The impact of comics on audiences' knowledge of, attitude toward, and behavioral intentions related to wind energy

by

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ABSTRACT

This study compares two modes of presenting information about wind energy in brochure form—one using photographs and the other using cartoons as visual aids—on audience's knowledge of, attitudes toward, and behavioral intentions regarding wind energy. Participants were randomly assigned to the two treatments. Both brochures aim to debunk "myths" and unfounded statements about wind energy.

The results show a relatively low knowledge level about wind energy, suggesting the need for more science-based communication efforts. There were no significant differences between the two groups in terms of knowledge and attitudes, but those shown the cartoon/comics version showed stronger behavioral intentions (e.g., greater willingness to support government initiatives to make wind a significant part of national efforts to meet future energy needs, greater willingness to support investments in wind energy development, including wind projects) than the photo group. Both groups positively evaluated the brochure they have read, although those shown the cartoon/comics version found it more informative, interesting, and cognitively engaging. Those presented with the photo version found the brochure more credible, indicating that cartoons are still viewed as appropriate for entertainment or light-hearted content, but not for serious-minded topics.

Those exposed to the photo version showed statistically significant correlations between knowledge and attitude, and between attitude and behavioral intentions. Those shown the cartoon/comics version, on the other hand, demonstrated statistically significant correlations between knowledge, attitudes and behavioral intentions, indicating that the comics version offers a more efficient path toward the development of stronger intentions to perform recommended behaviors.

CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

Media technologies and various modes of communication have created an information explosion of sorts. In no other field has this been more evident than in the complex area of science and technology. Science stories are often newsworthy enough to hit newspaper front pages, penetrate movies, books, TV programs, and many other forms of media products and channels. Stem cell research, genetic engineering, and nanotechnology are examples of complicated scientific innovations that have become part of people's every day conversations because of the ways by which these topics can now be conveyed to the public. But despite rapid advances in communication technology, how much does the public really know about science and technology issues?

"There is substantial agreement in the academic community that levels of national and international scientific literacy among the general public are undesirably low for our technologically driven society" (Scearce, 2007, p. 2). Back in 1983, Miller (1983) described the level of science literacy in the United States as "deplorably low" (p. 29). After decades of information campaigns, including educators' efforts and media coverage, levels of adult scientific literacy in the U.S. increased only from 10% to 17% from the early 1990s to 1999 (Miller, 2002). In 2005, this figure rose to 28% (Miller, 2006). However, according to a report released by the U.S. Department of Education's National Center for Education Statistics (NCES) in 2008, U.S. students scored a dismal 489 in international comparisons of science literacy—11 points below the average of 30 nations (Planty et al., 2008). In 2002, Hazen also estimated the number of scientifically literate Americans to be fewer than 7% of adults, 22% of college graduates, and 26% of those with graduate degrees. Such low levels make a dramatic contrast with the advances scored by the scientific community in recent years.

Why is science literacy important? According to Scearce (2007), “the society we live in depends to an ever increasing extent on technology and the scientific knowledge that makes it possible” (p. 3). Besides personal improvement, everyone in modern democratic societies has the responsibility and the right to participate and make decisions regarding issues such as waste disposal in the local community to issues that affect the entire planet, such as global climate change. All of these demand citizens with sufficient knowledge about science and technology.

For example, reducing greenhouse gas emissions to mitigate adverse climatic impacts is an undertaking that should involve every citizen in every nation of the world. It cannot be the sole purview of scientists and policy-makers. Becoming responsible citizens who will help protect the global environment requires everyone to be aware of and take actions to safeguard the planet. This demands a citizenry that is knowledgeable enough about basic science concepts, principles and processes to make wise choices.

The public’s attitudes and opinions directly or indirectly influence policy and financial support for the scientific enterprise. In short, the level of people’s support for scientific and technological undertakings determines, to a large extent, the nature and amount of public spending for research and development. Thus, for scientists, increasing the public’s science literacy can result in a range of outcomes, including motivating greater interests and concern, influencing political or personal behavior, and defining policy choices or options.

How can the general public's science literacy be enhanced? The mass media are thought to be the public's main sources of information on science and technology topics after formal science education ends. Science communication has been defined as the process of transmitting scientific information from experts to the public with the goal of "filling in" the deficits in scientific knowledge (Nisbet, 2009). Therefore, how ordinary citizens come to understand a scientific event or policy issue related to science depends, at least in part, on how the issue is covered by the media. Cobb (2005) suggests that when new information about a science issue mainly or solely comes from the media, it can be assumed that the public's knowledge and perception of that issue will be greatly influenced by the way these issues are presented in the media.

Among the many forms of mass media, comics and cartoons can be potent vehicles for science education and communication (Tatalovic, 2009). Comics and cartoons are a popular art form, especially among children and young adults, which have been underrated as a cheap past time. Simon Locke (2005) summarizes the common prejudices against comics:

> Damned as culture, being popular, not 'high'; damned as a medium, being neither art nor literature but some perverse hybrid, at best suitable only for children (and retarded adults), at worst positively harmful…and they are damned as a genre, being the most outlandish fantasy involving absurd characters acting in the most bizarre fashion—the very antithesis, one might think, of plausibility (p. 29).

Tatalovic (2009) argues against all three damnations identified by Locke. He suggests that being part of the popular culture is a strength that enables comics and cartoons to reach many people of various backgrounds. Comics may indeed be a combination of art and literature, but those that do not display “outlandish fantasy” and “absurd characters” in their content may play an important role in communicating science, a subject some consider “dull” or “boring.” Others are even indifferent to it. Can comics overcome these common perceptions?

As argued by McCloud (2000), comics are able to communicate various messages, including those of a scientific nature, in an artistic way. It contains visual elements that can capture people’s attention and heighten their interests. In comics, science stories can be represented in an illustrative and narrative way, which makes it a medium that caters to both left-brain and right-brain functions (Williams, 2005).

Educators have indeed experimented with comics as a teaching tool. They have also been used to inform the general public about science and scientific breakthroughs. In fact, Carter (1988) reports that “comic books throughout their history have contained a surprising number of references to chemical facts, many of which can be referred to in the teaching of chemistry” (p. 1029). In this case, comic illustrations served as a basis for initiating discussions on various topics. Rota and Izquierdo (2003) observed the same experience in teaching biology. By using science fiction, the authors report that through comics, scientific concepts are contextualized, identified, and strengthened with a playful vision:

> The teachers in general considered the use of science fiction and comics as a very effective tool for teaching biotechnology. As the fiction makes part of the world of the children, they assimilated easily, and even almost “playing” the concepts of agri-biotechnology presented in the comics, showing great curiosity on the topic, asking many questions and being motivated to look for more information in magazines, newspapers, the Internet and other means (p. 88).

Considering these pioneering studies on the role of comics in enhancing learning about different areas of science, this study asks: Do comics and cartoons assist people in understanding specific science topics? Do audiences learn from or are they just entertained by comics that illustrate science topics and issues? Will comics evoke people's interest to search for more information about certain science topics? Are there drawbacks in using comics and cartoons to communicate science?

This study aims to examine the benefits and disadvantages of communicating a science and engineering subject matter, wind energy, in comics/cartoon form and to understand how such a mode of presenting information affects people's knowledge of, attitudes toward, and behavioral intentions related to wind energy. The goal is to provide guidelines and insights regarding the application of comics and cartoons as a way of communicating science outside classroom settings, and to enhance its value as a tool to improve science literacy among non-scientific audiences.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This chapter introduces the scientific and engineering topic that will be tested in this study—wind power as an alternative energy source—and reviews the results of research that has so far been done to explore the publics' perception of this renewable source of power. The chapter then discusses the characteristics and potential of comics and cartoons as a mode of presentation that can promote science literacy, and reviews the studies that have explored the role of comics in developing a more scientifically literate population. The study's hypotheses and research questions are outlined in the final section.

Wind Energy

One of the world's most pressing problems today is arguably meeting people's energy needs while reducing the impact of energy production on the global climate. Wind, the moving air, contains the energy of motion, which is defined as kinetic energy. "Wind energy" or "wind power" refers to the process of converting this kinetic energy into mechanical or electrical energy that can be used for human activities. Because wind energy emits no greenhouse gases and is relatively low-cost, broad consensus exists that the future American energy portfolio must contain a large wind energy component. Given that today's installed electric generating capacity in the U.S. is 1200 GW, of which only 36 GW is from wind, the Department of Energy (2008) recommends increasing the wind energy contribution to 300 GW by 2030. To address the impacts of the electricity and transportation sectors on climate change, many have suggested the electrification of transportation, resulting in a projected wind capacity growth to as much as 600

GW (McEowen, 2009). This wind capacity can be reached only with significant investments in technology development, the building and strengthening of a wind energy workforce, and changing electricity market structures while managing interrelationships with agriculture, economic structures, and rural life (Ibáñez et al., 2008). Thus, a wind energy build-out of 300-600 GWs will require dramatic progress in fundamental wind energy research and development and in establishing suitable policies. It should also go in tandem with innovations in the educational system to build the required workforce.

The Midwest U.S. is among the richest wind regions in the nation, with Iowa being a leading state in terms of its installed wind capacity of 3670 MW, second in the nation. With future Iowa wind capacity predictions between 30 and 60 GW, at 2 MW/turbine, the upper bound would require 30,000 turbines to meet state projections (Dai et al., 2010). This would result in a significant Iowa land mass supporting, on average, four to five turbines per square mile—a visible change in landscape with potentially dramatic social repercussions (McCalley et al., 2010).

The first use of wind for power dates back more than 5,000 years when the ancient Egyptians sailed from shore to shore by wind. It was not until the 1930s that large scale electricity-producing wind turbines were built in the U.S. (Iowa Energy Center, n.d.). They were intended to produce electricity for farms beyond the reach of power lines. In the 1970s, the escalating prices of conventional petroleum-based fuels and federal and state tax incentives triggered the drive to develop alternative energy sources, including wind power. By 2009, over 10,000 megawatts of new wind power generating capacity were installed in the U.S., enough to power the equivalent of 2.4 million homes. Texas leads the country in wind capacity. In Iowa, 14%

of electricity is now generated by wind, which makes the state a national leader in terms of percentage of use (American Wind Energy Association, 2010).

Wind electric turbines come in two designs: vertical-axis and horizontal-axis machines. The horizontal-axis wind turbines look like the traditional farm windmills most commonly seen today. In the vertical-axis wind turbines, also called the “egg-beater” style, the main rotating axis is arranged vertically. All electric-generating wind turbines are made up of a rotor, an electrical generator, a speed-control system and a tower. The blades (the rotor) rotate under the force of wind to power the electrical generator that supplies electric current. To generate large amounts of electrical power, wind turbines are often arrayed into a single wind power plant, often called a wind farm. Wind-fueled electricity is transferred into a utility grid and transmitted to household users (American Wind Energy Association, n.d.; Wind Energy Development, n.d.).

The output of a wind turbine depends on its size and the wind’s speed through the rotor. Wind turbines come in various sizes. For land-based wind farms, the rotor diameters can range from about 50 meters to about 90 meters with towers of similar sizes. Offshore turbines have larger rotors; the 110-meter rotor diameter as the largest. For individual residences and small businesses, the rotors are much smaller, most of which are eight meters in diameter (American Wind Energy Association, n.d.). The largest wind turbine can produce electricity needed for 1,400 homes.

Wind speed is a crucial element influencing performance. According to the American Wind Energy Association, “an annual average wind speed greater than four meters per second or 9 mph is required for small wind electric turbines; utility-scale wind power plants require minimum average wind speeds of 6 m/s (13 mph)” (para.16). According to the Wind Energy

Development (WED), abundant wind energy in many parts of the United States could supply about 20% of the nation’s electricity. Theoretically, North Dakota alone is capable of producing enough wind-generated power to meet more than one-fourth of the country’s electricity demand. In Iowa, “a 250-kW turbine installed at the elementary school in Spirit Lake provides an average of 350,000 kWh of electricity per year, more than what is necessary for a 53,000-square foot school. Excess electricity fed into the local utility system earned the school $25,000 in its first five years of operation” (AWEA, para.15).

Public Response

The advantages of wind energy are obvious. It is powered by a renewable source and entails only construction costs. Wind is a clean, non-polluting source of electricity compared to oil and coal. With better engineered turbines, electricity-producing efficiency is expected to be 25% to 30% by 2030. Iowans, for one, are encouraged to take strong steps to participate in wind energy programs (The Iowa Policy Project, 2010).

Despite the obvious benefits and government incentives, many keep skeptical attitudes toward wind energy, mainly due to several concerns. These concerns can be roughly classified into two groups—impressions based on personal experience and/or preferences and misunderstandings due to the lack of knowledge and/or information. Concerns based on personal experience or preferences include notions that the big turbines are a scar on the landscape, creating “visual pollution,” especially in populated and tourist areas. Many also say that the turning blades and whirring generators produce intolerable noise. Concerns based on lack of knowledge often include worries that the turning blades hurt wild animals and kill birds and bats and concerns about the efficiency of wind turbines. However, poor visual reception can be minimized by thoughtful wind farm design and by adjusting the scale and arrangement to satisfy aesthetic concerns. With new technology, the “swishing” sound generated by turbines has been largely reduced and could hardly be heard from 300 meters away. The wildlife impact can be avoided by careful site selection. Data also show that wind turbines can be very efficient electricity producers.

Public opinion polls (e.g., Klick and Smith, 2009) report that the general public is ambiguous about wind energy at best. This comes as no surprise considering that a litany of studies have consistently found that people are generally not well informed about most scientific issues, even those that are prominent and long-standing (e.g., National Science Foundation, 2004; Yale Project on Climate Change Communication, 2010). Because wind energy is a relatively new topic in the media and the science agenda, the findings of those who attempt to determine public perception of this renewable source show the same trajectory. For example, Grady (2002) found that “most western North Carolinians do not foresee or cannot articulate a problem with developing a wind industry in the state” (p. 12). Klick and Smith (2009) also note a weak public understanding of wind energy. The pattern of responses the authors detected was said to “reflect wishful guessing” (p. 9) as only 18% of their respondents were aware that wind-fueled electricity was more expensive than that from conventional sources.

How to inform people about this new development also appears to be problematic. Liarakou et al. (2009) observed that secondary school teachers in Greece had difficulties in expressing clear positions regarding several issues about wind farms. Despite the teachers’ positive attitudes toward this innovation, they could hardly influence their students’ opinion toward wind energy. Thus, they recommended more teachers training to clarify their opinions and positions regarding the topic (Liarakou et al., 2009). In 2005, a survey by the British Wind Energy Association (BWEA) showed that before the construction of wind turbines, 27% of its sample of local citizens worried about the wind farms' impact on the landscape. Such a negative opinion went down to only 12% after construction. Before the wind farm was built, 86% were concerned about noise nuisance, a factor that moved down to 4% after construction. These findings suggest low public knowledge of wind energy that may mitigate people's attitudes (whether positive or negative) toward wind power. They strongly indicate the need to improve public literacy on the topic.

Science Literacy

Scientific literacy, the subject of much debate, has been defined and measured in various ways (Miller, 1983, 1998; Wallace, 2004; Brossard, 2006). To Miller (1983, p. 29) to be "literate" has two basic meanings—"to be learned" and "to be able to read and write." To be scientifically literate is to be able to "read about, comprehend, and express an opinion on scientific matters" (p. 30). In 1989, the American Association for the Advancement of Science (AAAS) laid out the benchmarks for scientific literacy in the book *Science for All Americans*. Scientific literacy, according to the AAAS, entails being familiar with the natural world; understanding scientific concepts, principles, processes, and their interactions, and thinking in a scientific way; and applying science-based knowledge into daily life. As the trend of conceptualizing scientific literacy as a construct with multiple dimensions continued, Miller (1998) offered a definition of scientific literacy that involves three concepts—mastery of scientific vocabulary and constructs, knowledge of the scientific process, and understanding of the social impact of the scientific process.

Wallace (2004) offered a similar definition. He says that scientific literacy requires "knowledge of scientific vocabulary, understanding the nature of inquiry in science, being able to use scientific concepts in everyday life, and being able to read and interpret scientific information in the popular press" (p. 901). His framework involves three related skills: (1) the ability to read and learn scientific knowledge; (2) the ability to use what has been learned to argue scientific issues; and (3) "meta-cognition, or the ability to self-monitor learning" (as cited in Olsen, 2008, p. 11).

Supporting this framework are several elements. Among them is what Wallace (2004) calls "authenticity in scientific language use" (p. 903)—the ability to talk about science correctly from one's own point of view using one's own language instead of "textbook words" or expert-defined terminology. Because people use different sources to learn about science, they develop multiple discourses about a scientific topic or issue. Wallace suggests that "different types of discourses are appropriate for different situations, such as casual peer group discussions and 'bench work' talk" (p. 905). A third element of science literacy proposed by Wallace is akin to the concept of "communication noise." That is, what sources said may not be precisely what they meant; audiences, therefore, may interpret what was said in different ways. These three elements introduce possibilities for misconceptions and misinterpretations in discourses about science.

Is there a standard for measuring civic scientific literacy? Brossard and Shanahan (2006) propose that instead of focusing on "what people should know normatively in terms of science and technology vocabulary (on the basis of an ideal knowledge defined by experts)," science literacy should focus "on what people in the United States can be expected to know on the basis of collective social decision making to reveal which scientific constructs are important" (p. 48).

They espouse an approach to civic scientific literacy that "thinks not about what citizens should ideally know but what they do know relative to what they can be expected to know" (p. 50).

The Media as Sources of Scientific Knowledge

It may be difficult to reach an agreement about the definition and measurement of scientific literacy, but rarely is there any objection that the mass media are the main sources of scientific information for the general public (Nisbet, 2002 and 2009; Brossard & Shanahan, 2006). For a long time, science communication has been seen as a process of transmitting scientific information from experts to the lay public with the goal of filling-in knowledge deficits (Nisbet, 2009). In this process, the mass media are considered "the most available and sometimes the only source for most of the public to gain information about scientific discoveries, controversies, and events, and the work of scientists" (Brossard & Shanahan, 2006, p. 51). Indeed, a positive relationship has been found between exposure to mass media science content and factual scientific knowledge (Nisbet, 2002). In fact, Brossard and Shanahan (2006) suggest that the media can be used as a gauge of civic scientific literacy itself. That is, being able to understand and argue scientific issues frequently seen in the media is valid proof of being scientifically literate. Thus, the mass media can both inform and determine the general public's literacy in science and technology.

Comics as a Communication Tool

Comics have been widely used to disseminate ideas of public utility, but like science literacy, there is no general agreement about what comics is. When speaking of comics, people may refer to comic strips, comic books, graphic novels, single-panel cartoons, and animated cartoons, among other forms. Tatalovic (2009) found that some people consider comics “as a narrative form consisting of pictures arranged in sequence” while others see the “juxtaposition of words and pictures, not sequence” as essential to the comics form (p. 2). Tatalovic (2009) equates comics to film in that a single cartoon frame is just like a single photograph that helps build an entire movie. To Rota and Izquierdo (2003), comics are “pictorial images and graphics juxtaposed in a deliberate sequence destined to transmit information and/or to produce an answer in the reader” (p. 85).

While cartoons and comics use images with text to inform audiences, some experts believe they are “primarily a visual mode of communication and derive their rhetorical power of construction and persuasion primarily from their visual nature” (Abraham, 2009, p. 122). Textual materials are applied, at best, to enhance the pictures, if they are not completely useless at all (Abraham, 2009). Streicher (1967), however, thinks that text is useful in comics because they give “their subjects life and natural reality” (p. 438).

Comics combine two very rich forms—literature and the visual arts—to make them effective pedagogic tools (Rota & Izquierdo, 2003). Weitkamp and Burnet (2007) find comics an excellent vehicle for conveying scientific knowledge because of their ability to fuse the visual appeal of graphic representations and intriguing narrative.

Tatalovic (2009) says there are two comics subsets: fiction comics and educational comics. In fiction comics, like the super-hero series, characters are often endowed with super-human powers that cannot be explained by known science. Still, producers are able to convince readers to suspend their belief about such supernatural powers; everything else in the plot is justified by scientific principles. The scientific phenomena portrayed in fiction comics may be wrong, but they may still hold “scientific spirits” (Tatalovic, 2009). For example, readers can assume that Superman can fly, but the super-hero is still subject to the rules of physics, including gravity and air friction. Thus, he still falls to the ground when injured while flying. The distortion of reality and amusing activities in fiction comics are excellent tools with which to draw peoples’ attention and to entertain them.

Comics are not necessarily humorous, and educational comics are an example of its more serious form. Some of them are called “science comics,” those that aim to communicate science topics and issues. “They are intended to educate the reader about some non-fictional, scientific concept or theme, even if this means using fictional techniques and narratives to convey non-fictional information” (Tatolovic, 2009, p.4). The current study focuses on educational comics or educational cartoons as a tool for conveying scientific information and promoting scientific literacy.

Comics Characteristics

Why comics are so entrancing and are somehow able to press images in the reader’s mind are a function of their characteristics. It is often said that a picture is worth a thousand words. Comics are a form of sequential art loaded with visual images, narratives, and humor (both visual and textual). It can therefore be surmised that such a combination can convey a concept more easily than words or pictures alone (Weitkamp, 2007).

Visuals. According to Crow (2003), visual messages can be categorized into three levels in term of their relationship with structures. The first level is iconicity, referring to a sign, which physically resembles the meaning. Indexicality, the second level, holds a direct and logical link between the sign and the object (e.g., the skull and crossbones imply toxic materials). There is no logical link between the signifier and the signified in the third level, symbolicity, so that readers are expected to learn the connections between the meaning and the object. The iconic nature of images (e.g., its vividness, spontaneity, and the universal nature of non-verbal cues) is a boon to the use of comics and cartoons as a science communication tool. The visual or non-verbal elements are thought to have more primacy over verbal cues alone in the creation of meanings (Abraham, 2009). Substantial research in cognitive and social psychology has offered evidence that images enhance learning and recall of information (e.g., Rogers and Thorson, 2000; Wischmann, 1987). Compared with language and words, pictures are easier to understand, easier to remember, and can be stored in memory for a longer period of time (Gunter, 1987). Hughes (1998) showed that visuals can help children understand concepts by, for example, depicting what happens to a scene over time.

To create effective messages, the first step is to draw the audience's interest. Abraham (2009) lists four methods used to create a cartoon—selection, distortion, criticism and prediction. An effective selection (of images) will assist cartoonists in catching attention, while a bad selection will distract attention from the message. Distortion as a "rhetorical framing device reveals the intentions of the cartoonist, while also functioning as an instrument for gaining attention and eliciting emotional responses toward the caricatured subject or event" (p. 125). Thus, by selecting and distorting, cartoons and comics goad viewers to "attend to them, become emotionally engaged with them, and thus be motivated enough to consider the information the message contains" (p. 126).

Although cartoons work on an iconic level to represent and describe objects, the representations are less contained than photographic representation. Abraham (2009) claimed that cartoons can capture a person's physical traits (the nose, ears and eyes, for example) as well as character traits such as honesty, age, and morality. These can be used as "shorthand for identifying figures, forming the basis of caricature for the purpose of social commentary" (p. 136), which can then shape stereotypes that can become publicly shared conventions. Moreover, symbolic icons in cartoons may not be necessarily extracted from the real world; instead, they can be fictional or historical characters. As Abraham (2009) suggested, "the meanings of cartoons derive not solely from commonplace themes circulating in society, but also from the interaction of the commonplace with an allusion to an identifiable fiction or myth that help orient our understanding of the issue" (p. 136). Therefore, cartoons allow abstract analytical communication by rising above simply describing objects with iconic signs.

Narratives. The use of narrative is another advantage of comics and cartoons. Weitkamp and Burnet (2007) report that science books became the standard approach to teaching science in the early 20th century. Strude (1990) argues that this approach was not very successful in making students apply scientific principles to different situations. However, narrative stories made it much easier to remember scientific details. In Weitkamp and Burnet's (2007) view, the narrative helps students make connections between scientific principles and the real world, thus reinforcing their understanding of scientific concepts. They further suggest that the careful use of narrative assists learning. Because they naturally incorporate narratives, comics can gain superiority in helping people acquire scientific knowledge.

Humor. Cartoons and comics are often thought to be funny, the main reason why people find them entertaining. Humor can also affect people's understanding of information. Roesky and Kennepohl (2008) argue that "a simple image can often change the tone and the dynamics of a group by injecting a little humor" (p. 1355). They claim that humor can create a healthier atmosphere for the introduction of new ideas, concepts, and attitudes more directly and painlessly. Humor is thought to enhance various aspects of learning even at the university level, including "increasing the rate of learning, improving problem-solving skills, increasing retention, reducing nervousness (especially in test situations), and increasing perceptions of teacher credibility" (p. 1358). It is also suggested that humor lightens up "dread" courses, such as science classes (Kher et al., 1999).

However, humor affects different audiences differently in terms of their ability to retain scientific concepts. Humor related to instructional content holds the attention of adults for a longer period of time, while for young children, humor unrelated to content was found to be more effective (Roesky & Kennepohl, 2008).

Emotional engagement. Iconicity, an intrinsic characteristic of any visual, also introduces emotional disposition toward the person and objects portrayed in comics (Abraham, 2009). Iconicity makes it "possible for images to draw upon the rich variety of visual stimuli and associated emotions to which we are already attuned through our interaction with our social and natural environments: facial expressions, gestures, postures, personal appearance, physical surroundings, and so on" (Messaris, 1997, p. 34). These associations can be activated automatically through the visual medium. On the other hand, written and spoken language devoid of iconicity delays such associations (Abraham, 2009). Comics and cartoons rely on the iconicity of visuals to elicit an emotional response. Emotion, in turn, can mediate people's perception of scientific topics discussed in comics form.

Cognitive engagement. Although comics are a form of sequential art, readers still imagine actions and events between two successive pictures or comic frames. Thus, comics can "jump" discontinuously (Hansen, 2004). To fill the space between movements, engaged readers need to use their own imagination. In this way, they become active participants in the communication process (McCloud, 1993). As Rota and Izquierdo (2003) said, "participation is a powerful force in any means of communication, mainly when the target are children who have a lively imagination and are not interested in rigid and static concepts" (p. 87). Thus, comics can provide people greater autonomy in the learning of science.

According to Messaris (1997), a greater degree of mental participation is needed for viewers to interpret images. Thus, visuals invite viewers to be more mentally engaged, helping them to reach their own conclusion about an issue under discussion. If it is true that people are more likely to adopt a proposition they themselves constructed, then visuals make for potent tools for persuasion.

Visual persuasion. Images have been used as persuasion tools, as seen commonly in commercial advertising, political messages, and social issue campaigns. In this regard, comics and cartoons have an inherent advantage. Visuals, according to Messaris (1997), have a greater ability to evoke rich emotions because they are able to reproduce the real world. Advertisers, for example, are able to exploit the relationship between vision and emotion to promote products and services.

Compared to text, the visual form has a more subtle and indirect way of suggesting certain meanings. That is, explicit messages can be shown in words, whereas implicit messages can be communicated in pictures to avoid the consequences of saying it explicitly. Thus, comics, with its combination of visual and verbal claims, can deliver the message with greater impact.

Comics are known as an important medium for influencing public opinion on salient issues. As Abraham (2009) notes, “cartoon are intended to transform otherwise complex and opaque social events and situations into quick and easily readable depictions that facilitate the comprehension of the nature of social issues and events” (p. 119). Caswell (2004) see cartoons as “rhetorical devices, persuasive communication analogous to print editorials and op-ed columns that are intended to influence readers” (p. 15). As such, cartoonists have been credited with the creation and manipulation of public opinion (Coupe, 1969). Comics, at least in the area of social issues, do not merely describe objective facts; they are often more explicitly political and socially constructed.

The foregoing capabilities of comics can be harnessed to communicate science to audiences many of whom are not experts about science.

Science Communication through Comics

Many exploratory studies have been conducted to understand the role of comics in science communication. Di Raddo (2006) used comics as a teaching aid to enhance the learning of laboratory safety practices and ethics. Nagata (1999) showed that the use of *manga* (Japanese printed comics in graphic-novel format) prevented biochemistry classes from being monotonous, and made the classes more “light-hearted.” In this case, comics were able to attract students’ attention, and help them to easily recover concepts from memory. Nagata (1999) found that *manga* had “cognitive-psychological and pedagogical-technical effects,” giving “students clues to remember what they have learnt and make biochemistry lectures exciting” (p. 203).

Weitkamp and Bunet (2007) used the comic strip called *The “Chemedian” and the Crazy Football Match* to add humor to science classes. They found that humor in the narrative of a football match successfully drew children’s interest, especially those of boys. They surmise that this was because a football match could be easily related to a familiar activity in children’s daily life. Besides bringing joy to reading, the children were able to provide “explanations for the ‘science’ performed by the Chemedian based on their own experience” (p. 1911).

Animated cartoons in Dalacosta et al.’s work (2009) were found to have obvious advantages as a learning aid. They improved students’ understanding of scientific concepts, such as mass, volume, and density. The animated cartoons were observed to “provide learning opportunities such as to facilitate the differentiation of scientific concepts, to recall effectively prior knowledge and, therefore, promote the process of conceptual development” (p. 741).

In Olsen’s (2008) study, the use of comic strips in warm up activities for science classes engaged students in “thinking, conversing and writing about science and science issues” as well as “practicing and engaging in science literacy activities” (p. 84). Students improved their performance in learning the ionic bond concept. Many found “comic strips preferable to working out of the textbook” and “made learning science fun” (p. 89).

Using comics in science classes, Keoghy et al. (1998) notes a number of effective learning outcomes: “The naughtiest boy in class wanted to stay even during breaks to continue discussing the concept cartoon," "pupils who are generally reluctant to be involved in discussion or to put their views forward find it easier to join in debates with cartoon characters" (p. 222). These results support animated cartoons' power to change pupils' motivation and engage them in discussions. In 2007, Alaba also found that comics and cartoons enhanced primary pupils' creativity.

However, most of these studies were conducted in classroom settings. Because of this, there is no guarantee that the results can be generalized to the regular way people learn about science outside the classroom. Most of these studies also have children or young people as respondents, a sample that limits the applicability of results to adult audiences. Furthermore, they emphasized comics' role in attracting attention and enhancing memory, while the influence of comics on other dimensions of scientific literacy, such as the ability to apply scientific principles in daily life, have yet to be explored. Moreover, the majority of these studies used knowledge or the process of learning science as dependent variables. The extent to which comics can change the general public's attitude and behavior toward science issues—and how they do so—cries for research attention.

Hypotheses and Research Question

This study aims to compare two modes of presenting information about wind energy (cartoons+text and photographs+text) to determine the impact of comics on people's knowledge of, attitudes about and behavior toward wind energy. As the foregoing literature suggests, comics have the ability to draw audience's interest and attention, create a healthier learning atmosphere, enable readers to make connections between scientific principles and real world, and help people to remember scientific details. It can also introduce emotional disposition and engage readers to use their own imagination so that the readers become active participants in the communication process. Considering these potentials for comics, this study hypothesizes that:

H1: The cartoons + text version will outperform the photographs + text presentation in improving people’s knowledge of wind energy.

H2: The cartoons + text version will outperform the photographs + text presentation in enhancing people’s positive attitudes about wind energy.

H3: The cartoons + text version will outperform the photographs + text presentation in producing more positive behavioral intentions toward the use of wind energy as an alternative source of power.

H4: Wind energy information presented in cartoons + text form will be more positively evaluated by audiences as an informational aid in terms of (a) credibility, (b) informativeness, (c) interest, (d) emotional engagement, and (e) cognitive engagement.

Beyond these hypothesized main effects of comics on knowledge, attitude and behavioral intentions, this study also aims to examine relationship between knowledge, attitudes and behavioral intentions:

RQ1: Is there a relationship between and among knowledge of, attitudes about, and behavioral intentions related to wind energy?

CHAPTER 3

METHOD

This study compares people's responses to two ways of presenting information about an ascendant alternative source of power, wind energy. One mode involves the use of cartoons with text (cartoons + text); the other involves the use of photographs with text (photos + text). In order to gather data under natural information consumption conditions, an online field experiment was employed to test the study's hypotheses and answer the research question. In this conventional post-test only design, respondents were randomly assigned to one of the two experimental treatments after which the two groups were compared in terms of knowledge gained about wind energy as well as their attitudes and behavioral intentions toward wind energy. The study also aims to determine which mode of presentation readers found more credible, informative, interesting, emotionally engaging, and cognitively engaging.

Sampling and Data Collection

To gather data for this study, a sample of 2,000 adults who reside in Iowa was procured from National Data Group, an email list provider based in Omaha, NE, which compiles email addresses from U.S. resident listing services, unique compilers, credit bureaus, and privately-owned databases. Anticipating a low response rate, this list was supplemented by a convenience sample of 247 graduate and undergraduate students at Iowa State University. The undergraduate participants received credit in an introductory Advertising course for their participation in the study. The participants were randomly assigned to view one of two informational brochures about wind energy. Finally, they were asked to complete a questionnaire that was administered online.

An introductory email was sent to the sample, apprising the respondents of the study and its objectives, and specifying the conditions for informed consent. The email also contained an active link to the study website. To boost the response rate, a reminder email was sent once a week to those who had yet to respond. The data-gathering phase lasted five weeks.

This study used a purposive sample of Iowa residents. Iowa was selected as the study locale because it is a state that has provided incentives to wind power since 1983 when it enacted a law that required investor-owned utilities to buy a total of 105 MW of wind-generated electricity (Wiser, 2011). By 2008, Iowa overtook the historical leader in wind power, California, in terms of installed wind power capacity. The American Wind Energy Association (2010) reported that installed wind power capacity in Iowa stood at 3,670 MW in 2009. In 2010, Siemens, a global powerhouse in the industry, energy and healthcare sectors, received an order to deliver 258 wind turbines to wind farms in Iowa, intended to supply 190,000 U.S. households with clean energy (Siemens, n.d.). A number of companies involved in the wind power industry have offices or manufacturing facilities in Iowa. Today, the state registers the highest density of wind power generation capacity in the country (U.S. Energy Information Administration, 2012).

Experimental Treatments

As wind farms expand, more people are being introduced to wind turbines in their communities. Wind power is still a relatively new technology, and a number of myths—some based on experiences with energy technologies, some based on misunderstandings—are constantly repeated. The brochure titled *Wind Power—Myths vs. Facts*, produced by the Minneapolis-based National Wind, LLC, a company that develops community wind projects, aims to dispel some of the most common myths about wind power with facts. These “myths” include observations that (1) wind turbines are ugly; (2) wind turbines are noisy; (3) wind projects harm property values; (4) wind turbines harm wildlife because they kill bats and birds; (5) wind turbines are unreliable because they are inefficient; (6) wind turbines operate only a small fraction of the time; and (7) wind energy provides only a small amount of electricity.

Two versions of the brochure were created. The first (Brochure 1, Appendix A) uses mainly text supplemented by photographs to clarify commonly heard concerns about wind energy. The second brochure presents the same information using text supplemented by single-panel cartoons (Brochure 2, Appendix B).

Experimental Procedure

The solicitation email described the project and its purpose and explained what is expected of participants. This solicitation was sent via the university's email system. Those who agreed to participate were sent an informed consent document a week later. At the bottom of the document, a link to the study's site that houses the experimental stimuli and the questionnaire was provided. Respondents were reminded that their participation in the study should be completely voluntary, and that they can refuse to participate or leave the study at any time. Following the initial email message, they received three weekly email reminders requesting them to complete the questionnaire.

The participants were randomly assigned to two groups. Group 1 was presented with the text + photos informational material (Brochure 1). Group 2 was exposed to the text + cartoons brochure (Brochure 2). Then, they were asked to complete a questionnaire. The experimental protocols were such that respondents were not allowed to re-examine the experimental stimulus once they had began answering the questionnaire.

Variables and Their Measure

The questionnaire was divided into five sections. The first section aims to measure previous exposure to information regarding wind energy and knowledge about wind energy after exposure to the brochure.

Three questions were posed to measure respondents' *exposure* to wind energy prior to viewing the brochure. These were: (1) How familiar were you about wind energy before responding to this study? (Very familiar, Somewhat familiar, Unfamiliar, Never heard of it before). (2) Have you ever seen an actual wind turbine in operation? (Yes, I am living/working with wind turbines; Yes, I have visited wind turbines and/or a wind farm; Yes, I have seen a wind turbine from a distance; No, I have never seen one at all). (3) To what extent have you read, watched or heard about articles or stories about wind energy in the media, including the Web? (Very often, Often, Seldom, Rarely, Not at all).

To measure *knowledge* about wind energy, respondents were asked six true or false items. Their correct answers were added as a measure of knowledge, the values for which ranged from -6 to 6.

The second section aims to measure *attitudes* toward wind energy. Participants were asked the extent to which they agree to ten statements related to wind energy using Likert scales the response items to which range from 1 to 5 where 1 means "strongly disagree" and 5 means "strongly agree." These items were: (1) Wind turbines are as quiet as a refrigerator one normally finds in the kitchen; (2) Wind turbines spoil the scenery; (3) Wind turbines close to my community will lower local property values; (4) Wind turbines are more efficient in generating electricity than coal plants; (5) Wind turbines operate only for short periods of time and are therefore unreliable; (6) Wind turbines kill a lot of bats and birds; (7) Wind turbines produce small amounts of electricity compared to coal plants; (8) Wind energy is clean energy; (9) Overall, the benefits of wind energy overshadow its drawbacks; and (10) Wind farms will boost the local economy. The responses were averaged to serve as a measure of attitudes. The reliability of this attitude index was determined by computing for Cronbach's alpha (α=.795).

The third section focuses on *behavioral intentions.* Seven items were listed to gauge students' behavioral intentions toward wind energy. Similarly, Likert scales were used with response items that ranged from 1 to 5 where 1 means "strongly disagree" and 5 means "strongly agree." The behavioral intention items were: (1) I will support government initiatives to make wind energy a significant part of national efforts to meet America's future energy needs, (2) I will support more investments in wind energy projects in the U.S., (3) I will support a wind project in my community, (4) I will vote for candidates for public office who are in favor of wind energy, (5) I will join groups and organizations that will advocate for the development of wind energy, (6) I intend to learn more about wind energy by seeking more information about it, and (7) I am willing to pay a little more to support wind energy initiatives in my community. The answers were summed and averaged as a measure of behavioral intentions. The reliability of this index was acceptable (α=.845).

The fourth section asked respondents to evaluate the brochure as a communication tool based on five criteria: (1) informativeness, (2) interest, (3) credibility, (4) emotional engagement, and (5) cognitive engagement. Two items tapped each criterion. Respondents were asked where they position themselves on each of these statements using Likert scales with responses ranging from 1 to 5 where 1 means "strongly disagree" and 5 means "strongly agree." For each criterion, the items were: *Informativeness*—(1) The brochure helped me a great deal in understanding wind energy and (2) The brochure clarified the drawbacks of wind energy I keep hearing about. *Interest*—(1) The brochure held my interest and (2) I find the overall appearance of this brochure very interesting. *Credibility*—(1) I find the information contained in the brochure very credible and (2) There is no reason for me to doubt the information contained in the brochure. *Emotional engagement*—(1) I feel more positively about wind energy after reading the brochure and (2) I find the visuals in the brochure emotionally engaging. *Cognitive engagement*—(1) The visuals in the brochure helped me follow the logic of the arguments and (2) I intend to learn more about wind energy after reading this brochure. The items comprising each criterion were averaged. A series of Pearson's correlation tests was conducted to evaluate the relationship between the two questions asked to measure each criterion. The five criteria were summed and averaged to serve as people's evaluation of the brochure. The reliability of this index also was ascertained using Cronbach's alpha (α=.842).

The fifth section solicited demographic information (gender, age, income, education, race, and employment status). In addition, respondents were asked to indicate their political orientation on a scale from 1 to 10 where 1 means "conservative" and 10 means "liberal." Using a scale from 1 to 7 where 1 means "do not identify at all" and 7 means "strongly identify," respondents were asked the extent to which they identify with the "environmentalist" label.

The complete questionnaire is presented in Appendix C.

Data Analysis

Independent samples *t*-tests were used to determine whether there was a significant difference in knowledge, attitudes, behavioral intentions, and the five evaluation criteria between the two groups. T-tests also were conducted to analyze if there were differences on these variables based on gender. Pearson correlation tests were employed to determine the relationship between each of these variables and the demographic characteristics political orientation (conservative-liberal), and identification with the environmentalist label. Rank correlation tests were conducted to determine differences in knowledge, attitudes, behavioral intentions, and the five evaluation criteria based on age, education and income. The significant correlations were examined using one-way analysis of variance (ANOVA) tests. ANOVA tests also were employed to determine differences in the four major variables based on race and employment status. Tukey post hoc tests were conducted on those with significant ANOVAs to examine the differences among groups based on race/ethnic backgrounds and employment status.

The research question asks: Is there a relationship between and among knowledge of, attitudes about, and behavioral intentions related to wind energy? To answer this question, a series of Pearson correlation tests were conducted.

CHAPTER 4

RESULTS AND DISCUSSION

This study tests the effects of two types of brochures—one with photographic visual aids and another that uses comics and cartoons as visual supplements—on people's knowledge of, attitudes toward, and behavioral intentions about wind energy. To gather data, an online experiment was conducted using a non-probability sample of adult Iowa residents as participants. A total of 226 participants who were randomly assigned to one of the two groups returned their completed questionnaire. One hundred and eleven saw the photo version while 115 were exposed to its comics or cartoon counterpart.

Of the 226 participants, 61.5% were female. The participants' ages ranged from 18 to more than 55 years old, with about 60% belonging to the 18 to 21 age group. About 80% claimed having an education level of some college and higher. About 68% were students, 20% were employed for wages, and the rest were out of work, retired or homemakers. A large majority (70%) were Caucasians, about 21% were Asian/Pacific Islanders, African American, or Hispanic, and the rest were multi-racial. The median household income was $ 10,255.50 in 2012 (range= $25,000 to $125,000). The demographic characteristics of the sample, divided into the two groups, are shown in Table 1.

Table 1. Demographic characteristics of the sample by group

	Group 1: Photos	Group 2: Cartoons
Gender		
Female	67	72
Male	43	42

Table 1. (Continued).

Did not respond	1	1
Age		
18-21	69	68
22-25	14	14
26-34	12	23
35-54	6	2
55+	10	8
Education level		
12th grade or less	4	20
Graduated high school or equivalent	18	53
Some college, no degree	58	5
Associate degree	3	9
Bachelors degree	6	14
Masters degree	13	12
Doctoral degree	8	1
Professional degree (MD, JD)	0	20
Employment status		
Employed for wages	23	23
Self-employed	1	1
Out of work and looking for work	1	3
Out of work but not currently looking for work	2	1
A homemaker	1	0
A student	72	82
Retired	10	5
Did not respond	1	0

Table 1. (Continued).

Race/Ethnic background		
African-American	2	1
Asian/Pacific Islander	21	27
Caucasian	81	77
Hispanic	3	2
Other/Multi-Racial	3	2
Household income (2012)		
Less than $25,000	25	28
$25,000 to $34,999	6	7
$35,000 to $49,999	14	13
$50,000 to $74,999	6	12
$75,000 to $99,999	10	12
$100,000 to $124,999	11	5
$125,000 or more	13	8
Don’t know	24	28

About a third of the participants (31.9%) considered themselves neutral in terms of political orientation or inclination, rating themselves 5 or 6 on a scale of 1 to 10 where 1 means “conservative” and 10 means “liberal.” Those who considered themselves conservative (1-4 on the scale) constituted 32.7% of the sample; those who rated themselves liberal (7-10 on the scale) made up 35.4%.

The same pattern was observed regarding the participants’ perception of themselves as environmentalists. Asked the extent to which they identify themselves with the “environmentalist” label on a scale of 1 (do not identify at all) to 7 (strongly identify), 71.6% gave a neutral response. About 17.8% did not identify with this characterization (1 to 3 on the scale), while 10.6% agreed (5 to 7 on the scale) that they can be described as such (Table 2).

More than half of the participants (51%) said they were unfamiliar with wind energy; about 41% were "somewhat familiar" with this renewable energy resource before participating in the study. An overwhelming majority (93%) claimed they had seen a wind turbine or visited a wind farm; less than 14% said they had done so only through media exposure (Table 2).

Table 2. The sample's political orientation, agreement with the environmentalist label, and exposure to wind turbines and wind farms

Variable	N	Means	Std. dev.
Political orientation[1]	226	5.41	2.31
Agreement with environmentalist label[2]	225	3.90	1.40
Exposure to wind turbines and/or wind farms[3]	225	6.37	1.36

[1]Political orientation was measured using a scale of 1 (conservative) to 10 (liberal).
[2]Agreement with the environmentalist label was measured on a scale of 1 (do not identify) to 7 (strongly identify).
[3]Exposure to wind turbines and/or farms was measured as the sum of responses to three items with four response options. The sum ranged from 2 (not familiar at all) to 11 (very familiar).

Knowledge about Wind Energy

Six "true or false" questions were asked to determine the participants' knowledge of wind energy after exposure to one of the two types of brochure. Reponses were scored from -1 to 1 where -1 means "incorrect," 0 means "not sure," and 1 means "correct." Their answers were added as a measure of knowledge, the values for which ranged from -6 to 6.

Despite the reported relatively low level of familiarity with wind energy, the sample provided an average of three correct responses to the knowledge test (M=2.96, SD=2.22) as shown in Table 3. More than 82% answered correctly that engineers and developers are now able to create a virtual view of a wind farm to give people a sense of how these farms may look like.

Seventy-three percent were correct in disagreeing that wind farms are less efficient than nuclear plants in generating electricity because nuclear plants never suffer from unexpected outages. Another 69% also correctly said that the statement, "Wind turbines kill more birds than any other human activity," was false.

Table 3. Results of the knowledge test (N=224)

	Means	Std. dev.	Percentage giving the correct answer
1. Engineers and developers can create a virtual view of a wind farm before construction begins so that people can have a sense of how these farms may look like. (T)	.79	.49	82.3
2. In some hilly terrains where houses are located downwind from turbines, the sounds these turbines create are less audible. (F)	.12	.85	42.0
3. There are studies showing that wind projects can increase property values. (T)	.35	.78	52.7
4. Wind turbines kill more birds than any other human activity. (F)	.57	.71	69.0
5. Wind farms are less efficient than nuclear plants in generating electricity because nuclear plants never suffer from unexpected outages. (F)	.61	.71	73.0
6. America's wind potential is larger than the total amount of electricity Americans now consume. (T)	.54	.67	63.3

Responses were scored from -1 to 1 where -1 means "incorrect," 0 means "not sure," and 1 means "correct."

A series of independent samples *t*-test was conducted to determine whether there was a significant difference between Group 1 (that received the photographic brochure) and Group 2 (that was exposed to the cartoon version) based on their performance on each of the six knowledge items and on the combined knowledge measure (sum of the six items). No significant differences were found between the two groups on the six knowledge items.

Table 4. Knowledge results for the two groups

	Group 1: Photos (n=109)		Group 2: Cartoons (n=115)		*t*-test results		
	Means	Std. dev.	Means	Std. dev.	*t* value	df	Sig.
1. Engineers and developers can create a virtual view of a wind farm before construction begins so that people can have a sense of how these farms may look like.	.77	.50	.82	.47	-.72	222	.473
2. In some hilly terrains where houses are located downwind from turbines, the sounds these turbines create are less audible.	.19	.83	.05	.88	1.18	220	.241
3. There are studies showing that wind projects can increase property values.	.31	.79	.38	.77	-.71	220	.480
4. Wind turbines kill more birds than any other human activity.	.54	.71	.60	.70	-.62	222	.535
5. Wind farms are less efficient than nuclear plants in generating electricity because nuclear plants never suffer from unexpected outages.	.58	.74	.63	.68	-.60	222	.549
6. America's wind potential is larger than the total amount of electricity Americans now consume.	.52	.68	.56	.67	-.38	222	.708
Knowledge index (sum of the six items combined)	2.88	2.24	3.04	2.20	-.56	218	.578

For items 1-6, responses were scored from -1 to 1 where 1 means “incorrect,” 0 means “partially correct,” and 1 means “correct.”

Group 2 members gave correct answers to all knowledge items, except for the second item that asked whether the sounds wind turbines make are less audible in hilly terrains where houses are located downwind from turbines, which is false (Table 4). For this group, illustrative cartoons were used to explain each myth related to noise, efficiency, and impact on scenery, among others. It should be noted that for both groups, the mean values for the second item in the knowledge quiz were much lower and show an unusually high standard deviation. This suggests that participants found this item much more difficult than the rest.

The results show that those shown the brochure that used cartoons as visual aids (M=3.04, SD=2.20) outperformed those that were exposed to the brochure with photos when it comes to knowledge scores (M=2.88, SD=2.24), but this difference was not statistically significant [t(218)= -.56, p=.578]. Thus, H1 was not supported.

Attitudes Toward Wind Energy

The combined sample exhibited a slightly positive disposition toward wind as an energy source based on their responses to ten attitudinal statements (M=3.74, SD=.54) as shown on Table 5. Here, the negatively framed items were recoded so that higher assessments indicate a more positive attitude. The participants agreed that wind offers clean energy. In general, they disagreed that wind turbines operate only for short periods of time and are therefore unreliable. Overall, they also tended to agree that the benefits of wind energy overshadow its drawbacks. The responses demonstrate a neutral to slightly positive attitudinal response to the other eight statements.

Table 5. Responses to the attitude items (N=226)

	Means	Std. dev.
1. Wind turbines are as quiet as a refrigerator one normally finds in the kitchen.	3.48	1.01

Table 5. (Continued).

2. Wind turbines spoil the scenery.	3.62	1.01
3. Wind turbines close to my community will lower local property values.	3.60	.93
4. Wind turbines are more efficient in generating electricity than coal plants.	3.64	.95
5. Wind turbines operate only for short periods of time and are therefore unreliable.	3.89	.82
6. Wind turbines kill a lot of bats and birds.	3.60	1.04
7. Wind turbines produce small amounts of electricity compared to coal plants.	3.48	1.00
8. Wind energy is clean energy.	4.41	.68
9. Overall, the benefits of wind energy overshadow its drawbacks.	3.92	.89
10. Wind farms will boost the local economy.	3.77	.71
Attitude index (average of the ten items combined)	**3.74**	**.54**

Response items ranged from 1 to 5 where 1 means “strongly disagree” and 5 means “strongly agree.” The negatively framed statements were recoded in the opposite direction to represent the same trajectory of responses. That is, high numbers mean more positive attitudes.

A series of independent samples *t*-test was conducted to evaluate if there was a significant difference between Group 1 and Group 2 based on their responses to the ten attitudinal statements and on the attitude index. The results, summarized in Table 6, suggest that those in Group 2 (cartoons) found wind energy quieter and cleaner, believed wind turbines are less likely to spoil the scenery or lower local property values, judged it as more efficient in generating electricity, demonstrated a more positive outlook that wind farms will boost the local economy, and assessed wind energy as having benefits that overshadow the drawbacks.

Of these items, the two groups differed significantly in their assessment that “wind turbines close to my community will lower local property values” [t(216.168)= -2.93, p=.004], with Group 2 (M=3.78, SD=.86) showing a more positive attitude than Group 1 (M=3.42, SD=.96). A statistically significant difference also was detected in responses to the statement "Overall, the benefits of wind energy overshadow its drawbacks" [t(223)= -1.99, p=.048], with Group 2 (M=4.03, SD=.85) agreeing more with it than Group 1 (M=3.80, SD=.93).

Group 1 (photos) agreed less that wind turbines operate only for short periods of time and are therefore unreliable, disagreed more that turbines kill a lot of bats and birds, and that they produce small amounts of electricity compared to coal plants. The differences between the two groups on these items, however, were not statistically significant.

To determine whether the ten items constitute an internally consistent attitude index, a reliability test was conducted. The results produced a Cronbach's alpha of .795, which suggests acceptable internal consistency. The *t*-test results show no statistically significant difference between the two groups in terms of the combined measure of attitude (Table 6). Thus, H2 was not supported.

Table 6. Comparative responses to attitude items between the two groups

	Group 1: Photos (n=111)		Group 2: Cartoons (n=115)		*t*-test results		
	Means	Std. dev.	Means	Std. dev.	*t* value	df	Sig.
1. Wind turbines are as quiet as a refrigerator one normally finds in the kitchen.	3.44	1.07	3.52	.95	-.565	223	.573
2. Wind turbines spoil the scenery.	3.54	1.01	3.70	1.02	-1.151	224	.251
3. Wind turbines close to my community will lower local property values.	**3.42**	**.96**	**3.78**	**.86**	**-2.933**	**216.168**	**.004**
4. Wind turbines are more efficient in generating electricity than coal plants.	3.62	1.00	3.63	.89	-.270	219	.787
5. Wind turbines operate only for short periods of time and are therefore unreliable.	3.93	.88	3.85	.75	.714	219	.476
6. Wind turbines kill a lot of bats and birds.	3.61	1.01	3.59	1.07	.155	220	.877

Table 6. (Continued).

7. Wind turbines produce small amounts of electricity compared to coal plants.	3.54	1.02	3.43	.97	.770	221	.442
8. Wind energy is clean energy.	4.35	.67	4.47	.69	-1.304	224	.193
9. Overall, the benefits of wind energy overshadow its drawbacks.	**3.80**	**.93**	**4.03**	**.85**	**-1.985**	**223**	**.048**
10. Wind farms will boost the local economy.	3.75	.73	3.79	.70	-.387	223	.699
Attitude index (average of the ten items combined)	**3.69**	**.55**	**3.79**	**.53**	**-1.251**	**205**	**.212**

Response items ranged from 1 to 5 where 1 means “strongly disagree” and 5 means “strongly agree.” The negatively framed statements were recoded in the opposite direction to represent the same trajectory of responses. That is, high numbers mean more positive attitudes.

Behavioral Intentions About Wind Energy

The combined sample generated relatively neutral behavioral intentions based on the participants’ responses to seven behavioral statements (M=3.48, SD=.57) listed in Table 7. Most said they were willing to support government initiatives, investments related to wind energy, and wind projects in their community. The majority also said they were likely to vote for candidates who advocate for wind energy, and are willing to pay a little more to support wind energy initiatives in their area. They also want to learn more about wind energy. However, the majority also said they were not willing to join groups and organizations that will work to develop wind energy.

Table 7. Responses to behavioral intention items (N=226)

	Means	Std. dev.
1. I will support government initiatives to make wind energy a significant part of national efforts to meet America's future energy needs.	3.80	.80
2. I will support more investments in wind energy projects in the US.	3.78	.70

Table 7. (Continued).

3. I will support a wind project in my community.	3.73	.76
4. I will vote for candidates for public office who are in favor of wind energy.	3.65	.77
5. I will join groups and organizations that will advocate for the development of wind energy.	2.96	.83
6. I intend to learn more about wind energy by seeking more information about it.	3.25	.85
7. I am willing to pay a little more to support wind energy initiatives in my community.	3.23	.87
Behavioral intention index (average of the seven items combined)	3.48	.57

Response items ranged from 1 to 5 where 1 means "strongly disagree" and 5 means "strongly agree."

An independent samples *t*-test was conducted to evaluate if there were significant differences between Group 1 and Group 2 on their responses to the seven behavioral statements (Table 8). The results show that Group 2 indicated greater willingness to support wind energy initiatives, investments and projects, and are likely to vote for pro-wind energy political candidates. Compared to those in Group 1, Group 2 members also indicated they were willing to pay more for wind energy. The two groups statistically differed only in terms of their behavioral intentions toward the item "I will support government initiatives to make wind energy a significant part of national efforts to meet America's future energy needs" [$t(202.553)= -2.773$, $p=.006$], with Group 2 ($M=3.95$, $SD=.67$) agreeing more with the statement than Group 1 ($M=3.65$, $SD=.89$).

To determine whether the seven items constitute an internally consistent behavioral intention index, a reliability test was conducted. The results produced a Cronbach's alpha of .845, which suggests acceptable internal consistency. The *t*-test result shows a statistically significant difference between the two groups in terms of the combined measure of behavioral intentions [t(212)= -2.348, p=.020], with Group 2 (M=3.57, SD=.54) showing stronger behavioral intentions related to wind energy than Group 1 (M=3.39, SD=.60). Thus, H3 was supported.

Table 8. Comparative responses to behavioral intention items between the two groups

	Group 1: Photos (n=111)		Group 2: Cartoons (n=115)		*t*-test results		
	Means	Std. dev.	Means	Std. dev.	*t* value	df	Sig.
1. I will support government initiatives to make wind energy a significant part of national efforts to meet America's future energy needs	**3.65**	**.89**	**3.95**	**.67**	**-2.773**	**202.553**	**.006**
2. I will support more investments in wind energy projects in the US	3.72	.76	3.83	.63	-1.177	211.131	.241
3. I will support a wind project in my community	3.62	.85	3.83	.64	-1.966	201.533	.051
4. I will vote for candidates for public office who are in favor of wind energy	3.55	.82	3.75	.70	-1.900	214.282	.059
5. I will join groups and organizations that will advocate for the development of wind energy	2.95	.81	2.96	.85	-.007	222	.994
6. I intend to learn more about wind energy by seeking more information about it	3.15	.87	3.35	.81	-1.836	220	.068
7. I am willing to pay a little more to support wind energy initiatives in my community	3.17	.85	3.28	.89	-.922	224	.358
Behavioral intention index (average of the seven items combined)	**3.39**	**.60**	**3.57**	**.54**	**-2.348**	**212**	**.020**

Response items ranged from 1 to 5 where 1 means “strongly disagree” and 5 means “strongly agree.”

Is there a relationship between knowledge of, attitudes about, and behavioral intention? A series of Pearson's correlation tests was conducted to answer this question. The analysis was done separately for each group.

For Group 1, the results show statistically significant correlation between knowledge and attitude (r=.412, p=.000), suggesting that people having more knowledge about wind energy tended to demonstrate more positive attitudes toward it (Table 9). Attitudes and behavioral intentions also correlated significantly (r=.585, p=.000), indicating that people who viewed wind energy more positively also demonstrated stronger behavioral intentions. Although the correlation between knowledge and behavioral intention was not significant (r=.156, p=.122), the positive value implies that higher knowledge level enhances behavioral intention.

For Group 2, the results (Table 9) show statistically significant correlations between knowledge and attitude and between knowledge and behavioral intentions. These suggest that people having more knowledge of wind energy tend to maintain more positive attitudes (r=.569, p=.000) and stronger behavioral intentions (r=.280, p=.003). In addition, those with positive attitudes toward wind energy exhibited stronger behavioral intentions (r=.451, p=.000).

Table 9. Pearson correlation results testing the relationships between knowledge, attitudes, and behavioral intentions

		Knowledge	Attitudes	Behavioral Intention
Group 1				
Knowledge	R	1	**.412****	.156
	Sig.		**.000**	.122
	N	105	98	99

Table 9. (Continued).

Attitudes	R	**.412****	1	**.584****
	Sig.	**.000**		**.000**
	N	98	103	98
Behavioral Intention	R	.156	**.584****	1
	Sig.	.122	**.000**	
	N	99	98	105
Group 2				
Knowledge	R	1	**.569**	**.280**
	Sig.		**.000**	**.003**
	N	115	104	109
Attitudes	R	**.569**	1	**.451**
	Sig.	**.000**		**.000**
	N	104	104	99
Behavioral Intention	R	**.280**	**.451**	1
	Sig.	**.003**	**.000**	
	N	109	99	109

Evaluation of the Brochure

The participants evaluated the brochures based on five criteria: (1) informativeness, (2) interest, (3) credibility, (4) emotional engagement, and (5) cognitive engagement. A series of Pearson's correlation tests was conducted to evaluate the relationships between the two questions that measure each criterion. The values were r=.537 (p=.000) for informativeness, r=.562 (p=.000) for interest, r=.611 (p=.000) for credibility, r=.385 (p=.000) for emotional engagement, and r=.118 (p=.080) for cognitive engagement. The combined sample gave a relatively positive evaluation of the brochure to which they were exposed (M=3.54, SD=.50). The correlation results are summarized in Table 10.

Table 10. Evaluation of the brochure (N=225)

	Means	Std. dev.
1. Informativeness	3.56	.60
2. Interest	3.55	.73
3. Credibility	3.58	.69
4. Emotional engagement	3.64	.65
5. Cognitive engagement	3.38	.56
Evaluation index (average of the five criteria combined)	**3.54**	**.50**

Response items ranged from 1 to 5 where 1 means "strongly disagree" and 5 means "strongly agree."

An independent samples *t*-test was conducted to see if there was a significant difference between Group 1 and Group 2 regarding their evaluation of the brochure as an information aid. The descriptive statistics (Table 11) suggest that Group 2 found the cartoon-aided presentation more informative, interesting, and cognitively engaging. However, these differences were not statistically significant.

In terms of emotional engagement, both groups exhibited the same mean value (3.64). Group 1 found the photo version more credible although the two groups' rating of the brochure's credibility also was not statistically significant. This may be because cartoons are still viewed as art for fun rather than for serious matters, which may have lowered the participants' estimation of its credibility as a science communication tool.

To determine whether the nine items constitute an internally consistent evaluation index, a reliability test was conducted. The results produced a Cronbach's alpha of .842, which suggests acceptable internal consistency. The *t*-test results show no statistically significant difference between the photo group (M=3.52, SD=.47) and the cartoon group (M=3.57, SD=.54) in terms of overall brochure evaluation (Table 11). Thus, H4 was not supported.

Table 11. Comparative evaluations of the brochure

	Group 1: Photos (n=110)		Group 2: Cartoons (n=115)		*t*-test results		
	Means	Std. dev.	Means	Std. dev.	*t* value	df	Sig.
1. Informativeness	3.53	.58	3.59	.63	-.733	219	.464
2. Interest	3.48	.72	3.62	.74	-1.410	220	.160
3. Credibility	3.63	.67	3.52	.71	1.153	218	.250
4. Emotional Engagement	3.64	.57	3.64	.72	-.046	213	.963
5. Cognitive Engagement	3.33	.54	3.42	.59	-1.177	217	.240
Evaluation index (average of the five criteria combined)	**3.52**	**.47**	**3.57**	**.54**	**-.678**	**201**	**.499**

Response items ranged from 1 to 5 where 1 means “strongly disagree” and 5 means “strongly agree.”

Additional Analysis: The Impact of Political Involvement and Environmentalist Orientation

A series of Pearson’s correlation tests was conducted to evaluate whether the participant’s political orientation or identification as an environmentalist correlated with the four dependent variables. Again, the analyses were done separately for each group.

Table 12 outlines the results. For Group 1, the findings show a positive, weak, but statistically significant correlation between political orientation and attitude (r=.298, p=.002). Political orientation also correlated significantly with behavioral intentions (r=.342, p=.000).

These suggest that more liberal individuals are more likely to form positive dispositions and greater behavioral intentions toward wind energy. The results of a one-way analysis of variance (ANOVA) test find significant differences in attitudes (F=2.341, p=0.020) and behavioral intentions (F=2.059, p=.041) based on political orientation. The results for Group 1 also indicate no significant correlation between identification with the environmentalist label and any of the four dependent variables (Table 12).

The Pearson correlation results for those in Group 2 (Table 12) show a significant relationship between political orientation and behavioral intentions (r=.248, p=.009). This indicates that more liberal individuals have stronger behavioral intentions related to wind energy. The results of an ANOVA test find no significant difference in behavioral intentions (F=1.541, p=.153) based on political orientation. Similarly, a significant correlation was found between identification with the environmentalist label and behavioral intention (r=.364, p=.000), suggesting that the more strongly individuals identify themselves as environmentalists, the stronger behavioral intentions they have related to wind energy. The results of an ANOVA test find that the difference in behavioral intentions (F=3.511, p=.003) based on identification as an environmentalist is significant.

Table 12. Pearson correlation results for Groups 1 and 2

Dependent variables	Political orientation		Identification as an environmentalist	
Group 1				
	R	Sig.	R	Sig.
Knowledge	.31	.756	-.014	.891
Attitudes	**.298**	**.002**	.129	.196

Table 12. (Continued).

Behavioral intentions	**.342**	**.000**	.191	.051
Evaluations	.129	.200	.122	.226
Group 2				
Knowledge	.049	.602	.137	.145
Attitudes	.078	.433	-.012	.901
Behavioral intentions	**.248**	**.009**	**.364**	**.000**
Evaluations	.161	.104	.162	.105

Additional Analysis: The Impact of Demographic Variables

Do demographic characteristics have a bearing on knowledge, attitude, behavioral intention and evaluations of the brochure? A series of tests were conducted separately for each group. For these analyses, the combined knowledge score and the index for each of the three other dependent variables were used as dependent variables.

Table 13 shows the results of *t*-tests conducted to determine if males and females in the two groups differed in terms of the four dependent variables. The results indicate that the females in Group 1 had significantly more positive attitudes than the males [t(100)= -2.477, p=.015]. Specifically, women indicated greater willingness to support wind energy initiatives, investments, and projects; tended to vote more for candidates with pro-wind energy platforms; and were willing to pay more for this renewable resource compared with men. Females also recorded higher knowledge scores, had stronger behavioral intentions, and viewed the photo-laden brochure as an effective information aid although these differences were not statistically significant.

Table 13 also shows the results of a series of *t*-tests conducted to determine if males and females in Group 2, who received the cartoon-aided brochure, differed in terms of the same four dependent variables. The results indicate that females viewed the brochure as an effective information aid more so than males [t(100)= -1.99, p=.049]. Specifically, women found the brochure more informative, interesting, credible, and emotionally and cognitively engaging than the males. In addition, in absolute terms, females had more positive attitudes toward wind energy than males. However, unlike in Group 1, the males in Group 2 outperformed the females in knowledge scores and behavioral intentions.

The findings for both groups suggest that females generally had a more positive attitude toward wind energy than their male counterparts.

Table 13. T-test results showing differences between males and females in terms of knowledge, attitudes, behavioral intentions, and evaluation of the brochure

Dependent variables	Males		Females		*t*-test results		
	Means	Std. dev.	Means	Std. dev.	*t* value	df	Sig.
Group 1							
Knowledge	2.59	2.60	3.06	2.00	-1.002	69.519	.320
Attitudes	**3.53**	**.54**	**3.80**	**.54**	**-2.477**	**100.000**	**.015**
Behavioral intentions	3.33	.73	3.43	.50	-.764	57.638	.448
Evaluation	3.47	.44	3.57	.46	-1.132	97.000	.260
Group 2							
Knowledge	3.14	2.19	2.99	2.24	.364	112	.717
Attitudes	3.75	.54	3.82	.53	-.593	101	.555
Behavioral intentions	3.63	.53	3.54	.55	.827	106	.410
Evaluation	**3.43**	**.53**	**3.65**	**.53**	**-1.99**	**100**	**.049**

Based solely on mean scores, the men in Group 2 obtained higher knowledge scores, showed more positive attitudes and higher behavioral intentions. However, the men in Group 2 evaluated their brochure, presented with cartoons, lower. This suggests that while cartoons enhanced knowledge, attitudes and behavioral intentions, the males underestimated the value of cartoons as an information aid, specifically in terms of the credibility of the brochure that showcased them. On the other hand, the females in Group 2 scored higher than those in Group 1 in terms of the dependent variables, except knowledge. This implies that while cartoons generated a more pleasing feeling, they tended to distract women from reading the text, thus reducing their opportunity to learn more useful information and greater detail.

A series of rank correlation tests was conducted to evaluate if age, level of education, and household income correlated with the four dependent variables. Again, the analysis was done separately for each group (Table 14).

For Group 1, the results show a negative, weak, but significant correlation between age and attitude (r=-.194, p=.050), suggesting that older individuals tended to have a less positive attitude toward wind energy. The results of an ANOVA test find no significant difference in attitudes (F=2.397, p=.055) based on age. A positive, weak, but significant correlation also was found between education and behavioral intention (r=.199, p=.043), indicating that those with higher education were more willing to support wind energy initiatives. Another ANOVA test shows no significant difference in behavioral intentions (F=1.081, p=.379) based on education. A negative, weak, but significant correlation was found between household income and behavioral intention (r=-.264, p=.006) for Group 2, which means that those with higher incomes have weaker behavioral intention related to wind energy. The results of an ANOVA test find significant difference in behavioral intentions (F=2.972, p=.007) based on household income.

Table 14. Rank correlation test results for Groups 1 and 2

Dependent variables		Age	Education	Household Income
Group 1				

Table 14. (Continued).

Knowledge	R	-.161	-.011	.090
	Sig.	.101	.910	.368
Attitude	R	**-.194***	-.018	-.034
	Sig.	**.050**	.859	.732
Behavioral Intention	R	.105	**.199***	-.079
	Sig.	.284	**.043**	.427
Evaluation	R	.016	.129	-.033
	Sig.	.875	.203	.747
Group 2				
Knowledge	R	.021	.125	-.151
	Sig.	.820	.185	.110
Attitude	R	-.149	-.153	-.113
	Sig.	.130	.124	.257
Behavioral intention	R	.155	.160	**-.264***
	Sig.	.108	.099	**.006**
Evaluation	R	-.125	-.074	-.106
	Sig.	.210	.460	.293

A series of one-way ANOVA tests was conducted to determine whether knowledge, attitude, behavior and evaluation of the brochure varied by race/ethnic background for each of the two groups.

The findings (Table 15) show that the Caucasians in Group 1 registered the highest knowledge scores. They also had the most positive attitudes toward wind energy. The results of a

Tukey post hoc test indicate that Caucasians differed significantly from Asian/Pacific Islanders in knowledge scores; Caucasians also had significantly more positive attitudes than Asian/Pacific Islanders. However, there were no differences in behavioral intentions and brochure evaluation ratings among the racial or ethnic groups.

The findings also indicate that for Group 2, Caucasians had the most positive attitudes toward wind energy. Hispanics showed the strongest behavioral intention and the highest brochure evaluation ratings. The results of a Tukey post hoc test show that the attitude of Asian/Pacific Islanders toward wind energy differed significantly from that of Caucasians and of the other/multi-racial group. A significant difference in attitude also was found between native Americans/Alaskans and the other/multi-racial group. Tukey test results also indicate that the other/multi-racial group had significantly stronger behavioral intentions than native Americans/Alaskans. The other/multi-racial group also evaluated the brochure they saw more positively than Asian/Pacific Islanders, Caucasians, and native Americans/Alaskans. However, for Group 2, knowledge scores did not differ by racial/ethnic categories (Table 15).

Table 15. Results of one-way ANOVA tests to determine differences in knowledge, attitudes, behavioral intentions, and evaluations of brochure based on race/ethnic background

		N	Means	Std. dev.	ANOVA test results	
Group 1						
					F	Sig.
Knowledge	African-American	2	3.0000	1.41421	**4.480**	**.001**
	Asian/Pacific Islander	20	.9500	2.72368		
	Caucasian	76	3.3947	1.91192		
	Hispanic	3	2.3333	2.08167		

Table 15. (Continued).

	Other/Multi-Racial	3	2.6667	1.15470		
Attitude	African-American	2	3.3500	.77782	**2.876**	**.018**
	Asian/Pacific Islander	19	3.3632	.40717		
	Caucasian	77	3.7831	.55498		
	Hispanic	2	3.3500	.07071		
	Other/Multi-Racial	2	3.6000	.00000		
Behavioral Intention	African-American	2	3.3571	.70711	.198	.963
	Asian/Pacific Islander	19	3.3910	.60953		
	Caucasian	78	3.3846	.61877		
	Hispanic	3	3.4762	.08248		
	Other/Multi-Racial	2	3.1429	.20203		
Evaluation	African-American	2	3.3500	.49497	.740	.596
	Asian/Pacific Islander	19	3.4211	.44294		
	Caucasian	72	3.5667	.48586		
	Hispanic	3	3.2667	.32146		
	Other/Multi-Racial	3	3.3000	.10000		
Group 2						
Knowledge	African-American	1	5.0000	.	.818	.559
	Asian/Pacific Islander	27	2.6296	2.15100		
	Caucasian	77	3.1818	2.23446		
	Hispanic	2	1.5000	3.53553		
	Other/Multi-Racial	2	2.5000	2.12132		

Table 15. (Continued)

Attitude	African-American	1	3.8000	.	3.784	.002
	Asian/Pacific Islander	23	3.5130	.42029		
	Caucasian	70	3.8771	.52865		
	Hispanic	2	3.4000	.28284		
	Native American/Alaska Native	2	2.9500	.07071		
	Other/Multi-Racial	4	4.4000	.33665		
Behavioral Intention	African-American	1	2.5714	.	2.557	.024
	Asian/Pacific Islander	26	3.6374	.37521		
	Caucasian	72	3.5655	.55688		
	Hispanic	2	3.7857	.30305		
	Native American/Alaska Native	2	2.6429	.70711		
	Other/Multi-Racial	4	4.0357	.57588		
Evaluation	African-American	1	3.4000	.	4.102	.001
	Asian/Pacific Islander	23	3.5826	.44071		
	Caucasian	69	3.5551	.50803		
	Hispanic	2	3.7000	.42426		
	Native American/Alaska Native	2	2.6500	.91924		
	Other/Multi-Racial	4	4.4250	.43493		

Table 16 outlines the results of ANOVA tests performed to find out if there were differences in the four dependent variables based on employment status. For the photo-aided group, the findings indicate that those who were out of work and/or looking for work had the strongest behavioral intentions, but no significant differences in knowledge, attitudes and evaluation of the brochure were found based on employment status. Similarly, for Group 2, no significant results were obtained. The descriptive statistics show, however, that those who were out of work or were retired scored the highest in all four variables.

Table 16. Results of one-way ANOVA tests to determine differences in knowledge, attitudes, behavioral intentions, and brochure evaluations by employment status

		N	Means	Std. dev.	ANOVA test results	
Group 1						
Knowledge	Employed for wages	22	3.0909	2.40850	2.160	.053
	Self-employed	1	2.0000	.		
	Out of work and looking for work	1	6.0000	.		
	Out of work but not currently looking for work	2	5.5000	.70711		
	A homemaker	1	-2.0000	.		
	A student	68	2.6765	2.18161		
	Retired	9	3.8889	1.36423		
Attitudes	Employed for wages	20	3.6250	.64716	1.161	.334
	Self-employed	1	2.8000	.		
	Out of work and looking for work	1	3.5000	.		
	Out of work but not currently looking for work	2	4.4000	.56569		
	A homemaker	1	3.5000	.		
	A student	68	3.6971	.52489		
	Retired	9	3.8222	.51424		

Table 16. (Continued).

Behavioral Intention	Employed for wages	22	3.3182	.57470	**3.464**	**.006**
	Self-employed	1	1.1429	.		
	Out of work and looking for work	**1**	**3.8571**	.		
	Out of work but not currently looking for work	2	3.5000	.10102		
	A homemaker	0	.	.		
	A student	70	3.4224	.55804		
	Retired	9	3.4603	.62588		
Evaluation	Employed for wages	21	3.3905	.44035	1.160	.335
	Self-employed	0	.	.		
	Out of work and looking for work	1	3.7000	.		
	Out of work but not currently looking for work	2	3.6500	.63640		
	A homemaker	1	2.7000	.		
	A student	65	3.5554	.48057		
	Retired	9	3.6222	.39299		
Group 2						
Knowledge	Employed for wages	23	2.6087	2.40717	.438	.821
	Self-employed	1	2.0000	.		
	Out of work and looking for work	3	2.6667	1.52753		
	Out of work but not currently looking for work	1	2.0000	.		
	A student	82	3.1585	2.23037		
	Retired	**5**	**3.8000**	**1.30384**		

Table 16. (Continued).

Attitudes	Employed for wages	21	3.6857	.52181
	Self-employed	0	.	.
	Out of work and looking for work	3	3.5667	.35119
	Out of work but not currently looking for work	**1**	**4.3000**	.
	A student	75	3.7920	.53493
	Retired	**4**	**4.2750**	**.52520**
Behavioral Intention	Employed for wages	21	3.4898	.45304
	Self-employed	**1**	**4.1429**	.
	Out of work and looking for work	**3**	**3.9048**	**.16496**
	Out of work but not currently looking for work	1	3.7143	.
	A student	78	3.5513	.56006
	Retired	5	3.8571	.66240
Evaluation	Employed for wages	19	3.4368	.72511
	Self-employed	1	3.7000	.
	Out of work and looking for work	**2**	**3.9500**	**.07071**
	Out of work but not currently looking for work	1	3.8000	.
	A student	75	3.5747	.47989
	Retired	5	3.7400	.73007

CHAPTER 5

CONCLUSIONS

This study sought to compare two modes of presenting information about wind energy in brochure form—one using photographs as visual aids and the other using cartoons and comics as visual supplements—on audience's knowledge of, attitudes toward, and behavioral intentions related to wind energy. A brochure, originally produced by National Wind, LLC, a Minneapolis-based company that develops large-scale, community-based wind energy projects, was manipulated to showcase these two types of visual aids that served as the study's experimental treatments. The brochure aims to debunk several unfounded statements or "myths" about wind energy. The study's 266 participants were randomly assigned to the two treatments. About half (111) were presented with the photo-aided brochure; the other half (115) was exposed to the cartoon version. The experimental treatments and their accompanying questionnaire were administered to the participants online.

Several conclusions can be drawn from the results. First, there was a clear indication that prior exposure to wind energy was relatively low. This suggests that future campaign efforts must expand reach and frequency of message dissemination.

Second, in terms of improving audience members' knowledge of wind energy, no significant difference was observed between the two groups, but the cartoon/comics version outperformed the highly photographic presentation in achieving higher knowledge scores.

Third, the same can be said about the treatments' impact on attitude toward wind as a source of renewable energy. Although the participants demonstrated slightly positive attitudinal dispositions toward wind energy, no significant difference between Group 1 (photos) and Group

2 (cartoons) was detected. A more detailed analysis indicates that those in Group 2 did not think that wind turbines close to their community will lower local property values. Group 2 also expressed more optimism that overall, the benefits of wind energy overshadow its drawbacks. In comparison, Group 1 members were more likely to think that wind energy is unreliable, that wind turbines kill bats and birds, and that the turbines can produce only small amounts of electricity, although the results were not statistically significant. Those who saw the cartoon-aided brochure, therefore, tended to have more positive dispositions toward wind energy.

Fourth, the present study found evidence that cartoons have the capacity to motivate people to strengthen favorable behavioral intentions, such as supporting government initiatives and investments in wind energy projects. In this study, the responses regarding this aspect were slightly positive. Group 2 (cartoons) showed stronger behavioral intentions than Group 1 (photos), and this difference was statistically significant. On closer inspection, those exposed to the cartoon version indicated greater willingness to support government initiatives to make wind energy a significant part of national efforts to meet America's future energy needs, and indicated greater willingness to support investments in wind energy development, including wind projects that may be cited locally. They also were more likely to vote for candidates with pro-wind energy platforms, pay more for wind energy, and learn more about it. Both groups, however, said they were not likely to join groups and organizations that will advocate for the development of wind energy. This finding suggests that although people were in favor of developing this resource, they do not see themselves as being directly involved with the process. Nonetheless, the comics version clearly produced stronger intentions to take actions in support of wind energy development.

Fifth, both groups positively evaluated the quality of the brochure they have read. A more detailed examination reveals that those exposed to the cartoon version found the brochure more informative, interesting, and cognitively engaging. However, those presented with the photo version found the brochure more credible. This suggests that cartoons may still be viewed as appropriate for entertainment or light-hearted content, but not for serious-minded topics.

Sixth, those shown the comics version demonstrated statistically significant correlations between knowledge, attitudes and behavioral intentions. Those who saw the photo version, however, showed statistically significant correlations only between knowledge and attitude, as well as between attitude and behavioral intentions. The latter shows the general pattern of communication influence (from knowledge gain to attitude change and from attitude change to behavioral intentions) following the conventional hierarchy of effects model. In the case of those who saw the comics version, however, there was an additional significant association between knowledge and behavioral intentions, which appears to bypass the traditional flow of influence. This suggests that the comics version offers a more efficient path toward the development of stronger intentions to perform recommended behaviors.

Seventh, political orientation was found to be significantly correlated with attitudes and behavioral intentions for members of Group 1, while a significant correlation was obtained only between political orientation and behavioral intentions for Group 2. It appears, therefore, that exposure to the photo version produced stronger correlations between political orientation and attitude formation and between political orientation and behavioral intention. That is, those with a more liberal orientation tended to hold more positive attitudes and to demonstrate stronger behavioral intentions. The identification with the environmentalist label significantly correlated with behavioral intentions only for those who saw the cartoon-laden brochure, suggesting that people who consider themselves more of an environmentalist show stronger behavioral intentions related to wind energy.

Eighth, demographic characteristics asserted some influence on the four dependent variables. In the photo group, females recorded higher knowledge scores, showed stronger behavioral intentions, and viewed the brochure as an effective information aid. In addition, females reported a more positive attitude than males, and this difference was statistically significant. The females in the cartoons group also showed more positive attitudes, and higher behavioral intentions and brochure evaluations. However, the men generated higher knowledge scores. These findings suggest that women were more likely to be distracted by the cartoons from learning more about the topic.

In both groups, age correlated negatively and significantly with attitudes, which means that older people have more negative attitudes toward wind energy. Education also showed a positive and significant relationship with behavioral intentions. In Group 2, a negative and significant correlation was detected between household income and behavioral intentions, implying that people with higher income were less likely to support wind energy initiatives. In Group 1, Caucasians scored highest in knowledge and exhibited the most positive attitudes. In Group 2, while Caucasians also showed the most positive attitudes, Hispanics recorded the strongest behavioral intentions and the highest brochure evaluation. The overwhelming number of Caucasians, however, may have biased the results.

For both groups, people who were out of work or have retired scored higher in knowledge, attitude, behavioral intentions and evaluation. This, however, may have resulted from the large proportion of students (more than 70%) in the sample.

Household income negatively correlated with attitude, behavioral intentions, and brochure evaluations for both groups. The negative association between income and behavioral intentions indicate that people with higher income may be more accustomed to the traditional text and visual presentation and less influenced by comics and cartoons.

Implications of the Findings to Theory and Practice

The participants reported a very low media exposure and a relatively low familiarity with wind energy even though most claimed having seen wind turbines or having visited wind farms before. This is consistent with Klick and Smith's (2009) finding of low knowledge levels about wind energy in their survey that asked a non-probability national sample. The low exposure to wind energy media content suggests the need to heighten audiences' literacy about this relatively new energy source. This may be done through informational materials that promote the personal relevance, local significance, and national importance of wind energy among audiences that are likely to know little about this innovation. With higher awareness and understanding, additional incoming information are likely to be processed using a more informed schema, thus contributing to the development of a public more literate about the topic.

For a rather complicated and multi-faceted topic, visuals, whether photographs or illustrations, can be combined with text to help audience members accurately recall informational items. The simplicity of cartoon presentations, in particular, and their popular appeal allow them to propel science and technology topics, including lesser-known sources of energy, to the general public's attention. Indeed, comics have shown their potential to aid audience's understanding of scientific concepts and processes (Dalacosta et al., 2009).

There are other reasons why cartoons can enhance wind energy literacy. Clever cartoons are often the motivator for people to actually read news reports and editorial viewpoints. Duus (2001) asserts that cartoons have an increased chance of becoming viral and therefore usually have wider circulation, a longer life, and a greater influence than written stories among the public. As shown in this study, those who were exposed to the comics-aided brochure assessed it as more informative, interesting and cognitively engaging. Such characteristics can be tapped to advance the public's literacy about wind energy.

This study hypothesized a difference between photographs used as textual aids and comics used as visual supplements in terms of the attitudes audiences develop toward wind energy. However, the study's respondents demonstrated close to neutral attitudinal dispositions toward items related to this subject, with no significant difference between Group 1 (photo) and Group 2 (comics). In a nutshell, the results suggest a lack of attitude commitment that risk communicators can exploit. Studies (e.g., Bord & O'Connor, 1990) have shown that such attitudes are more transient and are easier to adjust or secure. It is important to note, however, that those exposed to the cartoon-enhanced brochure more strongly supported the statement that the benefits of wind energy overshadow its drawbacks, an important objective for an information material that aims to debunk commonly held misgivings about wind energy.

It is said that the simplicity with which cartoons portray even complex issues aids readers' comprehension of these issues because readers can understand their message faster. The results of the study, however, show no differences between the two groups in terms of knowledge gain. One can also surmise that the use of humor allows the spectator to easily elaborate on the image and develop an opinion and attitude about the subject (Bal et al., 2009). Again, the results of the study show no differences between the two groups in terms of attitude.

Unexpectedly, however, the group exposed to the comics version demonstrated stronger behavioral intentions. This resulted, perhaps, because like urban graffiti, jokes, and other genres of popular culture, cartoons expose viewers to a serious point of view presented in a humorous way. Condensing wind energy myths and concepts within a single frame, a cartoon can re-contextualize these myths and evoke reference points in ways that photographs or even films cannot. Cartoons aim not just to inform but also to make people reflect on current events and issues. Such a reflection also may have enhanced behavioral intentions.

The knowledge-attitude-behavior model of communication effects suggests that the right information will influence attitudes and thus change behavioral intentions and, subsequently, actual behavior. The correlation results suggest that in the group exposed to the brochure with photographs, knowledge scores correlated with attitudes; attitude toward wind energy, in turn, correlated with behavioral intention. The group that saw the brochure with comics and cartoons, however, indicated positive relationships between knowledge and attitude, knowledge and behavioral intent, and between attitude and behavioral intentions. This suggests that the comics version was able to trigger a more active interaction of intended effects. This result adds to the roster of studies showing that the relationship between knowledge, attitudes and behavior is more complex, that the line-up of effects may not necessarily follow the K-A-B sequence, and that the K-A-B link is neither consistent nor unidirectional.

There is a preponderance of studies suggesting that information efforts are more effective in raising cognitive and knowledge levels, but only inconsistently effective in producing attitude and behavior change. The findings of the present study suggest that the brochure with cartoon/comics visual aids were more effective in influencing behavioral intentions, but had no influence on two factors known to be strong determinants of behavior—knowledge about a topic and attitude toward it.

Additional analysis on the impact of demographic variables show that age, education level and household income negatively correlated with the evaluation of the cartoon-aided brochure. Those who saw the cartoon version also found the brochure less credible. These might be indications of the common prejudices against, or common experiences with, comics. Some, especially older respondents, may have seen comics as suitable only for children and involving absurd characters acting in a bizarre fashion (Locke, 2005), thus perceiving them as not too credible. As expected, the comics version resonated more with the younger respondents.

Limitations of the Study and Suggestions for Future Research

There are limitations that curtail the extent to which the findings can be applied in some situations. The present study involved a relatively large proportion of students in the sample, which boosted the reported educational attainment level to some college and above. Thus, the results cannot be generalized to the entire population of Iowa residents. Future studies should test the same hypotheses on a more heterogeneous state population.

A qualitative evaluation of the cartoons used in Brochure 2 (catoons+text) was not done. Because the interpretation of cartoons highly depends on individuals cognitive processing strategies and personal perceptions, a qualitative evaluation can offer a better understanding of the effects of cartoons as experimental stimuli.

The study did not take into account the sample's pre-existing knowledge about wind energy, which may have influenced the results. To be able to evaluate the effectiveness of a brochure with the communication goal of clarifying myths, misunderstandings and/or misgivings about wind energy, pre-exposure benchmarks for knowledge, attitudes, and behavioral intentions related to wind energy would have provided stronger statements of effects.

The participants also suffered from response fatigue, with some commenting that the brochure was too long and took some time to understand. An experiment in a laboratory setting or a focus group approach may be better able to capture participants' attention and hold it longer.

This study did not take the participants' predisposition toward cartoons into consideration. Cartoons are more often seen in the form of editorial cartoons, related to politics and controversial social issues, which are usually presented in extreme and absurd tones. These conventional uses of cartoons may have shaped audience members' perceptions of the comics form, tune their initial emotional perceptions, and lead to biased assessments.

Deeper insights about the independent and/or combined influence of the two treatments can be gleaned from open-ended, unprompted, and more free-wheeling responses that can be gathered through in-depth interviews and other qualitative research approaches.

This study approached the impact of comics as a science communication tool from a persuasive stance (i.e., using them to enhance positive attitudes toward and thus strengthen public support for wind energy). Using comics for a different purpose, however, will further illuminate its communicative function.

Considering that the visual representation of risk is still a nascent field of study, an interdisciplinary approach is necessary to develop an overarching framework that encompasses the psychological processes individuals go through when presented with visual stimuli. The findings of cross-disciplinary research should begin to bridge the gap between scientific experts and the general public when it comes to risk assessment pertaining to a relatively new energy source.

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APPENDIX A

EXPERIMENTAL TREATMENT: PHOTO-AIDED BROCHURE

NATIONALWIND™

Partnering People With Wind Power One Community at a Time

Wind Power Myths vs. Facts

Wind energy is clean, inexhaustible, readily available, and cost-effective. It is an essential element to America's solution to global warming and the increasing demand for electricity. As wind power generates more electricity in the U.S. and moves into new areas of the country, more people are being introduced to wind turbines in their communities. Wind power is still a relatively new technology to most and there are many common myths and misunderstandings out there. This document hopes to dispel some of the common myths based upon old technologies and replace it with the real wind power facts.

MYTH: WIND TURBINES ARE A NUISANCE BECAUSE…

… turbines are ugly.

FACT: Beauty is in the eye of the beholder. Many people feel wind turbines are awe-inspiring, majestic machines. Wind farm developers have computer modeling tools that can create a virtual view of the farm to alleviate any visual concerns before construction begins.

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Media Inquiries:
Contact: Erin Edholm,
Director of Communications
Direct: 612-746-6646
Email:
eedholm@nationalwind.com

NATIONALWIND™

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MYTH: WIND TURBINES ARE A NUISANCE BECAUSE…

… they are noisy.

FACT: Wind turbines are quiet. Within 750 to 1,000 feet, wind farms are as quiet as a kitchen refrigerator and other modern day equipment. They make a light whooshing or swishing sound. However, in some hilly terrain where residences are located downwind from turbines, turbine sounds can be more audible. This can easily be avoided through adequate setbacks from homes throughout the development process. National Wind takes great care to design an effective turbine layout to appropriately address these concerns.

"Many people feel wind turbines are awe-inspiring, majestic machines."

NATIONALWIND™

Partnering People With Wind Power One Community at a Time

MYTH: WIND TURBINES DO NOT BENEFIT LOCAL COMMUNITIES BECAUSE...

… wind projects harm property values.

FACT: There is no evidence to suggest this. A nationwide study conducted in 2003 surveyed property near wind farms. The study found that property values did not decrease and, in some instances, nearby wind projects actually increased property values.

"Economic development associated with a new wind farm extends far beyond taxes to increased employment, directly from wind farm operation and construction."

NATIONALWIND™

Partnering People With Wind Power One Community at a Time

MYTH: WIND TURBINES HARM WILDLIFE BECAUSE...

… they kill bats and birds.

FACT: Wind energy projects have a very minimal impact on bat and bird populations in most areas. According to a 2002 summary on causes of bird mortality, for every 10,000 birds killed by human activities, less than one death is caused by a wind turbine. Despite the minimal impact, the wind industry and National Wind take potential harm to bird and bat populations seriously. We conduct routine pre-construction wildlife and avian studies to ensure their overall safety.

"For every 10,000 birds killed by human activities, less than one death is caused by a wind turbine."

NATIONALWIND™ *Partnering People With Wind Power One Community at a Time*

MYTH: WIND TURBINES ARE EXPENSIVE AND UNRELIABLE BECAUSE…

…they are inefficient.

FACT: Wind turbines are quite efficient. One of the ways to measure overall efficiency is to look at how much energy wind turbines produce over time compared with traditional power plants. A recent study by the University of Wisconsin found that wind farms pro-duce 17 to 39 times more energy than they consume. Nuclear plants generate only about 16 times and coal plants about 11 times more energy than they consume. Wind turbines are efficient also because they generate electricity from a natural, renewable source not one that needs to be mined, causes global warming pollutants, and one that needs to be stored, treated, and disposed of.

Source: AWEA (American Wind Energy Association).

"Many sources of electricity considered highly reliable, such as coal or nuclear power, often suffer from unexpected outages and need to shut down completely for repairs."

NATIONALWIND™

Partnering People With Wind Power One Community at a Time

MYTH: WIND TURBINES ARE COSTLY AND UNRELIABLE BECAUSE…

… wind turbines operate only a small fraction of the time.

FACT: Wind turbines generate electricity 65 to 80 percent of the time. No power plant operates at 100 percent nameplate capacity all the time. Nameplate capacity refers to the maximum generation potential of a power plant. Most power plants are occasionally closed for repairs or run below full capacity to best match demand.

… wind energy provides only a small amount of electricity.

FACT: America's wind potential is larger than the total U.S. electricity consumption (U.S. Department of Energy). In the United States today, wind energy currently produces approximately 17 billion kilowatt-hours of electricity, which can power 1.6 million American homes. By 2020, 100,000 MW of wind energy could be installed, providing at least 6 percent of the electricity generated in the U.S. One MW of wind energy can power 300 homes.

"A recent study by the University of Wisconsin found that wind farms produce 17 to 39 times more energy than they consume."

APPENDIX B

EXPERIMENTAL TREATMENT: CARTOON-AIDED BROCHURE

NATIONALWIND™

Partnering People With Wind Power One Community at a Time

Wind Power Myths vs. Facts

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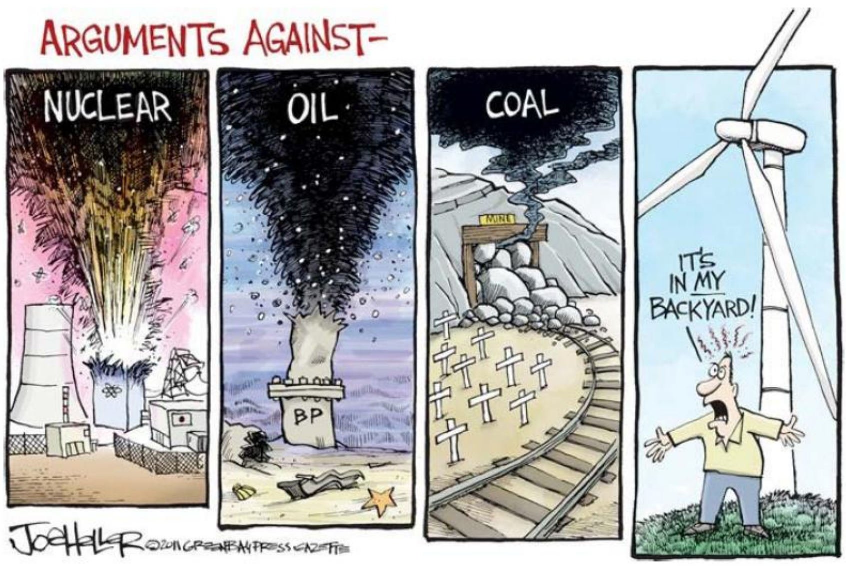
NATIONALWIND™ *Partnering People With Wind Power One Community at a Time*



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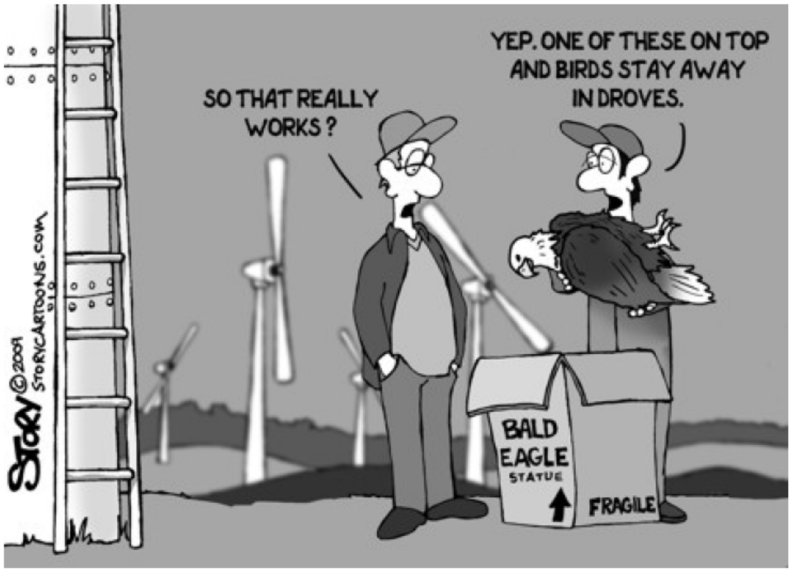

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Source: AWEA (American Wind Energy Association).

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"A recent study by the University of Wisconsin found that wind farms produce 17 to 39 times more energy than they consume."

APPENDIX C

STUDY QUESTIONNAIRE

Wind Power: Myths vs. Facts

Exposure to Wind Energy

1. How familiar were you about wind energy before responding to this study?

Very familiar

Somewhat familiar

Unfamiliar

Never heard of it before

2. Have you ever seen an actual wind turbine in operation?

Yes, I am living/working with wind turbines.

Yes, I have visited wind turbines and/or a wind farm.

Yes, I have seen a wind turbine from a distance.

No, I have never seen one at all.

3. To what extent have you read, watched or heard about articles or stories about wind energy in the media, including the Web?

Very often

Often

Seldom

Rarely

Not at all

The following section aims to gauge your comprehension of the information presented in the wind energy brochure you have just read. If you do not know the answer to a question, you may leave it blank.

4. Please state whether the following statements related to wind energy are true or false:

	True	False	Not Sure
Engineers and developers can create a virtual view of a wind farm before construction begins so that people can have a sense of how these farms may look like.			
In some hilly terrains where houses are located downwind from turbines, the sounds these turbines create are less audible.			
There are studies showing that wind projects can increase property values.			
Wind turbines kill more birds than any other human activity.			
Wind farms are less efficient than nuclear plants in generating electricity because nuclear plants never suffer from unexpected outages.			
America's wind potential is larger than the total amount of electricity Americans now consume.			

Attitudes toward wind energy

The following are statements people make when discussing wind energy. On a scale of 1 to 5 where one means "strongly disagree" and means "strongly agree," where do you position yourself on each of these statements? Please check the box that most corresponds to your response.

1. Wind turbines are as quiet as a refrigerator one normally finds in the kitchen.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

2. Wind turbines spoil the scenery.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

3. Wind turbines close to my community will lower local property values.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

4. Wind turbines are more efficient in generating electricity than coal plants.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

5. Wind turbines operate only for short periods of time and are therefore unreliable.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

6. Wind turbines kill a lot of bats and birds.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

7. Wind turbines produce small amounts of electricity compared to coal plants.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

8. Wind energy is clean energy.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

9. Overall, the benefits of wind energy overshadow its drawbacks.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

10. Wind farms will boost the local economy.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

Behavior

The following are suggestions people offer to make the most of wind energy. On a scale of 1 to 5 where one means “strongly disagree” and means “strongly agree,” where do you position yourself on each of these suggestions? Please check the box that best corresponds to your answer.

1. I will support government initiatives to make wind energy a significant part of national efforts to meet America’s future energy needs.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

2. I will support more investments in wind energy projects in the U.S.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

3. I will support a wind project in my community.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

4. I will vote for candidates for public office who are in favor of wind energy.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

5. I will join groups and organizations that will advocate for the development of wind energy.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

6. I intend to learn more about wind energy by seeking more information about it.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

7. I am willing to pay a little more to support wind energy initiatives in my community.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

Brochure Evaluation

How would you evaluate the wind energy brochure you have just seen? On a scale of 1 to 5 where one means “strongly disagree” and means “strongly agree,” where do you position yourself on each of these statements? Please check the box that best corresponds to your answer.

1. The brochure held my interest.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

2. I feel more positively about wind energy after reading the brochure.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

3. I find the information contained in the brochure very credible.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

4. There is no reason for me to doubt the information contained in the brochure.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

5. I find the visuals in the brochure emotionally engaging.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

6. The brochure helped me a great deal in understanding wind energy.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

7. The brochure clarified the drawbacks of wind energy I keep hearing about.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

8. The visuals in the brochure helped me follow the logic of the arguments.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

9. I intend to learn more about wind energy after reading this brochure.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

10. I find the overall appearance of this brochure very interesting.

Strongly disagree

Disagree

Undecided

Agree

Strongly agree

Tell us a little about yourself.

1. What is your gender?

Female

Male

Prefer not to say

2. What was your age on your last birthday?

18 – 21

22 – 25

26 – 30

31 – 40

41 – 50

51 – 60

61 or over

3. What is the highest level of education you have completed?

Less than high school

High school or GED

2-year college (Associate degrees)

4-year college (BA, BS)

Master's

Doctoral

Professional degree (MD, JD).

4. What is your current employment status?

Employed for wages

Self-employed

Out of work and looking for work

Out of work but not currently looking for work

A homemaker

A student

Retired

Unable to work

5. On the following ten-point scale in which 1 means "conservative" and 10 means "liberal," where would you position yourself when it comes to your political orientation or inclination? Please circle the number that applies.

1 2 3 4 5 6 7 8 9 10

Conservative Liberal

6. Using a scale from 1 to 7 where 1 means "do not identify at all" and 7 means "strongly identify," how much do you identify yourself with the label "environmentalist"? Please circle the number that applies.

1 2 3 4 5 6 7

Do not identify Strongly identify

7. How much total income before taxes did your household earn in 2011? Please estimate the combined income for all household members from all sources.

Less than $25,000

$25,000-$49,999

$50,000-$74,999

$75,000-$99,999

$100,000-$125,000

More than 125,000

Don’t know

8. Which of these categories best represent your race/ethnic background? Please mark all categories that apply to you.

African American

Asian American

European American

Native American

Hispanic/Latino/Latina American

Other (Please specify ________________________________)

Thank you for participating in this study.

APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 12/27/2012

To: Xiao Lin
Physics Hall 12

CC: Dr. Lulu Rodriguez
214 Hamilton Hall

From: Office for Responsible Research

Title: The impact of comics on people's knowledge of, attitudes toward, and behavioral intentions related to wind energy

IRB ID: 12-627

Study Review Date: 12/19/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption,** even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

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