or his).

Variable: Scale

18. **Female oriented nouns and pronouns in book content** – Write the number of female oriented nouns and pronouns that occur within the content of the book (e.g. names, she, or her).

Variable: Scale

19. **Male Scientist illustrations in book content**- Write the number of images of males in science-related roles appearing in the content of the book (only include images of animals if they are distinctly male judging by clothing or identified by name).

Variable: Scale

20. **Female Scientist illustrations in book content**- Write the number of images of females in science related roles appearing in the content of the book (only include images of animals if they are distinctly female judging by clothing or identified by name).
Variable: Scale

21. Male non-scientist illustrations in book content- Write the number of images of males in non-science related roles appearing in the content of the book (only include images of animals if they are distinctly male judging by clothing or identified by name).

Variable: Scale

22. Female non-scientist illustrations in book content- Write the number of images of females in non-science related roles appearing in the content of the book (only include images of animals if they are distinctly female judging by clothing or identified by name).

Variable: Scale

23. Gender neutral character illustrations in book content- Write the number of images of gender neutral characters appearing in the content of the book (non-gendered animals, or other characters).

Variable: Scale

24. Equal Representations- Answer the question “was each gender portrayed equally to the other?” (e.g. were boys more often seen handling equipment, doing experiments, in superior roles/positions, etc.?)

Variable: Nominal
Categories: 1 = yes
          2 = no

25. Notes- Write any notes regarding qualitative information about the roles and position of women/girls in the stories.
Table 1

*Interrater Reliability*

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent Agreement</th>
<th>Cohen’s Kappa</th>
<th>Cohen’s Kappa Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author Gender</td>
<td>100</td>
<td>1.0</td>
<td>.000</td>
</tr>
<tr>
<td>Illustrator Gender</td>
<td>95</td>
<td>.255</td>
<td>.178</td>
</tr>
<tr>
<td>Focus in Life Science</td>
<td>75</td>
<td>.184</td>
<td>.328</td>
</tr>
<tr>
<td>Focus in Physical Science</td>
<td>80</td>
<td>.385</td>
<td>.071</td>
</tr>
<tr>
<td>Focus in Earth Science</td>
<td>70</td>
<td>.400</td>
<td>.051</td>
</tr>
<tr>
<td>Targeted Age</td>
<td>65</td>
<td>.913</td>
<td>.000</td>
</tr>
<tr>
<td>Equitable Representations</td>
<td>60</td>
<td>.266</td>
<td>.154</td>
</tr>
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</table>
Table 2

Descriptive Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Words Content</td>
<td>131.19</td>
<td>19.50</td>
<td>249.97</td>
</tr>
<tr>
<td>Female Words Content</td>
<td>93.52</td>
<td>12.00</td>
<td>199.76</td>
</tr>
<tr>
<td>Male Scientists</td>
<td>12.98</td>
<td>4.50</td>
<td>29.60</td>
</tr>
<tr>
<td>Female Scientists</td>
<td>15.93</td>
<td>1.0</td>
<td>77.92</td>
</tr>
<tr>
<td>Male Non-Scientists</td>
<td>21.43</td>
<td>3.00</td>
<td>65.01</td>
</tr>
<tr>
<td>Female Non-Scientists</td>
<td>11.65</td>
<td>2.00</td>
<td>18.50</td>
</tr>
<tr>
<td>Gender Neutral Images</td>
<td>142.69</td>
<td>33.5</td>
<td>336.33</td>
</tr>
</tbody>
</table>
Table 3

*Chi Square Statistics*

<table>
<thead>
<tr>
<th>Category</th>
<th>Chi-square</th>
<th>Significance</th>
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<tbody>
<tr>
<td>Author Gender*Category</td>
<td>3.127</td>
<td>.537</td>
</tr>
<tr>
<td>Illustrator Gender*Category</td>
<td>2.027</td>
<td>.731</td>
</tr>
<tr>
<td>Physical Science*Category</td>
<td>2.975</td>
<td>.226</td>
</tr>
<tr>
<td>Earth Science* Category</td>
<td>.199</td>
<td>.905</td>
</tr>
<tr>
<td>Life Science * Category</td>
<td>12.980</td>
<td>.002</td>
</tr>
<tr>
<td>Age Range* Category</td>
<td>1.197</td>
<td>.550</td>
</tr>
</tbody>
</table>
Table 4

Male to Female Ratio per book

<table>
<thead>
<tr>
<th>Book</th>
<th>Male:Female Scientists</th>
<th>Male:Female Non-scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Animal Book.</td>
<td>1:0</td>
<td>0:0</td>
</tr>
<tr>
<td>The Animal Book.</td>
<td>0:0</td>
<td>45:1</td>
</tr>
<tr>
<td>Animals Upside Down.</td>
<td>1:0</td>
<td>0:0</td>
</tr>
<tr>
<td>Best Foot Forward.</td>
<td>0:0</td>
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