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ABSTRACT

A qualitative study analyzed images of science and scientists in children's educational science programs on television to determine whether they conveyed the images found in other media. Four episodes of each of four 30-minute, non-animated programs ("Beakman's World" broadcast on CBS, "Bill Nye, The Science Guy" shown on independent stations, "Mr. Wizard's World" which airs on Nickelodeon/MTV, and "Newton's Apple" broadcast nationally on PBS stations) were analyzed. Results indicated that the programs perpetuated the image of science as truth, while providing little evidence for the image of science as magical and mixed evidence for the image of science as dangerous. Results also indicated that the programs perpetuated the image of scientists as omniscient and elite, and they did not promote the image of scientists as evil. Four other images of science and scientists emerged: science as fun, science as part of everyday life, science is for everyone, and scientists as benign. (Contains 28 references.) (Author/RS)

Images of Science and Scientists on Children's Educational Science Programs

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Abstract

Images of Science and Scientists on Children's Educational Science Programs

This qualitative study analyzed images of science and scientists in children's educational science programs on television to determine whether they conveyed the images found in other media. Results show the programs perpetuated the image of science as truth, while providing little evidence for the image of science as magical and mixed evidence for the image of science as dangerous. Results also show the programs perpetuated the image of scientists as omniscient and elite, and they do not promote the image of scientists as evil.

Four other images of science and scientists emerged from this study: science as fun, science as a part of everyday life, science is for everyone, and scientists as benign.

Images of Science and Scientists on Children's Educational Science Programs

Images of science and scientists have appeared on television for many years. These images have been broadcast on prime-time dramatic series, soap operas, newscasts, documentaries, docudramas, and children's educational programs. Recently, images of science and scientists on television have become even more prevalent as the number of children's educational shows devoted to science has increased. This increase may stem from the Federal Communications Commission's 1993 announcement that shows like "The Flintstones" no longer fulfill FCC licensing regulations that require broadcasters to provide educational and informational programming for young viewers (O'Connor, 1993; Walter, 1993).

While the FCC directive has not revolutionized children's programming, now children are more likely to encounter science shows as they flip through network, cable, public, and independent channels. On average, children watch between two and four hours of television per day, and 98 percent of U.S. households have televisions (Chen, 1994). Consequently, even a small increase in children's science television programming is significant.

The recent growth in children's educational science programs provides a good opportunity to compare these current images of science and scientists to traditional media images. These current images are important to examine because research on

social learning theory indicates that children can learn attitudes, behaviors, and social stereotypes from television (Bandura, 1986). In fact, researchers have found that children's science shows appear to influence children's attitudes toward careers in science (Chen, 1994) and that children hold some stereotypical views of science and scientists (Boylan et al., 1992; Font and Varney, 1989; Schebeci, 1986; Chambers, 1983).

The purpose of this study is to qualitatively analyze the images of science and scientists in four children's science shows: "Beakman's World," which appears on CBS; "Bill Nye, the Science Guy," which is shown on independent stations; "Mr. Wizard's World," which airs on Nickelodeon/MTV, and "Newton's Apple," produced by KCTA-TV in St. Paul and broadcast nationally on PBS stations. These four shows represent the major outlets for television programming (i.e., network, cable, independent, and public television), and represent the range of available programs.

MEDIA IMAGES OF SCIENCE AND SCIENTISTS

Researchers have studied the images associated with science and scientists in many media venues including prime-time television, newspapers, magazines, and movies. Taken together, these studies do not indicate a unified stereotype of science or of scientists. Rather it seems that specific images of science and scientists have cropped up at different times and in different media outlets. Therefore, instead of looking for a

unified stereotype in current children's educational science shows, we looked for the presence of the specific images. These images are outlined in the following sections.

Images of Science

Science as Mysterious or Magical

Petkova and Boyadjieva (1994) state that the image of science as mystical is rooted in ancient Greece when science had to "veil itself in mystery" to garner acceptance. Hornig (1990) states that this image is perpetuated because scientific activity is rarely revealed or explained. She writes:

> We are shown endless bottles of chemicals and various liquids dripping through complicated glassware constructions, but little in the way of human actions. (p. 18)

Nelkin (1990) asserts that the alchemy image is one of several metaphors present in press reports about science.

> Scientists are magicians, miracle workers, wizards, discovering ultimate truths, secret knowledge, magic bullets. (p. 42)

LaFollette (1990) suggests that this image has helped journalists report on science:

> Many people, including professional writers, believed that science was simply beyond understanding; the metaphor of magic enabled one to discuss the topic without really comprehending it. (p. 100)

Science as Dangerous or Violent

The dangerousness of scientific advancements has served as fodder for numerous movies, such as "Jurassic Park," "2001: A

Space Odyssey," and "The China Syndrome."

In his analysis of horror films shown between 1931 to 1984, Tudor (1989) reports:

> The belief that science is dangerous is as central to the horror movie as is a belief in the malevolent inclinations of ghosts, ghouls, vampires, and zombies. (p. 133)

This image of the danger and violence of science is also perpetuated in television entertainment. For example, many episodes of "The Twilight Zone" projected a foreboding image of technology (Banks and Tankel, 1990). Similarly, the "Star Trek" series would frequently depict technology taking over the society that developed it, often dehumanizing that society; in these episodes, however, the Enterprise's crew always rescued the society from its technology (Banks and Tankel, 1990; Saunders, 1994).

Print media also tend to depict science as dangerous and violent. For example, magazine coverage of nuclear weapons development after Hiroshima emphasized the dangerous and violent nature of science, according to LaFollette (1990).

> They [the magazines] characterized the new bomb, an "apocalyptic mushroom-topped mountain of nuclear fire," as "the greatest threat to the survival of the human race since the Black Death." (p. 105)

A concern for the negative consequences of scientific development also colored early magazine coverage of computer development (LaFollette, 1990).

Science as Truth

A recurring image of science in the media shows science as truth. Science is often presented as accurate, infallible, and above criticism. LaFollette (1982) found that "any information labeled as 'scientific' is uncritically accepted as fact."

Bennett (1986) states journalists encourage the "science as truth" image by emphasizing the "facts" of science in their stories as opposed to emphasizing the process of science. Consequently, Bennett argues,

> The result is a disturbing overemphasis on the authority of science as a source of truth, rather than on its revolutionary potential as a way of thinking. (p. 127)

Television images present science as the ultimate form of truth by focusing on its inviolability. For example, Lessl (1985) argues that the images conveyed by the language and rhetoric of the PBS program "Cosmos" promote the sacredness of science. He states:

> "Cosmos" is an attempt to ground science in a higher order, to place science within the realm of the sacred, and consequently to remove it from the banalities of profane existence. (p. 183)

In her analysis of the PBS series "NOVA," Hornig (1990) noted that the sacredness of science was conveyed through the portrait of scientists as "high priests who negotiate for us between their mysterious world and our more mundane one" (p. 17).

Broad and Wade (1982) and Nelkin (1987) found that even instances of scientific fraud do not taint the sacredness of science. In these cases, the scientific community labels the

fraudulent scientists, not the scientific enterprise, as deviant.

Gardner and Young (1981) assert that typical presentations of scientific information on television reinforce the image of science as superior to other forms of inquiry. According to Gardner and Young, a typical presentation is a segment that alternates between interviewer voice-overs and talking head shots of scientists in white lab coats surrounded by scientific instruments. Such presentations, according to Gardner and Young, "convey a sense of authority and the advancing edge of objectivity" (p. 178). Nelkin (1987) states that newspaper journalists also help perpetuate this image of science as "a superior form of knowledge."

The image of science as authority is not ubiquitous. Silverstone (1991) found that the prevalence of this image varies depends on the type of television program. He claims programs that focus on scientific discoveries and processes often present science "as an orderly activity that moves human knowledge toward certainty," while programs that focus on social and political issues and controversies often "reflect uncertainty."

Science as a Cure for Problems

Another common image in the media is science as a way to solve problems, particularly social problems. This image of science has been promoted in television since the 1960s, according to Dunn (1979). Banks and Tankel (1990) found this image in the prime-time, science fiction series "Star Trek: Next

Generation." In this show, scientific and technological achievements are depicted as a means of effecting social change and as a way of maintaining social stability.

LaFollette (1981) found some children's programs present scientists as saviors "who do what they can to help rebuild the world" (p. 11). Nelkin (1987) also found this image in newspaper coverage of science education. She asserts that the numerous articles about the crisis in science education perpetuate the view that science is a national resource.

Images of Scientists

Scientists as Omniscient

The image of the all-knowing scientist is common in media portrayals of scientists. For example, Silverstone (1984) found evidence of this image in his analysis of the BBC program "Horizons." Similarly, in her analysis of NOVA episodes, Hornig (1990) notes:

> The scientist is the man (or, more rarely, woman) called upon to rationalize the mystery recounted or even recreated in the show's opening scenes; framed against a background symbolic of his role, the scientist appears -- typically after an abrupt cut from a gripping dramatization -- as reason and authority personified, the self-confident master of malevolent forces. (p. 21)

An excellent example of the omniscient scientist on television is The Professor from "Gilligan's Island," who could answer any question and solve nearly every problem, except, of course, how to get off the island. Another good example is Quincy, a forensic scientist who can take a blood sample from a corpse and

determine the exact time and place of death.

Nelkin (1987) and LaFollette (1990) found the image of omniscient scientists to be so strong in newspapers and magazines that scientists were often asked to comment on topics outside of their areas of scientific expertise. Scientists were asked their opinions on a host of nonscientific issues including the way to achieve world peace.

Scientists as Elite

Media often portray scientists as having special status (Nelkin, 1990). This image is most striking in the way that male Nobel laureates are portrayed in news stories as "isolated, removed, and more than slightly above the rest of humanity" (Nelkin, 1990, p. 42).

Hornig (1990) asserts that the elitist image is perpetuated by showing scientists more often explaining science than doing science. Assistants or technicians perform the mundane work of science, while scientists have the more glamorous job of explaining science to nonscientists (Hornig, 1990).

The special status of scientists is often emphasized by their attire and appearance. For example, a scientist's white lab coat serves to separate the scientist from others. LaFollette (1981) describes the typical image of science in television programming for children:

> Fictional scientists are most often 'professors' and are shown wearing white lab coats, whatever their specific field of research. (p. 17)

Scientists as Eccentric and Antisocial

In contrast to the image of scientists as elite is the image of scientists as eccentric and socially unskilled. Television programs often present scientists as eccentric individuals (Dunn, 1979). In an analysis of prime-time dramatic TV programs, Gerbner (1987) found that scientists often were presented as strange, forbidding, and antisocial. LaFollette (1981) notes that most representations of scientists in children's programming "emphasize the eccentricities or the unusual features of scientists" (p. 17).

In newspapers, male scientists are portrayed as eccentric, "as socially removed, apart from, and above most normal human preoccupations" (Nelkin, 1987). Another frequent image, Nelkin reports, is the dedicated male scientist who spends 12 hours a day, every day, at work.

Successful female scientists, on the other hand, are characterized differently. Nelkin (1987) gives the following account of the coverage of female Nobel laureates:

> Far from being insulated, and apart from ordinary mortals, women scientists are admired for fitting in and for balancing domestic with professional activities. (p. 20)

Scientists as Evil or Violent

Basalla (1976) noticed this image in children's television cartoons and educational programs. He found that educational programs, like "Electric Company," presented scientists as insane and out of control. Gerbner et al. (1981) found scientists were

more likely to be portrayed as violent and more likely to fail than were other professionals. The researchers added that "on weekend children's programs they [scientists] were also judged to be less rational and stable and much more violent than other characters" (p. 42). LaFollette (1981) found that evil or villainous scientists on children's programs act for personal gain, enjoyment or notoriety.

Dunn (1979) also found this evil image of scientists:

> In the popular culture of the thirties, forties and fifties (movies, radio, comics) the relationship between science and society, chronically ambivalent, focused on a stereotype of the mad, despotic scientist bent on ruling or destroying an imperfect world. (p. 345)

Basalla (1976) provides further evidence that these images reach back to the 1930s. According to Basalla,

> In comic strips the villainous scientist is recognized by his title of Doctor or Professor, his peculiar features and personality, his well equipped laboratory, his intellectual brilliance, and his nefarious schemes. (p. 261)

METHOD

To identify the images of science and scientists on children's educational science programs, we analyzed four episodes of each of the following 30-minute, nonanimated programs: "Beakman's World," "Bill Nye, The Science Guy," "Mr. Wizard's World," and "Newton's Apple." All of the programs we analyzed were broadcast in the five-month period between February and June 1994. To ensure that the episodes we analyzed were typical, we viewed, but did not analyze, several additional

episodes of each program.

Program Descriptions

Mr. Wizard's World. A typical episode of "Mr. Wizard's World" includes approximately seven segments that take a serious look at science through experimentation and explanation. These segments show Mr. Wizard, played by Don Herbert, engaged in one of several activities: (1) performing an experiment with help from one of his 10- to 12-year-old apprentices; (2) explaining how science is being applied in various places around the country; (3) explaining the science behind an object; or (4) assisting one of his apprentices with an at-home science project. The program covers an array of science topics, including biology, chemistry, physics, nutrition and geography.

The central location for the show is Mr. Wizard's home. Children visit Mr. Wizard and help him conduct science experiments in his living room/den, kitchen, or what appears to be a garage converted into a lab. Each room contains items appropriate to that room's function, in addition to a long table filled with the equipment needed for science experiments.

Beakman's World. In "Beakman's World," Beakman answers viewer questions, typically six to eight questions per show. Some questions only require short answers, (e.g., "what's the largest body organ?"), while others require more extensive explanations, often involving demonstrations and simulations (e.g.,"how come hot things like cocoa get cool, and cool things

like chocolate milk get hot?"). These questions cover diverse areas, including biology, physiology, physics, technology, medicine, and psychology.

Beakman's World is inhabited by three adults: Beakman, played by performance artist Paul Zaloom; Josie or Liza, female assistants, one of which appears on each show; and Lester, a male assistant dressed in a rat suit.

As its name indicates, the show's setting is Beakman's world, which is a large, two-story stage that is cluttered with a mix of scientific (e.g., racks of beakers, a skeleton, a picture of Einstein, an atomic energy sign) and non-scientific (e.g., a sofa, a basketball hoop, a car tire, flashing siren lights) paraphernalia.

Bill Nye, The Science Guy. Each episode of this program focuses on a theme, such as circulation and blood, static electricity, chemical reactions, magnetism, biodiversity, or sound. Each episode has several segments, all related to that week's theme. Segment activities include the following: (1) at-home experiment demonstrations; (2) on-location interviews with scientists; (3) music videos about that week's theme; (4) demonstrations and explanations of various scientific principles; and (5) spoofs of other television programs.

Bill Nye, a stand-up comic and former mechanical engineer, shares the stage with several children, and celebrities sometimes stop by to help Bill explain science.

The central location for the show is the "Nye Labs," an area

that is reminiscent of a warehouse floor that has been sectioned into large rooms. The labs contain much scientific equipment both in the foreground and background. Often while Bill conducts experiments and demonstrations in the foreground, children are also conducting experiments in the background. The background in the Nye Labs is often bathed in colorful lights, several of which are flashing.

Newton's Apple. Like "Beakman's World," "Newton's Apple" concentrates on answering viewers' questions. During the show, David Heil, the show's host, and field reporter Peggy Knapp find the answers to questions about physiology, technology, nature, physics, medicine, and chemistry, among others. David and Peggy are often joined in their search for answers by naturalist Nancy Gibson. Children are rarely featured on the show, and celebrities make cameo appearances in a segment called "Science of the Rich and Famous."

The central setting for "Newton's Apple" are large rooms on a sound stage that resemble the rooms in a house. Some segments take place in David's office or his living room. Many segments, however, are filmed on location, such as a segment at the Columbia River Gorge about windsurfing and a segment at the Como Zoo in St. Paul, Minnesota, about zebras.

Themes Analyzed

Our analysis of each program involved looking for examples of the following images: science as mysterious or magical, as

dangerous or violent, as truth, and as a cure for problems; and scientists as omniscient, elite, eccentric, and antisocial. Before analyzing the programs, we agreed upon what would constitute examples of each image, based on the literature review. The following were our guidelines:

1. Science as mysterious or magical--actors not explaining science, references to mysterious happenings, references to magic;

2. Science as dangerous or violent--explosions, references to bodily harm, references to adverse effects of scientific processes and experiments;

3. Science as truth--references to science as the way to find answers, lack of questioning or criticism of scientific information, references to science as fact, as the ultimate truth;

4. Science as cure for problems--references to or examples of how science has solved or prevented problems;

5. Scientists as omniscient--scientists explaining the difficult to understand or the unknown, scientists as having all of the answers;

6. Scientists as elite--scientists having assistants, scientists not doing mundane work, scientists wearing lab coats and surrounded by complex equipment, references to scientists having special rights;

7. Scientists as eccentric or antisocial--references or examples of scientists acting strange or socially awkward, references to scientists not acting "normal";

8. Scientists as evil or violent--instances of scientists inflicting harm on others, instances of scientists acting in their own self-interest.

We also were aware that other themes might emerge as we examined the programs. Several new themes did, in fact, emerge from our analyses. The themes that emerged were science as fun, science as a part of everyday life, science is for everyone, and scientists as benign. Examples of these themes are as follows:

1. Science as fun--instances of actors enjoying themselves as they explained scientific principles or as they conducted experiments or demonstrations, instances of science being portrayed as a fun thing to do;

2 Science as a part of everyday life--instances of actors using everyday things to conduct experiments, instances of actors referring to the relationships between everyday things and science, instances of actors explaining everyday events or processes.

3. Science is for everyone--instances of diverse ethnic groups, age groups, professions, and genders in the shows, as well as references to anyone being able to conduct the at-home experiments;

4. Scientists as benign--instances of scientists acting friendly, helpful, and caring about their assistants or viewers.

ANALYSIS

Science as Mysterious or Magical

Despite the fact that one show is named "Mr. Wizard," depictions of science as mysterious or magical are rare in the episodes analyzed. In fact, in segments liked "Everyday Magic" and "Oddity," Mr. Wizard explains to his assistants how optical illusions and other strange things are actually examples of scientific principles.

In all of the shows, the actors and scientists explain science in a clear, straight-forward fashion, which also helps to dispel the image that science is mysterious or magical.

There were, however, a few occasions where the image of science as magical was reinforced. On "Mr. Wizard, a demonstration about chemical reactions does present science as mysterious. In the demonstration, Mr. Wizard tells his young

female assistant to squirt water into a flask and "release the genie in the bottle." As colored smoke emerges from the flask, Mr. Wizard tells her a chemical reaction has taken place. We never learn what chemicals reacted, why they reacted, why a colorful smoke was released, or why the water triggered the reaction.

While "Bill Nye" nearly always explains what viewers are seeing, there are a few times when scientific activity goes unexplained. For example, when Bill shows celebrity guest Candice Cameron a tornado of fire, neither Bill nor Candice explain what happens when Candice uses an oversized fire extinguisher to put out the tornado. Instead, after extinguishing the fire, Candice turns to the camera and says "Science rules."

Science as Dangerous and Violent

Some images of science as violent and dangerous were presented in the shows analyzed. In a segment from "Beakman's World," Beakman is seen mixing colorful chemicals, while wearing safety goggles and protective gloves. When Lester asks what he is doing, Beakman answers:

> I'm experimenting with a very dangerous concoction here. One wrong move and yours truly will be truly out of this world.

When Beakman stops his experiment to answer a viewer's question, he warns Lester not to bother his "major explosive stuff," and then Beakman places the beaker of colored fluid on a

black-and-yellow striped platform labeled "major explosive stuff." Later in the show, Lester accidentally knocks over the beaker. An explosion occurs, but Lester survives, though his rat suit looks much worse for the experience.

The violent image of science is reinforced in the "Bill Nye" episode about chemical reactions. During the show, many things are spectacularly blown up, e.g., pillows, balloons, a birthday cake, two large buildings, and even a Barney doll. While the spectacular explosions do help make a point, the number and size of the explosions seem excessive. In this episode, Bill also highlights the dangerous nature of some substances. When talking about chlorine gas, he says:

> If you breathe just a little bit of chlorine gas, it would do you in. You'd be out of here. You'd be a flatliner, just like that. You know what I'm saying?

To varying degrees, each show also enforces the potential danger of science in their instructions to viewers about at-home experiments. "Beakman's World" is the most obvious in this regard because on every show Josie, Liza, or Beakman tells viewers not to conduct any of their experiments without an adult present, to follow their instructions exactly, and not to make any substitutions. On "Bill Nye," safety instructions are only given for those experiments where there is potential danger; in this case either Bill or one of the child actors gives the instructions in a matter-of-fact manner. Likewise, not every episode of "Mr. Wizard" requires that safety precautions be mentioned. When they are necessary, viewers learn about safety

precautions through the dialogue that Mr. Wizard has with his assistants as they perform experiments and demonstrations.

The image of science as dangerous is the least apparent on "Newton's Apple." In the four episodes analyzed, none of the at-home experiments included safety instructions, nor did they need them.

In all shows, the image of science as dangerous is also conveyed on the occasions when people wear protective gear, such as safety goggles, gloves, and ear plugs.

Science as Truth

On "Beakman's World," science is presented as truth or fact, and the authority of science is emphasized in the explanations Beakman provides. The first word viewers hear on some episodes is "fact," as Beakman tells his viewers a scientific fact. Unlike other programs, however, skepticism and questioning are encouraged on "Beakman's World." Josie, Liza, and Lester often question Beakman's explanations and express disbelief during demonstrations. For example, during a demonstration of expansion and contraction, Lester exclaims: "Stop yanking my tail Beakman, that liquid stuff made the air go out of the balloon."

Skepticism is rarely expressed on "Mr. Wizard's World." While the young apprentices frequently have questions about how scientific principles work or how to do experiments, they never doubt Mr. Wizard's explanations. The children nod in quiet acceptance and politely respond: "Yes," "OK," "Yeah," "Oh," or

"That's interesting."

In the four episodes analyzed, only one child, Brian, challenges Mr. Wizard's authority. During Mr. Wizard's demonstration of how to calculate speed, he shows Brian a "cockroach race track." Brian asks: "What's that have to do with science?" Ignoring Brian's question, Mr. Wizard says: "Let's move the calculator out of the way. You get that stop watch." Mr. Wizard gives Brian another task to do and never answers his question.

On "Newton's Apple," while David and Peggy routinely ask questions of their science experts, they do not doubt the experts' answers. For example, in a segment on the heart, David asks numerous questions of cardiologists Sarah Shumway and Valerie Altstead, but he does not doubt what they say. In another segment, Peggy asks Tom Ostercamp, who works at the Geophysical Institute at the University of Alaska, several questions about permafrost. She doesn't doubt the truthfulness of his answers.

The authority of science is conveyed in different ways on "Bill Nye." As the credits roll at the beginning of the show, a voice-over says "science rules." In other episodes, children and adults are shown enthusiastically saying "It's science!" after particular explanations and demonstrations are given.

Another way that the authority of science is conveyed on "Bill Nye" is that every time Bill does a demonstration he announces his scientific equipment to viewers by saying, for

example, "this is the plastic water pump of *science*," "this is the rubber balloon heart model pump of *science*," or "this is the eyeball demonstrator of *science*." These pronouncements are sometimes accompanied by fanfare.

Science as Cure for Social Ills

Of the four shows, "Newton's Apple" was the major supporter of this image of science. For example, a segment on heart disease explained how by-pass surgery and heart transplant operations help people overcome heart problems. On another show, naturalist Nancy Gibson explains how herd management and "the science of genetics" have helped bring the buffalo back from the verge of extinction.

"Bill Nye" does provide one instance of this image in its show on vision. While science is not promoted as the cure for particular eye problems, it is presented as a way to help people who have vision problems.

Science as Fun

To varying degrees, the four shows demonstrate that doing science is fun. This image is particularly strong in "Beakman's World" and "Bill Nye."

Above all else, science must be fun on "Beakman's World." Puns, jokes, wacky humor, exaggerated facial expressions, and bizarre noises encourage children to have fun with science. In one segment, in which Beakman decides to travel up a makeshift

nasal passage to explain the purpose of snot, he tells Josie why he is going up the passage. Beakman says:

> Well Josie, I do it for science. I do it for my country. I do it for my never ending quest for knowledge. Most of all, I do it because I like it.

A dimension of "science as fun" is "science as cool," which is a strong image in "Bill Nye." This image is perpetuated by Nye and the children on the show. Often after an experiment or demonstration, Bill exclaims, "Pretty cool!" This sentiment is reiterated by the children. For example, after one segment in which two children make a fire extinguisher and then try it out, the two children say, in unison, "Cool, very cool."

The "science as cool" image is further reinforced by the weekly music video on "Bill Nye." Each week, a G-rated music video is shown, the subject of which is the theme of that week's show.

The "coolness" of science is further advanced on "Bill Nye" by the appearances of celebrity actors like Sinbad, "Marilyn" from "Northern Exposure," and Candice Cameron. Finally, the show emphasizes the coolness of science by introducing the segments in which guest scientists appear using a graphic that says "Way Cool Scientist."

Science as a Part of Everyday Life

In all of the shows, viewers are reminded that science is a part of everyday life. All of the shows relate scientific concepts and processes to everyday situations or items. For

example, when Bill Nye discusses elements in the periodic table, he relates potassium to bananas, calcium to milk, and sodium to salt. In addition, in the show on chemical reactions, Bill says,

> Everything is made of chemicals. The TV you're watching, the clothes you're wearing, and the foods you eat are all chemicals.

All of the shows use common, household items in their at-home experiments. For example, for a Bill Nye experiment viewers are shown how to make a "pulse meter" using a drinking straw and a plastic bottle cap. On "Newton's Apple," viewers just need to locate an egg and a contour sheet to do an experiment about physics. To demonstrate air pressure, Beakman uses a glass soft drink bottle and a piece of paper. Mr. Wizard also uses household items to explain scientific principles. For example, he uses drinking glasses full of varying amounts of water to talk about mass.

Science Is for Everyone

There is evidence in the shows that science is intended for everyone, not just white males. In all shows, viewers are encouraged to try the at-home experiments, thus indicating that anyone can do science.

People on the shows represent multiple ethnic groups and both genders. Furthermore, females and children of color play important roles in two programs, often explaining or presenting scientific information.

In a typical episode of "Bill Nye," for example, both girls

and boys are shown explaining at-home experiments and scientific concepts and processes. In addition, African Americans and Asian Americans receive more than just token representation. It seems quite apparent that the producers of this show are trying to encourage girls and children of color to participate in science.

The image that science is not just for white males is also apparent on "Newton's Apple." Field reporter Peggy Knapp and, to a lesser degree, naturalist Nancy Gibson are major figures on the show. Female scientists also appear often on the show. For example, in one episode, three of the five scientists consulted are female.

"Mr. Wizard also seems to make a concentrated effort to include girls and children of color in its program. Girls are often Mr. Wizard's assistants. To a lesser degree, children of color are represented.

On "Beakman's World," Josie and Liza's role is more important to the science aspect of the show than is Lester's. Josie and Liza often participate in experiments and offer intelligent commentary. Lester's role, on the other hand, is to provide comic relief by being the butt of jokes and making puns.

While the shows are taking steps to counter the white male scientist image, more could be done. For example, all of the programs have white male hosts, three of which are the major scientific figures on their shows (i.e., Mr. Wizard, Beakman, and Bill Nye). Children's educational science programs need to include women scientists in the lead scientist role to provide

strong positive role models for girls. However, this predominance of white males as the central science figures in three shows is not surprising. LaFollette (1981, 1990) notes that the scientific expert in television dramas and magazines is usually an older, white male. Male scientists also dominate children's television programming, according to LaFollette (1981). In her study of Saturday morning children's shows, only four of 12 characters identified as scientists were female.

"Newton's Apple" also supports the image that science is for everyone by having people other than scientists explain scientific principles. For example, a fire fighter discusses how fires burn, a scuba diver talks about the bends, and a dairy farmer explains how cows get energy from food. In this way, "Newton's Apple" can help viewers see that science is not an arcane.

Scientists as Omniscient

Support for the image of scientists as omniscient is quite apparent in all of the shows.

As the show's scientist, Beakman does the vast majority of explaining. For example, Beakman explains expansion and contraction:

> Behold. See the air is still in the balloon. Just when the air got colder, it contracted or got smaller because the air got colder. Now the air inside the balloon is heating up. Look at that. And it's expanding or getting bigger and it's blowing the balloon back up again. See expansion is the opposite of contraction.

Beakman's explanations are simple, straight-forward, and funny. He has the answer to any question, whether it is from a viewer or raised by his assistants. The fact that Beakman's assistants only occasionally explain science also supports the image that Beakman, the scientist, is omniscient.

Another way that Beakman's all-knowing image is perpetuated is through the way that Liza and Josie introduce him to viewers. In one typical episode, Josie calls Beakman "the merchant of mentality," "the kaiser of chemistry," "the one, the only, the Beakman!"

Like Beakman, Mr. Wizard constantly displays his expertise through his explanations of science. Mr. Wizard always knows the answer, and Mr. Wizard is always right. As with Beakman, Mr. Wizard's expertise seems limitless.

During each demonstration Mr. Wizard not only explains how to do the experiment, but he also explains the science behind the experiment. For example, Mr. Wizard uses a lead acid battery, a beaker filled with acid, and wires to explain electricity to his young female assistant:

> See what we're doing. You're sending electricity through here, and taking electrons from this lead plate, running it through the acid and storing them on the other lead plate. So, we're storing electrons, which is what electricity is, a bunch of electrons.

Mr. Wizard occasionally calls on his young assistants to explain scientific information. But Mr. Wizard does not tolerate incorrect explanations; he chuckles and quickly corrects assistants who make errors.

When compared to Mr. Wizard and Beakman, Bill Nye's expertise is not quite as all encompassing because children and celebrity guests sometimes provide explanations of scientific principles. However, these explanations are not as long as are Bill's. In addition, children also perform some of the demonstrations on "Bill Nye."

Because David and Peggy are clearly not scientists on "Newton's Apple," the authority of science is conveyed by their guest scientific experts. When experts are introduced, their scientific credentials are mentioned to help establish their credibility for viewers. Then the experts proceed to give detailed explanations of particular phenomena. For example, in one segment, Sarah Shumway, surgical director of heart transplants at the University of Minnesota, explains what happens in a heart transplant operation. In another segment, Leota Waisman, a chemist at Southeast Oklahoma State University, explains why peppers are hot.

Scientists as Elite

The elitist image of scientists is apparent to varying levels in all of the shows, and it is shown in various ways.

Both Beakman and Mr. Wizard have assistants who help them conduct their experiments and demonstrations. Liza, Josie, and Lester are on hand to help Beakman whenever he needs it. Likewise, Mr. Wizard has young assistants who come to his house to help him with science experiments. Mr. Wizard continually

asks these young assistants to help him. He says: "Will you measure the width of the television screen?" "What do you see?" "There's a calculator, divide 280 by 32," "Turn it off," and "Make a good connection."

On "Newton's Apple," guest scientists have assistants who do the work of science. For example, when dive injury specialist Cher Atkinson shows David a hyperbaric chamber, two technicians run the chamber as she explains the chamber to David. On another segment, a cardiac stenographer takes an ultrasound image of David's heart, while two cardiologists stand by providing explanations for the questions David asks.

On "Bill Nye" the demarcation between scientists and assistants is much less pronounced. Bill sometimes serves as the assistant for the child actors when they are conducting demonstrations and experiments. At other times, Bill and the children work as partners on demonstrations.

In "Mr. Wizard" and "Newton's Apple," scientists are often seen next to scientific equipment, which helps to emphasize their elite status. However, in all cases, the equipment is there to help the scientists explain science--it is not just window dressing. On "Beakman's World" and "Bill Nye," the equipment that Bill and Beakman use is generally less complex than that used in the other two shows.

One way that Bill Nye's special status is reinforced is through the cipher lock that is on the door to the "Nye Labs." Near the beginning of most shows, Bill is shown entering his lab.

Sometimes he has to unlock the cipher lock, while at other times the door to the lab opens for him. In one episode celebrity guest Candice Cameron tries to open the cipher lock. Cameron does not know the correct combination, and she is denied access to the lab. Bill, the lab's namesake, has to let her in.

The clothes scientists wear also provide a sign of their elite status. Bill Nye's outfit is closest to representing the stereotypical image of scientists wearing white lab coats over good clothes. Bill wears a white shirt, dress pants, and good shoes; however, his lab coat is light blue, not white. Furthermore, Bill wears a bow tie instead of the more traditional neck tie. When he goes on location, Bill usually wears regular clothes, but he sometimes wears his lab coat and bow tie.

Like Bill, Beakman wears a lab coat. But that is where the stereotypical image ends. Beakman's lab coat is a vibrant lime green, and the coat's breast pockets are filled with many colored markers. Beakman typically wears black jeans, a black shirt, tennis shoes, and a black fright wig. He also speaks with a broken Brooklyn accent.

Unlike Bill and Beakman, Mr. Wizard and the scientists on "Newton's Apple" do not dress like stereotypical scientists. Mr. Wizard wears plaid shirts, dress pants, and sweaters. His appearance leads us to believe that he either teaches science to the children on his days off or that he is a retired scientist. On "Newton's Apple," scientists dress casually and do not wear lab coats.

Scientists as Eccentric and Antisocial

In two shows, we found some support for the image of scientists as eccentric. Beakman is presented as an eccentric scientist. His wacky clothes and manner emphasize his eccentricity. He is not afraid to go out of his way for the sake of science, no matter how crazy the task may be.

Another way that Beakman's eccentricity is shown is in the way he dresses up as characters (e.g., Henry Ford, Professor I. M. Boring) to help explain science. And, even though he is in costume, viewers can easily tell that it is Beakman.

Though not to the extent that Beakman is, Bill Nye is also portrayed as an eccentric scientist. His eccentricities are shown in his dress, his mannerisms, and his interactions with viewers. For example, in one segment Bill wonders why people say that a heart goes "lub, dub." He says that maybe these people are the same people who think a dog goes "bow-wow." Bill then says that he doesn't think dogs go "bow-wow," and he proceeds to bark in the way he thinks a dog really sounds. He doesn't stop barking until a voice-over tells him to calm down.

We also found evidence in three shows for the image of scientists as antisocial; however, these images did not appear very often. One segment of "Beakman's World" perpetuates the image of scientists as socially inept. When Lester is confused about Beakman's explanation of molecules, the show cuts to a shot of Beakman disguised as a 19th Century scientist surrounded by shelves of dusty, leather-bound books which are stacked

haphazardly. Beakman is identified as "Prof. I.M. Boring" from "Inert State University." Dressed in a suit and bow tie and wearing reading glasses, Beakman reads, in a stilted English accent, the definition of molecules from a large book. After Beakman slams the book shut, the camera shoots back to Lester and Josie. Lester says: "Hey, bet he's fun at parties." Josie nods in agreement. Although the intent of this shot may have been to get children to learn by poking fun at science, a competing message is also presented here, that is, scientists are not fun people.

A segment from "Newton's Apple" also reinforces the image that scientists are not fun. On their trip out west to see buffalo, field reporter Peggy Knapp tells naturalist Nancy Gibson, "You're not a lot of fun. You're a good scientist, but you're not a lot of fun." However, in general, the guest scientists on this show do not support the image of scientists as antisocial. Guest scientists are shown calmly and comfortably interacting with Peggy and David.

One segment of "Mr. Wizard's World" depicts Mr. Wizard as somewhat ill-at-ease socially. When he shows a female assistant a turtle figure he has made from clay dough, she asks, "That's a turtle right?" Mr. Wizard laughs, but acts offended and says, "You mean you didn't recognize it. I thought it was pretty good myself. I'll challenge you to do something better. You can make what you think is good." When she later shows Mr. Wizard her clay figures, he asks for "some interpretation" of her work and

recalls that she made "some nasty comments about [his] turtle yesterday."

Scientists as Evil or Violent

We found no examples of this image in the shows we analyzed.

Scientists as Benign

None of the scientists in the shows were portrayed as evil or violent. Beakman is a friendly, helpful scientist who enjoys answering viewers' questions. Even when he is trading barbs with Josie, Liza, and Lester, it is all in fun. The scientists on "Newton's Apple" are friendly and very willing to answer the many questions David and Peggy pose. They gladly explain scientific concepts and processes. Mr. Wizard does not bear any trace of evil or violence. Continually, he is portrayed as a caring, grandfatherly figure -- a good neighbor who invites children over to his house to learn about science. Bill Nye is also a benign scientist. He has friendly exchanges with the children and adults on his show. He treats them with respect and courtesy.

DISCUSSION AND CONCLUSIONS

The images of science and scientists presented in children's programming have the potential to influence children's perceptions of and attitudes towards science. When children watch television, they often interact and identify with the people and characters who appear on television (Rosengren and

Windahl, 1989).

Our analysis of episodes from four children's educational science programs indicates these programs present an interesting mix of images of science. We found that the image of science as truth, the image of science as fun, and the image of science as a part of everyday life were quite strong. We found little evidence of the image of science as magical or mysterious. Evidence for the image of science as violent and dangerous and for the image that science is for everyone was mixed.

Likewise, we found an interesting set of images of scientists in these four programs. We found strong support for the image of scientists as omniscient, elite, and benign. We found no support for the image of scientists as evil or violent. We found mixed evidence for the image of scientists as eccentric and antisocial.

Given the images portrayed on these children's educational science programs, the important question becomes, what messages are these images sending to children who watch these shows? While the answer to that question is beyond the scope of this study, we can make some predictions about what we would expect.

These images may have some positive effects on children's attitudes and behaviors. First, the strong image of science as fun may encourage children to like science, which, in turn, may encourage them to take more science classes, to work harder in these classes, to major in science in college, and to consider pursuing a career in science. Second, the strong images of

science as a part of everyday life and the lack of images that present science as magical or mysterious may help dispel common misperceptions of science as alien, unimportant, or as something to be feared. Third, the fact that females and minorities will see more of themselves in these shows may encourage these groups to take a stronger interest in science throughout their educational careers. The image of scientists as benign may also encourage children to consider scientific careers.

The images we found may also have adverse effects. The dominant image of science as truth and the image of scientists as omniscient may discourage children from questioning science and discourage children from critically analyzing scientific information. The lack of females as lead scientists on these programs reflects the need for more female role models. The lack of these role models may be sending the wrong message to girls, i.e., the message that the most accomplished scientists are male.

It is difficult to draw conclusions from the mixed evidence of the image of scientists as eccentric and antisocial, and the image of science as violent and dangerous. Future research needs to explore whether children pick up on the few references present.

Another interesting way to look at the results of this study is to consider the role these images play in the functioning of the scientific community. Petkova and Boyadjieva (1994) suggest that the image of the scientist serves three functions for the scientific community. First, the image helps the scientific

community to recruit members by emphasizing certain images, e.g., scientists have special privileges, scientists work hard, scientists are seekers of truth. Likewise, emphasizing certain images also helps the scientific community discourage people who are not dedicated enough from joining. Thus, the image acts as a "natural filter for those who aspire to be accepted into the realm of science" (p. 221). The results of our study indicate that, in general, the children's shows reinforce good images of science and scientists (e.g., science is fun, scientists are benign), while minimizing the bad images (e.g., scientists as evil). Thus, the shows may help recruit potential scientists, but they cannot act as a filter because they don't show the full reality of being a scientist.

The second function that the image of scientists fulfills is to help scientists identify with their community (Petkova and Boyadjieva, 1994). The image provides a way for scientists to identify positively with the scientific community, which, in turn, helps to ensure the community's survival. The children's shows seem to support this function in that they generally portray science and scientists in a positive light.

The third function that the image fulfills is "regulating the relations between the scientific community and other social communities" (Petkova and Boyadjieva, 1994, p. 222). In this case, the positive aspects of the image of scientists help to justify the special status that society generally accords scientists. Nelkin (1990) states that this function is important

because otherwise, scientists may be perceived as "simply another interest group seeking its share of public resources" (p. 43). As before, the generally positive light that science and scientists are shown in on the children's shows helps fulfill this function for the scientific community.

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