On Learning Science and Pseudoscience from Prime-Time Television Programming

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ON LEARNING SCIENCE AND PSEUDOSCIENCE FROM PRIME-TIME TELEVISION PROGRAMMING

by

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ABSTRACT

The purpose of the present dissertation is to determine whether the viewing of two particular prime-time television programs, *ER* and *The X-Files*, increases viewer knowledge of science and to identify factors that may influence learning from entertainment television programming.

Viewer knowledge of scientific dialogue from two science-based prime-time television programs, *ER*, a serial drama in a hospital emergency room and *The X-Files*, a drama about two Federal Bureau of Investigation agents who pursue alleged extraterrestrial life and paranormal activity, is studied. Level of viewing, education level, science education level, experiential factors, level of parasocial interaction, and demographic characteristics are assessed as independent variables affecting learning from entertainment television viewing.

The present research involved a nine-month-long content analysis of target television program dialogue and data collection from an Internet-based survey questionnaire posted to target program-specific on-line "chat" groups.

The present study demonstrated that entertainment television program viewers incidentally learn science from entertainment television program dialogue. The more they watch, the more they learn. Viewing a pseudoscientific fictional television program does necessarily influence viewer beliefs in pseudoscience. Higher levels of formal science study are reflected in more science learning and less learning of pseudoscience from entertainment television program viewing. Pseudoscience learning from entertainment television programming is significantly related to experience with paranormal phenomena, higher levels of viewer parasocial interaction, and specifically, higher levels of cognitive parasocial interaction.

In summary, the greater a viewer's understanding of science, the more he or she learns when watching a favorite science-based prime-time telvision program. Viewers of pseudoscience-based prime-time television programming with higher levels of paranormal experiences and parasocial interaction demonstrate cognitive interest in and learning of their favorite television program characters' ideas and beliefs. What television viewers learn from television is related to what they bring to the viewing experience. Television viewers are always learning, even when their intentions are simply to relax and watch television.

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PREFACE

I entered the University of New Mexico with the intention of studying why people go to museums to learn about scientific topics, so that I might apply my findings to improve public school education, a place where many people go and avoid learning. During my first semester I enrolled in Dr. Everett Rogers' *History and Philosophy of Communication* course. For my final paper I created a comprehensive and interactive model of museum communication (Whittle, 1997). While writing that paper I discovered that the current educational system, like the old museum exhibit departments, had a one-way view of communication: from the sender to the receiver. However, current communication models are multi-dimensional. The receiver actually chooses what communications to attend to, and all the receiver's past experiences are potential filters for the communication's message. The concept that communication theory was the key to better public education drove the remainder of my doctoral research and provided a multi-disciplinary approach to the present dissertation.

I also learned that most people go to museums as a social function, with educational motivations less important. Additionally, only a small percentage of a population spends more than ten hours per year in museums. I asked myself what people were doing, if they were not enjoying museums. Frequent observation of an omnipresent glowing, blue light in virtually every home in my neighborhood during the evening led me to the conclusion that people were spending at least their evenings with the blue light, a turned-on, tuned-in, television set.

My next avenue of research was to explore the educational impact of contemporary educational science programs like *Bill Nye, The Science Guy* and *NOVA*.

While both shows are popular with their audiences, and the Bill Nye Science Teaching Model should be mandated for all science teachers, the audiences for these two shows is small, typically three percent to five percent of all television viewing households. The next question was, “What are the other 95 percent watching?”

I scanned the Nielsen Ratings for the next several months and discovered that, on some weeks, at least 35 percent of the viewing public were watching two science-based prime-time television programs, *ER* and *The X-Files*. One show, *ER*, is medical science-based and prides itself on its scientific accuracy. The other show, *The X-Files*, dizzily and unabashedly mixes science and pseudoscience into a potentially hallucinatory concoction for the scientifically illiterate. Three hours of different episodes are currently broadcast each week for each program on broadcast television:. six hours of popular, science-based prime-time television programming every seven days. After analyzing the content of about 18 broadcasts of each television program, I realized that a staggering amount of scientific information was contained in both *ER* and *The X-Files*. If tens of millions of people watch science-based television programming each week and if they actually learn the television program’s science content, then prime-time television programming might be the next wave in education and life-long learning.

So begins the present dissertation....

Christopher Whittle
Albuquerque, NM

CHAPTER 1: INTRODUCTION

> Television is the school book of modern adults, as much as it is the only authoritative school book for our children.
>
> Umberto Eco, 1978, p.22.

Contemporary American society provides up to 12 years of science education to each individual via the public and private school systems. Although formal schooling ends, people continue to learn throughout their lives. Most people learn from out-of-school sources (Lucas, 1983) and much of what people learn (Stokes, 1984) is incidental knowledge: information acquired unintentionally. People learn an enormous amount of information incidentally while watching television programs (Gagne, 1986). Aside from sleeping and working, people spend most of their leisure hours with a television set. We learn incidentally from television even if our intention in watching is not to learn. Incidental learning is a likely effect of viewing commercial television (Stokes, 1984). Extensive research has been conducted on educational science-based television programs (Chen, 1984) (e.g., *NOVA, National Geographic*, and *3,2,1 Contact*), but relatively few people tune in to educational programming. The science education literature is relatively silent on what we learn when we watch science-based prime-time television programs (Lucas, 1983).

Two science-based prime-time television programs typically draw a weekly audience of between 10 and 20 million viewing households per episode. The first, *ER*, is a drama set in a hospital emergency room that depicts the actions of medical personnel in a large urban hospital. The second program is *The X-Files*, a shadowy drama about two Federal Bureau of Investigation agents who pursue alleged extraterrestrial life and paranormal activity. The protagonists in *ER* and *The X-Files* frequently use the scientific method to solve problems. But, as Goode (2002) points out, "...[T]he program did contrast a paranormal...point of view with a more scientific or skeptical perspective—and week after week, the skeptical perspective always lost."

Learning science in school is something few of us do to "completion," i.e., obtaining a college degree in a science-related field and continuing on in a science-related career field. Consequently, most of our learning about science and scientists is vicarious and comes from "informal education" sources (Lucas, 1983). As was noted above, Americans spend a great deal of time watching television. For many people, their "informal education" source is the television.

The present study sought to identify the relationships between viewing of science-based and/or pseudoscience-based prime-time television programs and viewers' change in knowledge of science as a result of viewing. Additional relationships explored were between knowledge acquired from television programming and select personality characteristics and viewer demographics. Data was collected via an Internet-based survey questionnaire.

The Problem

When asked to agree or disagree with the statement, "It is not important for me to know about science in my daily life," 14 percent of all Americans agreed (National Science Foundation, 1994, p. 132). Eighty-six percent of Americans surveyed felt that science knowledge was important to them. However, only 18 percent of the public is attentive to, and knowledgeable about, science and science policy (Miller, 1987), and even fewer watch educational science-oriented television programming (Nielsen, 1998).

Singer and Benassi (1981) reported on research in which respondents cited *The Reader's Digest, The National Enquirer*, the movies *The Exorcist* and *Star Wars*, and the "documentary" *Chariots of the Gods*, as "scientific media." Other respondents thought that "islands float in the ocean," and that "the moon is fixed in the sky" and "only visible at night." Only five percent of American adults were found to be "scientifically literate" in a comprehensive science survey conducted in 1985 (Miller, 1987). A five percent science literacy rate is an alarming statistic for an advanced technological country like The United States of America. Therein lies a problem.

The Notion of Science Literacy

> Programmatic efforts to reduce [science] illiteracy through knowledge acquisition alone may do little more than produce persons who are scientifically illiterate, that is, they possess knowledge but choose not to act on their knowledge. For the general public to be attentive but indecisive is ominous for a nation likely to become increasingly dependent on public support to sustain an economy committed to science and technology.
>
> Simpson et al., 1994, p. 231

Why do we need to have an understanding of science and scientific processes? In an early article on science literacy, Hurd (1958) outlined the importance of having a scientifically literate public. Science literacy is defined as a general understanding of science topics and processes and their applications (technology) to society. Hurd stated that science and technology have become so integral to our society that they affect virtually all discussions of economic, educational, human, and political needs and values. "More than a casual acquaintance with scientific forces and phenomena is essential for effective citizenship today. Science instruction can no longer be regarded as an intellectual luxury for the select few." (Hurd, 1958, p. 13) Although Hurd's ideas were not new (they are linked to the original purpose for which we created schools:, to prepare individuals to be productive members of society), they helped define a renewed debate on what science education should be.

Shamos' 1995 book entitled *The Myth of Scientific Literacy* argued that it is not feasible to give each citizen a complete grounding in all aspects of science and technology, or what he terms "'True' Scientific Literacy" (p. 89). What is more desirable and practical is creating science appreciation and awareness on the part of the general public. Shamos outlined three goals for educating the non-scientist about science (p. 217).

1. Science should be presented "mainly to develop appreciation and awareness of the enterprise, that is as a cultural imperative, and not primarily for content" Over half of America's Gross National Product is spent on the results of scientific research and development. The public should be aware of, and support, any enterprise that consumes so much of the country's resources.

2. Science ought "[t]o provide a...focus on technology as a practical imperative for the individual's personal health and safety, and on an awareness of both the natural and man-made environments."

3. Science education should also "emphasize the proper use of scientific experts" as it is impossible, even for a professional scientist, to keep abreast of all new developments in all branches of science.

Martin (1994) adds to Shamos' goals for science education: "The goal of science education should not just be to get students to understand science but to be scientific; that is, to tend to think and act in a scientific manner in their daily lives." Where do we start?

The Danger of Science Illiteracy

Paranormal beliefs (and pseudoscientific ones) seem harmless, but they are dangerous. Psychic surgeons and faith healers are responsible for hundreds of deaths; fraudulent clairvoyants, *Feng Shui* consultants, and fortune tellers induce people to waste vast amounts of money; mass hysterias like the witchcraft trials in Europe and later in the nascent United States resulted in over two hundred thousand deaths; the eugenic theories of Nazi Germany were used to kill millions of human beings (Hines, 2003). Makgoba (2000) cites "political pseudoscience": politicians blaming AIDS on poverty and malnutrition, as an example of science illiteracy causing needless human deaths. The states of Colorado, Utah, and New Mexico recently spent tens of thousands of dollars to rename a highway; the governors of these three states believed the highway designation, "Route 666" was responsible for the high number of deaths on the road (Wilgoren, 2003). If we do not challenge "harmless" pseudoscientific beliefs, "faulty evidence, intellectual shoddiness and fraud, and twisted logic in the case of relatively benign pseudosciences, it becomes much easier to accept the same type of evidence when it is presented in support of much more damaging pseudosciences" (Hines, 2003, p.41).

The courts have acknowledged the danger of pseudoscience foisted on an unsuspecting public. The United States Food and Drug Administration was created to deal with the ever-increasing number of miracle medical cures and devices that were sold to the public at the beginning of the twentieth century. The Quadro Tracker, The Positive

Molecular Locator, or the Golfball Gopher, a device that was alleged to remotely identify the presence of guns, drugs, golfballs, and the AIDS virus, was profiled on *Dateline NBC* (Emery, 1997). The device was controlled by "programming chips" which contained combinations of dead ants, epoxy and plastic-coated paper. Over one thousand Quadro Trackers were purchased by law enforcement, corrections, and school officials. In granting an injunction against the device's manufacturer, a United States District court judge ruled that "the lives of innocent people can be ruined..., legitimate cases [can be] thrown out of court..., and a reliance on The Quadro Tracker [the pseudoscientific device in question] 'poses a danger to anyone relying on the device..." (Emery, 1997). Hundreds of supposedly intelligent, responsible public officials were conned into buying Quadro Trackers at a cost of $400 to $8,000 each.

Opportunities for Learning Science

> Among lay people, it is not the exploits of scientific explanation that serve as a reference point, but the memory of science in the classroom — a rigid, dogmatic science, spreading foregone conclusions and, what's more, serving as a means of selection and a justification of authority.
>
> Fayard (1991, p. 600)

Where do Americans learn science? Most people who have attended a public or private elementary or secondary school have been exposed to formal science education. However, if only five percent of people are scientifically literate (Miller, 1987), these people may not be learning as much science as they could in our schools. Americans who graduate from high school spend less than 12,000 hours (45 minutes/day/class x 7 classes x 180 days x 12 years = 11,340 hours) in formal classroom activities. Assuming that some type of science is taught each day, about 1,600 hours (45 minutes/ day x 5 days/week x 180 days/ school year x 12 years) of that is spent in science class, although 12 years of science instruction is the exception, not the rule. During a child's school years, a child will watch an average of 15,000 hours of television programming (Fowles, 1974) and by the time he or she turns 65 years of age will have watched television for ten years (Noble, 1975). "... [I]t is from ...out-of-school sources that most people must learn for most of their lives" (Lucas, 1983). Lucas (1991, p. 496) identified these sources: "print and other media", museum exhibits, and conversations.

According to a survey by SRI International (1988, p.78), about 20 percent of a national sample "identify leisure-time pursuits with a significant scientific component as their most important informal learning activity." Roughly 14 percent of Toledo, Ohio's population visits museums three or more times per year, 40 percent visit once or twice a year, and 46 percent do not visit museums (Hood, 1983). If one assumes similar data on museum attendance for other urban areas and a generous three hours per museum visit, one must conclude that Americans spend little time in museums: less than ten hours per year per person. Dr. P. Boverie (personal communication, 2003) stated that most museum visits are to art museums rather than science museums, further eroding the potential that science museums have for teaching science. One can reasonably conclude that the American public is not learning much science in museums. Conversation, along with print and other media sources are American's sources of science information.

Educators at all levels are concerned about scientific literacy and the effectiveness of current science instruction. "Conventional science teaching suppresses students' natural curiosity and leaves them with the impression that they are incapable of understanding science" (American Association for the Advancement of Science, 1990, p.

333). Recent reports have emphasized that learning in science and mathematics is idiosyncratic: Learners must collect ideas and apply them in their own way. Few people will argue that traditional science instruction offers regular opportunities to explore and apply science topics “in his or her own way.”

Steen (1991) summed up the problem by stating: “It’s clear to virtually everyone that the present system of science education works well only for those already committed to science; it fails almost totally in the broader task of educating citizens.” Steen describes a videotaped news vignette in which new Harvard University graduates, interviewed at commencement, were unable to explain the science of the changing seasons. “Few…miss its message.” Steen (p.12) commented:

> It conveys vividly the reality of scientific illiteracy among our best educated students — our future lawyers and politicians, business leaders and school superintendents — who will soon become society’s opinion leaders and main actors on issues of energy, environment and health care. The ignorance about science — arguably the most important force for change in modern society — is frightening. People laughed at Nancy Reagan for consulting astrologers for advice; many current college graduates can claim no better authority for their opinions about science.

The American Association for the Advancement of Science (1990, p. xvi) summarized the current state of formal science education: “The present science textbooks and methods of instruction, far from helping, often actually impede progress toward scientific literacy.”

A New Paradigm for Education

A recent Hollywood animated movie has increased calls to plumbers to retrieve fish from sewer lines. The protagonist in the movie, an animated fish, escapes from captivity to the ocean via a toilet. Viewers of the movie, believing they are releasing their pet fish to the ocean, flush their pets in an altruistic action to "free" their captive pets. Broadcast news stations have reported the story during the evening news, apparently in an effort to correct viewers' thinking.

Television programs and movies are effective communicators of consumer-oriented messages. Everyone is familiar with commercial television advertisements and will soon become familiar with advertisements shown in movie theaters, but the television programs and movies themselves are also used to create a market for consumer products. A study in the British Journal *Lancet* (Dalton et al., 2003) reported that teenagers were significantly more likely to smoke cigarettes as a result of exposure to smoking from movies in which the stars smoke cigarettes. Teenagers from non-smoking homes were found to be more likely to start smoking after exposure to smoking in movies than were teenagers from homes in which the parents smoked cigarettes. An advertisement in a 1999 *Shotgun News*, a sales-oriented newspaper for firearms dealers and aficionados, trumpeted "DEVASTATORS", "*As seen on TV's* ER" [italics added for emphasis]. You will never shoot a more 'DEVASTATING' ammo. A special detonating tip causes gross expansion...." *ER*, a prime-time medical show, used to hawk exploding bullets. Hollywood movies and television programs can teach viewers an ineffective method of releasing fish to the wild, promote smoking, and identify the type of bullet as the most effective killer. What else can these media teach us?

Scientific educational programming is not reaching vast numbers of our population, as evidenced by low Nielsen ratings for these types of shows. Science programs are viewed by those who already have an interest in science, approximately four to five percent of viewers (Jerome, 1988). The vast majority of Americans spend important amounts of time watching television. We start watching television at approximately age two and typically spend two to three hours with the television set through adolescence, accounting for 11,680 hours to 17,520 hours. During our school years we spend more time in front of a television than we spend in front of a teacher. Calculating television usage over a lifetime, Americans spend more than 114,000 hours (2-3 hrs/day x 16 years and 4.3 hrs/day x 73 years = 114,573.5 hours/lifetime) watching television programming (Nielsen Media Research, 1993). During prime time, the most heavily viewed part of the day (Nielsen Media Research, 1998, p. 1), programs that we prefer are dramas, situation comedies, variety shows, and feature films (Nielsen Media Research, 1998, p. 3). If educators are to make an effort at promoting lifelong learning, then they need to target people when they are doing what they prefer during their leisure time. People clearly prefer the activity of watching television. Education does occur during prime-time television. What we do not know is what, and how much, is learned from prime-time television viewing.

Purpose

The purpose of the present study was to determine if the viewing of two particular prime-time television programs, *ER* and *The X-Files*, increases viewer knowledge of science and to identify factors that may influence learning from entertainment television programming. The present study sought to identify:

1. If science-based prime-time television programming has the ability to affect the viewer's knowledge of science and pseudoscience concepts and facts.
2. The relationship between recognition of science-based television program content, viewers' levels of education, and personal knowledge of science.

3. The relationship between personal experiences and beliefs related to science-based television program content and recognition of science-based television program content.
4. The relationship between a viewer's level of parasocial interaction and recognition of science-based television program content.

The specific objectives of the present study were:

1. To determine if viewers recognize science and/or pseudoscience content from specific fictional prime-time, entertainment television programs.
2. To determine to what extent level of education has on recognition of prime-time, entertainment television program science or pseudoscience content.
3. To determine to what extent formal science education has on recognition of prime-time, entertainment television programs science or pseudoscience content.
4. To identify the effects of resonance or reinforcement in viewers.
5. To identify the extent to which parasocial interaction affects viewer recognition of television program content.

Importance of the Present Research

> ...[T]he skills learned [from watching television programs] seem likely to be grotesque ones, such as how to hold a handgun steady, how to address a judge in a court room, how to open a metal can, how to pour soap powder into a washing machine, and the like.
>
> Gagne (1986, p. 9)

As the application of science and technology becomes more pervasive in the public's lives, science educators need to find more, and more effective, ways of increasing understanding of scientific developments. Additionally, the general public must have confidence in the goals of science and in the people that undertake science for the good of society (Shamos, 1995, p. 201). Statistics on participation in formal educational activities do not show the rise in activity and participation warranted by the explosion of the information age and of our need to stay current with new information in science and technology. In fact, higher education enrollments for persons aged 14 years of age to 34 years of age have been fairly flat since they nearly doubled in the decade of 1965-1975 (U.S. Department of Commerce, 1998). Most of the adult public is not actively seeking scientific knowledge in its leisure time (U.S. Department of Education, 1997), so educators must reach people through the activities in which they prefer to engage. The mass media entertainment genre is the most ubiquitous of any mass media genre throughout history (Singhal, 1990). Most people spend much of their leisure time watching television. Americans spend ten times more time with television than they spend in elementary and secondary school. Mass media television programs do entertain and do educate. It is the primary philosophy driving the present research that it is through television that most people are informed about the science in their world.

If we learn from television, as the research indicates (Condry, 1989; Pezdek, Lehrer and Simon, 1984; Gibbons et. al., 1986; Greenfield and Beagle-Roos, 1988), then we need to look at whether or not people are learning accurate, societally-approved facts and concepts versus something else. If the public is learning non-factual material, then we may need to intervene in order to achieve a better-educated public. Such interventions might include using the successful entertainment-education strategy of creating programs with specific messages for the viewer (Bouman, 1999; Singhal & Rogers, 1999) or airing disclaimers throughout a television program in order to alert viewers to fictional content (Sparks, Hansen, & Shah, 1994). Inserting specific message content does not decrease the show's ratings if handled in an entertaining manner. In fact, controversial message content increases a show's ratings (Shefner & Rogers, in press).

The present study sought to determine the potential for information and misinformation transfer from fictional and non-fictional science-based, prime-time television programs. The present study is a further step in understanding the effects of commercial television on the public's knowledge and beliefs about scientists science knowledge.

Limitations

Many factors affect the outcome of a research study. The present study's limitations are:

1. Sample respondents are not random

Respondents for the study were self-selected. It is understood that self-selection may introduce a variable of motivation to participate in the study and those who chose not to participate may have characteristics not present in the self-selected sample. Specific demographic data are collected in the survey questionnaire which is used to compare the study respondents to the population of regular *The X-Files* and *ER* viewers. Determining the degree of similarity between respondents and regular viewers is important for making generalizations from the present study group.

2. Assignment of treatment versus non-treatment is not random

Viewers either chose to watch a television program or not. Regular viewers of a television program have a greater understanding of the characters and interrelationships of characters than do casual or non-viewers of a television program.

3. Inability to determine exact cause and effect.

The present study does not address the question “Does viewer interest and knowledge cause his or her choice of programming and subsequent knowledge acquisition from the program?” The present study uses associational and difference statistical methods to determine cross-sectional relationships among the variables.

4. Limitations of measurement methods.

The survey questionnaire developed for the present study is limited by its quantitative nature. Qualitative studies should be conducted to measure the fine details of when and where a respondent learned particular television program content and could provide more information about a viewer’s motivation in selecting a particular television program and what aspects of the program were particularly salient to the viewer.

Additionally, the respondents’ survey environment was uncontrolled. There was no way to standardize the environment or to prevent respondents from consulting reference books, for example.

5. Viewing conditions were uncontrolled

Here I examined learning from a typical television viewing situation. Environmental controls such as videotaping viewers or reading viewer diaries might skew the results of the study.