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Impact of *Sci-Tech Today*
Nanotechnology Cable News Segments



Museum of Science correspondent Tim Miller generates power from a light as part of a New England Cable News segment on nanotechnology and solar energy

Report
for
Museum of Science, Boston
and
Center for High-rate
Nanomanufacturing
at
Northeastern University,
University of Massachusetts Lowell,
and the
University of New Hampshire

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EXECUTIVE SUMMARY
IMPACT OF *SCI-TECH TODAY* NANOTECHNOLOGY CABLE NEWS SEGMENTS
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The Museum of Science (MoS) in Boston is contributing to early endeavors of informal science educators to engage and inform the public about the emerging field of nanotechnology by producing 3-5 minute segments that appear on a regional cable news station, New England Cable News (NECN). Multimedia Research implemented a naturalistic post-only experiment with three general goals: (1) to assess the effectiveness of four *Sci-Tech Today* segments in engaging, educating and motivating the public to learn more about nanotechnology; (2) to appraise local news viewers' support for science and technology news; and (3) to explore the perceived value of the Museum of Science's involvement in production of *Sci-Tech Today*. The study randomly assigned 62 adults to a treatment group and control group. Once a week for four weeks, the treatment group viewed a half-hour newscast in which was integrated a *Sci-Tech Today* nanotechnology segment and the control group viewed a newscast without a nanotechnology segment.

By many measures, the *Sci-Tech Today* segments were very successful in engaging, educating and motivating viewers to learn more about nanotechnology

- Immediately after seeing the NECN newscasts each week, half to three-quarters of *Sci-Tech Today* segment viewers identified as interesting the respective nanotechnology stories, indicating high engagement with the topic. Viewers described the unique and informative content, the demonstrations, the practical applications, the benefits and risks of nanotechnology, and the interdisciplinary aspect of the field. *Sci-Tech Today* viewers were significantly more likely to name the nanotechnology stories as interesting compared to a national news story, local news story, or sports and weather.
- After the four weeks of newscast viewing, significantly more of those who saw the *Sci-Tech Today* segments reported having heard more about nanotechnology than those who did not view the segments and reported that television was their major source of nanotechnology information, due to the *Sci-Tech Today* segments.
- The *Sci-Tech Today* viewers demonstrated significantly more knowledge about nanotechnology and its applications, deeper knowledge, and more confidence in their knowledge, as compared to the control group. Viewers of *Sci-Tech Today* acquired knowledge about the scale of nano, about specific beneficial applications of nanotechnology, and that scientists engineer materials and technologies at the nanoscale. The two groups did not differ significantly in their descriptions of what the prefix "nano" means.
- The treatment group rated nanotechnology as significantly more beneficial for the United States society as a whole, but the two groups did not differ in their ratings of risk.
- *Sci-Tech Today* nanotechnology segments were equal to national and local news stories in stimulating a curiosity to know more about topics, and a large majority of viewers agreed that seeing the segments excited them about future applications of nanotechnology.

- Viewers of the four *Sci-Tech Today* segments were significantly more likely than non-viewers to report paying attention to news about nanotechnology as well as thinking about, discussing and looking for information about nanotechnology and its applications.
- Exposure to the segments also motivated significantly more viewers than non-viewers to look for newscast-related information online, with 40% of the treatment group visiting a nanotechnology-related website announced on-air.

Viewers support the inclusion of science and technology segments in local newscasts

- The integration of *Sci-Tech Today* segments in the local newscast did not add to nor detract from viewers' ratings of interest in or perceived clarity of each overall newscast nor viewers' motivation to continue viewing the NECN evening newscast.
- Those who viewed *Sci-Tech Today* segments were very supportive of including science and technology news with other news and supportive of broadening the science topic coverage.

The Museum of Science benefits from association with the *Sci-Tech Today* segments

- A large majority of those who saw the nanotechnology segments recognized that they were filmed in the Museum of Science and agreed that these MoS-produced segments increased the value of the museum to the community.
- Two-fifths of viewers felt the nanotechnology segments increased their interest in visiting MoS; however, viewers' intention to visit in the next six months was not significantly different from those who did not view the segments.

In conclusion, the four *Sci-Tech Today* nanotechnology segments in this naturalistic experiment successfully fostered awareness and understanding of nanotechnology and its applications in adult viewers of a regional newscast. These results likely generalize to comparable newscast settings with similar carefully-crafted and well-produced segments about nanotechnology.

INTRODUCTION

Sci-Tech Today is a 3-5 minute televised science news segment airing on New England Cable News (NECN). Twice a week, the segments feature a live conversation between a science correspondent at the Museum of Science, Boston (MoS) and the anchor at NECN studios, made possible by a fiber optic link between the two sites, with both video feeds integrated into the live newscast. The role of science correspondent is rotated among several education associates at MoS, with specialties in a variety of science research areas. The segments are targeted at lay viewing audiences and sometimes include hands-on demonstrations, video roll-ins and images.

NECN is a 24-hour regional news network serving cable subscribers in all six New England states, providing news, sports, weather, and traffic.¹ The *Sci-Tech Today* segment appears on Wednesday evenings about 5:45PM within the *NewsDay Live* program and on Thursday mornings about 9:45AM within the *Morning Report* program. The evening news slot has an average of 7,000 adult viewers, and the morning news slot has an average of 18,500 adult viewers.² Thus, the *Sci-Tech Today* segments have a potential of influencing about 25,500 adults each week. Additional viewers are reached as the Thursday morning *Sci-Tech Today* segments are repeated throughout the day as part of the regular news cycle. *Sci-Tech Today* segments are also posted for web viewing on necn.com and mos.org/videocasts. Segments on the topic of nanotechnology are additionally posted to mos.org/nano and to the NanoNerds channel on YouTube.com, where they can reach a global audience.

In Jan.-Feb., 2009, Multimedia Research implemented a post-only experiment focusing on the impact of four *Sci-Tech Today* segments covering topics of nanoscience, nanoengineering and nanotechnology. The study was conducted for MoS under contract to the Center for High-Rate Nanomanufacturing (CHN), a National Science Foundation Nanoscale Science and Engineering Center headquartered at Northeastern University and the University of Massachusetts – Lowell, and the University of New Hampshire. The *Sci-Tech Today* nanotechnology news segments were presented live by Tim Miller and written, produced and directed by Carol Lynn Alpert, with the help of the MoS Strategic Projects and Current Science & Technology department production teams and the NECN News team, led by evening news director, Jonathan Cain. Funding for the production of the *Sci-Tech Today* nanotechnology news segments is provided by CHN and by the NSF Nanoscale Science and Engineering Center headquartered at Harvard University.

¹ See <http://www.necn.com/About>

² Nielsen data for Boston DMA provided by Gearon Hoffman Inc., Boston, MA. A Designated Market Area (DMA) comprises counties whose largest viewing share is given to stations of that same market area. The Boston DMA covers most of the eastern half of MA and into southern NH and VT. No NECN viewers are reported by Nielsen for the Providence DMA.

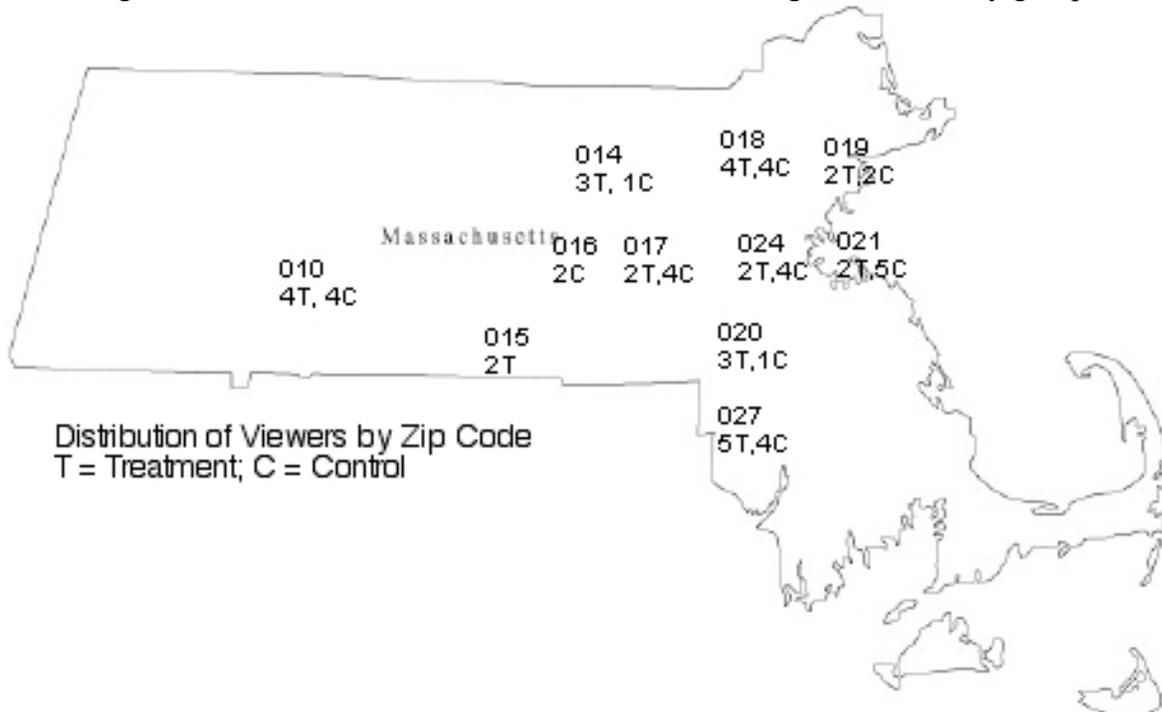
The four *Sci-Tech Today* nanotechnology segments in this study were intended to foster public awareness and understanding of nanotechnology and its applications. The post-only experiment design compares a treatment group, who viewed the *Sci-Tech Today* segments within the *NewsDay Live* half-hour newscast, to a control group, who viewed on the following day the *NewsDay Live* half-hour newscast without an integrated *Sci-Tech Today* segment.

The general goals of the experiment are to look at the impact of *Sci-Tech Today* segments on nanotechnology awareness, knowledge and attitude; on motivation for learning activities related to nanotechnology; on support for science and technology news; and on attitude toward the Museum of Science, Boston.

METHOD

Study Design

The evaluation of the impact of the nanotechnology *Sci-Tech Today* news segments utilizes a naturalistic post-only experiment. Adult participants recruited in the Massachusetts viewing area were stratified by gender and randomly assigned to a treatment group (T) and a control group (C). The map below shows the groups distributed according to Massachusetts' zip codes, indicating a wide distribution across the NECN broadcast range for both study groups:



Once a week for four weeks, the treatment group viewed at home a half-hour of the Wednesday NECN newscast that included a *Sci-Tech Today* segment, whereas the control group viewed the subsequent Thursday's half-hour newscast that did not include a *Sci-Tech Today* segment. *Sci-Tech Today* segments normally appear on Wednesday evening and not on Thursday evening.

After viewing each newscast, both groups completed online surveys. The first three surveys collected demographic and newscast appeal data. The final survey focused on the following six research questions:

1. Will the treatment group report a level of awareness of nanotechnology than the control group?
2. Will the treatment group demonstrate more knowledge of nanotechnology than the control group
 - a. by explaining the meaning of the prefix “nano;”
 - b. by explaining nanotechnology in more depth;
 - c. by describing more applications of nanotechnology; and
 - d. by answering more true/false statements correctly and with more confidence?
3. Will the treatment group differ from the control group in their ratings of benefit and risk of nanotechnology for the United States society as a whole?
4. Will the treatment group be motivated more than the control group to further their awareness and understanding of nanotechnology and its applications
 - a. by reporting a curiosity to know more about nanotechnology;
 - b. by reporting an excitement about the topic;
 - c. by participating more in follow-up learning activities related to nanotechnology; and
 - d. by looking for information online related to the newscasts?
5. Will the treatment group support the inclusion of science and technology segments in local newscasts
 - a. by rating the NECN newscasts with nanotechnology segments as equal in interest and clarity with the control group’s ratings of newscasts without such segments;
 - b. by expressing an intention equal to the control group’s to continue viewing NECN newscasts;
 - c. by recalling the nanotechnology segments as “interesting” news in proportions equal to other news;
 - d. by agreeing that science and technology segments are a positive feature in a local newscast?
6. Will the treatment group show a positive attitude toward the Museum of Science, related to MoS’ involvement in *Sci-Tech Today*?

Procedure

For a non-probability sample, equal numbers of males and females over 18 years old were recruited across Massachusetts, meeting the following criteria:

- a. Cable access to NECN;
- b. Able to view both the Weds and Thurs 5:30-6 PM periods during the four-week study period;
- c. Access to Internet to complete online surveys;
- d. Not in same household as another participant.

Recruited adults were told that the study was “a review of NECN newscasts.” *Sci-Tech Today*, the topic of nanotechnology, and the Museum of Science were not mentioned, and field recruiters also were unaware of the *Sci-Tech Today*/nanotechnology/MoS focus. Participants were debriefed after completing the four-week study when they received a \$100 honorarium.

The recruited 74 adults, stratified by gender, were randomly assigned to the treatment and control groups. Each group viewed at home their assigned half-hour newscast and was asked not to view the NECN newscast on the other groups’ assigned day. The half-hour newscast occurred during 5:30 to 6PM, with the *Sci-Tech Today* segment airing around 5:45PM. The non-science news presented during the broadcast period on each day was different but comparable within a 24-hour news cycle. The four weeks of viewing began with the first day of President Obama’s term, so most news focused on national political and economic topics as well as Boston local events, sports and weather. Seven recruits were prevented from viewing the first week by reasons unrelated to the study (e.g., travel, illness); three dropped out at the second week; and two more dropped at the third week. The final samples who viewed all four weeks comprise 30 in the treatment group and 32 in the control group.

Because of the early time period relative to the workday, participants were permitted to record the half-hour newscast but were required to view that evening in one continuous sitting and answer the online survey immediately following. The online survey was time-stamped to enforce the limited viewing period. Half of the treatment group and 60% of the control group viewed live newscasts, and the remaining viewers watched recorded newscasts on their respective days.

Immediately after viewing each of the first three live or recorded newscasts, both groups completed the same online surveys. The first three surveys were brief, asking demographic questions and four standard appeal and clarity questions about the newscasts. The first three surveys were designed not to bring attention to the goal of the study as focusing on the *Sci-Tech Today* segments. The fourth survey, after the fourth newscast, asked the same four standard appeal and clarity questions about that evening’s newscast and asked additional questions related to awareness, knowledge, attitude and behavior to address the six research questions stated on the previous page. In addition, the treatment group answered questions about which *Sci-Tech Today* segments were most memorable.³ Once respondents answered a question and moved forward in a survey, they could not return to modify their answers, so information in later questions would not influence answers to earlier questions.

³ These responses appear in the Appendix, because they were meant to provide production feedback rather than data for the research questions.

Treatment

The four *Sci-Tech Today* segments integrated into the Wednesday evening NECN news broadcasts and viewed by the treatment group are available for viewing on the MoS website, as described below:

- 1) Nanobama! (aired Jan. 21, 2009)
University of Michigan researcher John Hart made tiny 3-D images of Barack Obama by growing millions of carbon nanotubes on etched metal chips. Hugely magnified, the images helped to popularize the potential of nanotechnology and brought attention to the question of the new administration's plans for funding basic science research.
http://www.mos.org/events_activities/videocasts&d=3121
- 2) Nano, Silver and You (aired Jan. 28, 2009)
Nano-sized particles of silver are terrific at fighting bacteria and mold, and are being used both in hospital settings and for food storage. But they're also being incorporated into more casual types of consumer products, like children's toys and clothing. Could this lead to a harmful accumulation of nano silver in our wastewater treatment plants and in our rivers and streams?
http://www.mos.org/events_activities/videocasts&d=3126
- 3) Man Drinks Water Out Of The Charles (aired Feb. 4, 2009)
Nanotechnology can help provide clean water for NASA astronauts, disaster relief teams, and field clinics. The CEO of a Vermont nanotech start-up company drinks water out of the Charles River to make his point, and the Museum tests the water purification device in front of a live NECN audience.
http://www.mos.org/events_activities/videocasts&d=3131
- 4) Making Solar Energy More Affordable (aired Feb. 11, 2009)
Light, flexible solar panels made with nanotechnology will soon bring down the cost of installing household solar energy systems, and new federal and state tax credits are providing additional incentive.
http://www.mos.org/events_activities/videocasts&d=3144

Sample

The treatment group included 30 adults and the control group included 32 adults who completed the four-week viewing and surveys. None of the four demographic questions and seven news media habit questions, as summarized in Tables 1-4, revealed significant differences between the randomly assigned treatment and control groups.

Demographics

Table 1 on the next page presents demographic characteristics by group. There are no statistically significant differences between the treatment and control groups with respect to gender, age, race, and education.

Table 1. Demographic Characteristics

Classification Variables		% of Treatment N = 30	% of Control N = 32
Gender	Male	53%	53%
	Female	47%	47%
Age	Range	26-74	25-68
	Mean	41.3	40.2
	Median	41.5	39.5
Race	White, non Hispanic	70%	91%
	Non-white	30%	9%
Highest level of education	Some college or less	27%	9%
	College graduate	37%	34%
	Courses, degrees beyond college	37%	56%

Media Habits

Both groups were asked how frequently they view NECN news, outside of the four half-hours they were viewing for the study. Table 2 indicates that few respondents watch NECN news daily, about one-quarter watch frequently, half watch infrequently, and about one-fifth never watch. There is no statistically significant difference between the treatment and control groups in their NECN news viewing frequency.

Table 2. Frequency of Viewing NECN News

How frequently do you view NECN news, outside of the four half-hours you are viewing for this project?	% of Treatment N = 30	% of Control N = 32
Never	20%	22%
Infrequently	50%	50%
Frequently	27%	22%
Daily	3%	6%
	100%	100%

Both the treatment and control groups rated their interest in hearing newscasts about science/technology and arts/culture. The arts/culture question was included to avoid drawing attention to science and technology as an interest of the study. Table 3, on the next page, presents mean interest ratings of each viewing group. There were no statistically significant differences between the groups for these topic ratings. Science and technology newscasts are just as interesting to the treatment group as the control group.

Table 3. Newscast Topic Interest (T = Treatment N = 30; C = Control N = 32)

	1 Not at all interested	2	3	4	5 Very interested
How interested are you in hearing about science and technology in newscasts?	T: Mean = 4.1 C: Mean = 4.0				
How interested are you in hearing about arts and culture in newscasts?	T: Mean = 3.6 C: Mean = 4.0				

Both groups reported about their news media habits, with the response choices randomly presented for each respondent. Table 4 presents the distributions for news sources for each group. There were no statistically significant differences in the preferred news media for the two groups. As a source for science and technology news, about one-half of both groups prefer the Internet and one-quarter prefer television.

Table 4. Media Habits (T = Treatment N = 30; C = Control N = 32)

How do you get most of your news about...	Internet %	TV %	Newspapers %	Radio %	Magazines %
... national and international issues?	T: 47% C: 34%	T: 30% C: 44%	T: 3% C: 3%	T: 20% C: 19%	T: 0% C: 0%
... local issues?	T: 30% C: 22%	T: 33% C: 28%	T: 23% C: 37%	T: 13% C: 13%	T: 0% C: 0%
... science and technology issues?	T: 52% C: 47%	T: 26% C: 25%	T: 4% C: 9%	T: 4% C: 0%	T: 7% C: 19%
... arts and cultural issues?	T: 40% C: 34%	T: 20% C: 9%	T: 27% C: 31%	T: 3% C: 6%	T: 10% C: 19%

In summary, random assignment to the treatment and control groups reduced the chances for extraneous group differences. The two groups did not differ significantly in demographics, news media habits or interest in science and technology in newscasts.

Data Analysis

Qualitative responses were analyzed deductively drawing on content themes of *Sci-Tech Today* segments and inductively by looking at the responses themselves for keywords and key phrases. All tables present rounded percentages, so margin totals in tables may not be exactly 100%. Group comparisons were made with non-parametric statistics.⁴ In this study, a statistical test that gives a p-value, or probability value, lower than .05 is reported as “statistically significant.” This means that a difference between groups is noted as significant only if it has a 5% or smaller likelihood of occurring by coincidence or chance.

⁴ Non-parametric statistics (Fisher exact test, Chi-square, Mann Whitney U test, McNemar Test of paired proportions) are used when the assumptions of parametric tests may not be met, small samples are used, and when data are in ordinal or nominal scales. In this report, footnotes present a definition of a statistic when first used in the report and also present the statistical test results.

RESULTS: AWARENESS OF NANOTECHNOLOGY

Will the treatment group will report a higher level of awareness of nanotechnology than the control group?

A basic indicator of awareness of nanotechnology is how much a person feels they have heard about the topic. After viewing the four weeks of NECN newscasts, participants answered a multiple-choice question about how much they have heard about nanotechnology. Table 5 presents the question results for the treatment and control groups.

In order to test statistical difference in awareness between groups, the five categories were collapsed into three categories: (1) heard a lot/some; (2) heard a little; and (3) heard nothing/not sure. Self-reported level of awareness of nanotechnology was significantly related to group.⁵ The treatment group of those exposed to nano-topics through *Sci-Tech Today* was significantly more likely to report having heard a lot or some about nanotechnology compared with the control group and less likely to report having heard nothing about the topic. Seeing *Sci-Tech Today* segments within NECN newscasts led to significantly higher awareness of nanotechnology in the treatment group. Everyone in the treatment group had heard of nanotechnology, and two-thirds felt they had heard a lot or some about nanotechnology.

Table 5. Awareness of nanotechnology

How much have you heard about nanotechnology?	% of Treatment N = 30		% of Control N = 32	
A lot	23%	67%	9%	28% ⁶
Some	43%		19%	
A little	33%	33%	41%	41%
Nothing at all	0%	0%	22%	31%
Not sure	0%		9%	
	100%	100%	100%	100%

Respondents who had a little, some, or a lot of awareness of nanotechnology were asked about their information sources for nanotechnology. Given eight different randomly presented information sources, respondents indicated, via a yes/no response, whether or not they “clearly remember reading, seeing or hearing anything about nanotechnology” from each source.

⁵ A 2x3 chi-square test indicated that the relationship between group and awareness was significant, $\chi^2(2, N=62) = 14.51, p = 0.0007$.

⁶ In a recent national sample asking this same question, 24% of Americans say they have heard a lot or some about nanotechnology, similar to the 28% of the control group viewers. Peter D. Hart Research Associates, Inc. (Sept 16, 2008). *Awareness of and attitudes toward nanotechnology and synthetic biology: A report of findings*. Available from <http://www.nanotechproject.org/publications/archive/synbio/>

Table 6 indicates that major sources for more than half of both the treatment and control groups included television, print and the Internet. Only television was noted as a source of nanotechnology awareness for significantly more members of the treatment group (97%) than the control group (68%), due to exposure to the *Sci-Tech Today* segments.⁷

Table 6. Nanotechnology Information Sources

In which of the following do you clearly remember reading, seeing or hearing anything about nanotechnology?	% of Treatment N = 30	% of Control N = 32
Television	97%	68%
Print: Newspapers, magazines, journals, books	57%	77%
Internet	57%	64%
Museums, Science Centers	53%	27%
Word of Mouth: Family, friends, coworkers	30%	50%
Movies	30%	41%
Radio	17%	32%
Consumer product labels	3%	9%

In summary, seeing *Sci-Tech Today* segments within NECN newscasts produced significantly higher awareness of “nanotechnology” in the treatment group compared to the control group. Additionally, of eight potential sources that might influence awareness of nanotechnology, only television was checked as a source significantly more often by members of the treatment group compared with the control group, due to exposure to the *Sci-Tech Today* television segments.

⁷ Fisher Exact Probability Test is used with small samples to test whether two groups differ significantly in the proportion with which they fall into two classifications. Fisher Exact test, $p = 0.007$.

RESULTS: KNOWLEDGE OF NANOTECHNOLOGY

Will the treatment group demonstrate more knowledge of nanotechnology than the control group?

This research question examines whether or not the treatment group will know more about nanotechnology than those who view news without the science segments. “Knowledge” is operationalized as explaining the meaning of the prefix “nano;” explaining nanotechnology in more depth; describing more applications of nanotechnology; and answering more true/false statements correctly with more confidence.

Prior to answering the knowledge survey questions, the groups read a short motivational paragraph, presented below:

Treatment: The NECN newscasts presented some news about nanotechnology. We are interested in what you recall or know from other sources. You may feel you do not know enough to answer the questions that follow, but please answer as best you can.

Control: NECN is considering adding a short series about nanotechnology. Learning what you know about the topic will help position the series. You may feel you do not know enough to answer the questions that follow, but please answer as best you can.

Meaning of Prefix “Nano”

The *Sci-Tech Today* programs did not define the prefix explicitly but implied that “nano” meant a very small scale of science. Responses to the question of “what does the prefix ‘nano’ mean to you” were coded into four categories:

1. Respondents referred to microscopic or smaller scale, using the terms “microscopic,” “molecular,” “atomic,” “billionth;” for example,
T: *Microscopic* C: *On a molecular level or smaller*
T: *A nanometer is one billionth of a meter* C: 10^{-9}
T: *Micro* C: *Atomic sized, 10^{-6} (or there about)*
2. Respondents described a scale smaller than just small, using adjectives of “very” or “extremely” or “super” to define “small.” “Miniscule” and “tiny” also are included in this category.
T: *Extremely small* C: *Very very small*
T: *Super small* C: *Miniscule*
T: *Tiny* C: *Extremely small*
3. Respondents wrote the specific words “small” or “little” with no additional adjectives or explanation indicating a smaller than small scale.
4. Respondents did not give a size or scale response; for example,
T: *I think it might have something to do with a scientific way of looking at things.*
C: *Hello – from Mork and Mindy.*

Table 7 shows the distribution of percentages by group and category with respect to the meaning of the prefix “nano.” Group had no statistically significant effect on the category distributions.

Table 7. Meaning of Prefix Nano⁸

What does the prefix “nano” mean to you?	% of Treatment N = 30	% of Control N = 32
Microscopic or smaller	33%	19%
Smaller than just small – extremely small, very small, tiny, miniscule	33%	41%
Small or Little	30%	28%
Not a size or scale response	3%	13%
	100%	100%

Considering the answer of “microscopic or smaller” as more scientifically accurate, Table 8 combines the other categories and looks at whether the groups differ in their ability to give more scientifically accurate responses. In this comparison, the treatment viewers did not demonstrate statistically significant better understanding of the prefix “nano” than the control group.

Table 8. Meaning of Prefix Nano

What does the prefix “nano” mean to you?	% of Treatment N = 30	% of Control N = 32
More scientifically accurate (microscopic or smaller)	33%	19%
Less scientifically accurate (other 3 categories of Table 7)	67%	81%
	100%	100%

Explanation of Nanotechnology

To explore participants’ understanding of nanotechnology, they were asked to “explain nanotechnology to someone who knows nothing about it.” The responses were examined both for type of knowledge about nanotechnology and depth of knowledge. The coding scheme of the open-ended responses was devised based on an inductive analysis looking at the responses themselves for keywords and key phrases and a deductive analysis drawing on four central themes of the *Sci-Tech Today* segments: (1) nanoscale is incredibly tiny; (2) scientists engineer new materials and technologies at the nanoscale; (3) nanotechnology has beneficial applications; and (4) there may be risks associated with nanotechnology. Five categories were used to classify knowledge of nanotechnology as described by respondents:

1. Nanotechnology is small
2. Nanotechnology is microscopic or smaller
3. Scientists engineer materials and technologies at the nanoscale
4. Nanotechnology has beneficial applications
5. There may be risks associated with nanotechnology

⁸ Percentages are rounded in all tables.

Each category was coded dichotomously according to whether or not an open-ended response included the category. For example, the following treatment group response is coded into categories 2, 3, and 4: *Technology that makes use of our ability to manipulate (3) molecules at a very small and fine scale (2) for example to create super-fine filters for water and other applications (4)*. A full response could be coded into more than one category, as in the previous example. However, the same text word or phrase could not be included in more than one category; thus, the text *molecules at a very small and fine scale* is coded into category 2 (nanotechnology is microscopic or smaller) and not category 1 (nanotechnology is small).

Category coding and illustrative quotes are presented below. All quotes are verbatim, with grammar and punctuation mistakes included. Respondent statements may contain incorrect information. Note that some responses illustrating a category may include categories in addition to the one illustrated.

1. Nanotechnology is small: A respondent in this category knows that nanotechnology operates at a small size but does not reference a microscopic or smaller scale (which would be included in Category #2). Keywords include *small, very small, tiny, little* and synonyms. Respondent examples include:
T: *It is a science concerning things/technologies that are physically very small.*
T: *Nanotechnology is using small cells to help with today's growing issues.*
C: *How to use tiny things in technology.*
C: *Technology of small things.*
2. Nanotechnology is microscopic or smaller: A respondent in this category refers to smaller size or scale than category #1 above. This category includes reference to microscopic, molecular, or atomic scales. Keywords include *microscopic, molecule, atom, 10^{-9} , one billionth of a unit* and synonyms. Respondent examples include:
T: *I will tell them it's something very microscopic. It's basically one billionth the size of whatever unit it precedes.*
T: *Growing products at the molecular level.*
C: *It is a study of sub atomic matters.*
C: *The study of extremely small matter (i.e., atoms, electrons).*
3. Scientists engineer materials and technologies at the nanoscale: A respondent in this category is aware that nanotechnology involves manipulation or engineering to create new materials. Keywords include *manipulate, engineer, control, design, create, grow* and synonyms. Respondent examples include:
T: *Engineers are able to design products and materials at the sub-molecular level to manipulate the physical and chemical properties of materials.*
T: *Controlling matter at the molecular level to create new technologies.*
C: *Nanotechnology is the science of the manipulation of atoms.*
C: *The engineering of microscopically small particles.*
4. Nanotechnology has beneficial applications: A respondent in this category includes references to benefits generally or specifically to one or more positive applications of nanotechnology. Keywords include *help, good, aid, use, application, efficient* and synonyms. Although a respondent could note more than one benefit, their response is counted only once in this category. Respondent examples include:

- T: *Nanotechnology helps to enable green technologies like water filtration and home energy.*
 T: *It is a new technology using small atoms and molecules, which we can use for many, many things such as medical purposes, alternative electricity, we can grow the President's face.*
 C: *Science dealing with very small particles and the cool and innovative things that scientists have figured out these particles are good for.*
 C: *The science of engineering many very small things. For example, devices that could be injected into the blood stream that find and attack a tumor.*

5. There may be risks associated with nanotechnology: Only one respondent fell into this category:

T: *I would want to know more about it's impact on the environment and on us long term. It sounds very interesting. The zebra fish embryos mentioned in the silver nanoparticle segment worries me.*

Table 9 presents the distribution of the five nanotechnology explanation categories. Looking at individual categories, only one statistically significant difference between groups in type of knowledge was found: Significantly more of the treatment group (67%) than the control group (28%) noted that nanotechnology has beneficial applications.⁹ Although more respondents in the treatment group suggest that nanotechnology is microscopic or smaller, involves engineering materials, and has risks, the treatment proportions are not statistically significantly higher than the control group.

Table 9. Explanation of Nanotechnology

How would you explain nanotechnology to someone who knows nothing about it?	% of Treatment N = 30	% of Control N = 32
1. Nanotechnology is small.	47%	56%
2. Nanotechnology is microscopic or smaller.	33%	22%
3. Scientists engineer materials and technologies at the nanoscale.	30%	19%
4. Nanotechnology has beneficial applications.	67%	28%
5. There may be risks associated with nanotechnology.	3%	0%

⁹ Fisher Exact test, $p = 0.0047$

To look beyond the individual type of knowledge to the depth of knowledge, Table 10 presents how many categories of explanation respondents covered in their explanation of nanotechnology. Depth of knowledge was statistically significantly related to group.¹⁰ The knowledge of the treatment group was significantly deeper than the knowledge of the control group: 87% *Sci-Tech Today* viewers provided an explanation that went beyond “nanotechnology is small” compared with 47% of control respondents who were not exposed to the nanotechnology segments.

Table 10. Depth of Nanotechnology Explanation

How would you explain nanotechnology to someone who knows nothing about it?	% of Treatment N = 30	% of Control N = 32
<p style="text-align: center;"><u>No depth of knowledge:</u></p> <p>Explanation includes none of the coded categories; e.g., T: <i>A new way of looking at things, like finding out what is wrong with the waters of our shore line that frogs are being born deformed.</i> C: <i>I would tell them it is a device made by Apple to store music and video.</i></p>	3%	19%
<p style="text-align: center;"><u>Some depth of knowledge:</u></p> <p>Explanation includes only category #1 that nanotechnology is small; e.g., T: <i>Nanotechnology is a study of tiny objects.</i> C: <i>Technology that encompasses small things.</i></p>	10%	34%
<p style="text-align: center;"><u>Most depth of knowledge:</u></p> <p>Explanation includes one or more deeper knowledge categories: #2, 3, 4, and/or 5 T: <i>It is the use of very small carbon particles to create technology which can be applied to everyday uses such as filtering water and generating solar energy.</i> C: <i>Engineering and creating very small machines, tools, and materials that can perform various activities that we set them up to do.</i></p>	87%	47%
	100%	100%

¹⁰ ¹⁰ A 2x3 chi-square test indicated that the relationship between group and depth of nanotechnology explanation was significant, $\chi^2(2, N = 62) = 11.04, p = 0.0040$.

Applications of Nanotechnology

Participants were asked to describe any current or potential applications of nanotechnology. The responses were examined both for type of application and for depth of application knowledge. Table 11 presents the coded categories with illustrative responses. Looking at individual categories, four significant differences between groups were found. Significantly more of the treatment group than the control group mentioned applications of nanotechnology to solar energy,¹¹ water filtration,¹² and anti-bacterial uses,¹³ which were applications emphasized in three of the four *Sci-Tech Today* programs. Significantly more of the control group than the treatment group mentioned applications of nanotechnology to electronics.¹⁴ Electronics as an application was only noted in passing in one of the *Sci-Tech* segments.

Table 11. Nanotechnology Applications

Describe any current or potential applications of nanotechnology.	% of Treatment N = 30	% of Control N = 32
Solar energy; e.g., T: <i>To replace silicon in solar panels which is expensive so that solar panels can be less expensive and make solar energy accessible to a larger population.</i> C: <i>I think the applications could be in the energy field, like solar energy.</i>	67%	3%
Water filtration; e.g., T: <i>To filter dirty water to levels where it is safe for domestic uses such as drinking.</i> C: NA	53%	0%
Anti-bacterial uses; e.g., T: <i>Silver nanoparticles in consumer products to make them anti-bacterial.</i> C: NA	20%	0%
Stronger new materials; e.g., T: <i>Carbon nanotubes could be used to build stronger lighter structures because they are the strongest substance for its size that we know of.</i> C: <i>Nanotubes, which will create super-strong material.</i>	10%	3%
Military uses; e.g., T: <i>Nanocarbon tubes have had many applications such as improving soldiers' uniform.</i> C: <i>Military, espionage</i>	10%	3%
Electronics; e.g., T: <i>Processors, memory chips, storage devices and other circuitry for use in next generation computers</i> C: <i>Store large amount of data in small storage device.</i>	7%	47%
Medical uses; e.g., T: <i>Bio-medical devices</i> C: <i>Most of what I've heard would be in regards to medical uses</i>	17%	34%

¹¹ Fisher Exact test, $p \leq 0.0001$

¹² Fisher Exact test, $p \leq 0.0001$

¹³ Fisher Exact test, $p = 0.0097$

¹⁴ Fisher Exact test, $p = 0.0004$

Table 12 presents how many application categories appeared in each group's responses. Statistically, depth of application knowledge was significantly related to group.¹⁵ The application knowledge of the treatment group was significantly deeper than the knowledge of the control group. One-third of the control group had no knowledge of nanotechnology applications; whereas all but one member of the treatment group could describe at least one application. Half (53%) of the *SciTech Today* viewers could describe two or more applications compared with 22% of control respondents, and the applications noted by the treatment group were typically those emphasized in the nanotechnology segments.

Table 12. Depth of Application Knowledge

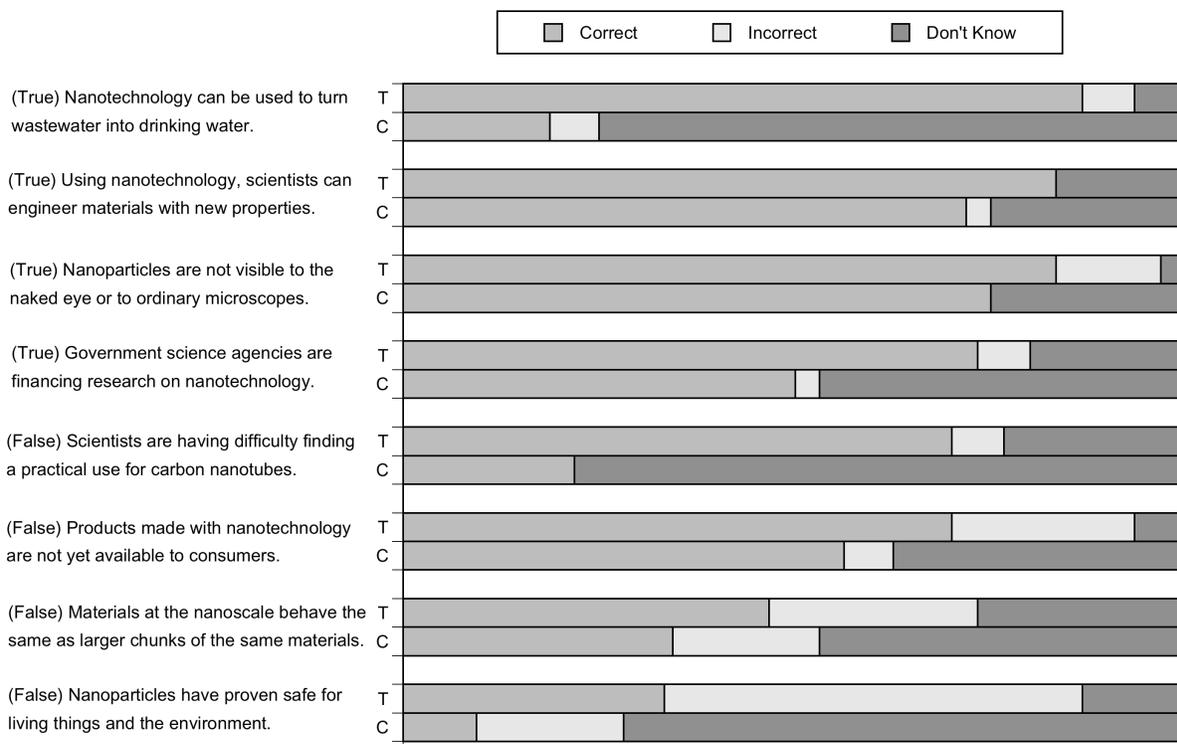
Describe any current or potential applications of nanotechnology	% of Treatment N = 30	% of Control N = 32
<p style="text-align: center;"><u>No depth of knowledge:</u></p> <p>Description includes none of the categories; e.g., T: <i>Unknown.</i> C: <i>I do not know.</i></p>	3%	31%
<p style="text-align: center;"><u>Some depth of knowledge:</u></p> <p>Description includes only one category; e.g., T: <i>Water filtration.</i> C: <i>Microchips.</i></p>	43%	47%
<p style="text-align: center;"><u>Most depth of knowledge:</u></p> <p>Description includes two or more categories; e.g., T: <i>1. Solar energy. 2. Water purification. 3. Antibiotic use.</i> C: <i>Computers, medical care.</i></p>	53%	22%
	100%	100%

¹⁵ A 2x3 chi-square test indicated that the relationship between group and depth of nanotechnology applications was significant, $\chi^2(2, N = 62) = 10.98, p = 0.0041$.

Factual Knowledge of Nanotechnology

To assess factual knowledge of nanotechnology, participants completed a True-False-Don't Know test of eight factual statements about nanotechnology. The order in which the statements were presented to each respondent was randomly sorted. Figure 1 presents the Correct-Incorrect-Don't Know percentages for the individual statements by group (T, C). The top four statements are true, and the bottom four statements are false.

Figure 1. Percent of Correct/Incorrect/Don't Know Responses to Nanotechnology Statements for Treatment (T) and Control (C)



"Don't Know" was provided as a possible answer because of the potentially low level of knowledge about nanotechnology but was scored as "incorrect" in the factual knowledge score. The maximum possible knowledge score is 8. The average or mean knowledge score for the treatment group is 5.47, which is significantly higher than the mean score of 3.38 for the control group.¹⁶ On the eight statement test, the treatment group demonstrated significantly more factual knowledge about nanotechnology than the control group.

To examine each group's confidence in their factual knowledge, a confidence score was developed, giving a "1" for an answer (correct or incorrect) and a "0" for a "don't know" response. The maximum confidence score is 8. The mean confidence score for the treatment group is 6.83, which is significantly higher than the mean confidence score of 3.94 for the control group.¹⁷ The treatment group demonstrated significantly more confidence in their answers about nanotechnology than the control group on the eight statement test.

¹⁶ Independent groups *t* test: $t(54) = 4.697, p \leq 0.0001$. T mean = 5.47; *SD* = 1.38; C mean = 3.38; *SD* = 2.08

¹⁷ Independent groups *t* test: $t(45) = 6.368, p \leq 0.0001$. T mean = 6.83; *SD* = 1.12; C mean = 3.94; *SD* = 2.3

In summary, the data answering the research question in this section supports the finding that the treatment group knows more about nanotechnology than those who viewed the news without the science segments. On a test of factual knowledge, the treatment group compared with the control group demonstrated significantly more knowledge about nanotechnology with more confidence in their knowledge. In explaining nanotechnology to others in an open-ended question, significantly more of the treatment group than the control group noted that nanotechnology has beneficial applications. The treatment group also showed significantly deeper knowledge than the control group by providing more explanations that went beyond the basic concept that nanotechnology is small. Significantly more of the treatment group’s explanations included more nanotechnology concepts such as the scale of nano, that scientists engineer materials and technologies at the nanoscale, or that nano has beneficial applications and risks. The treatment and control groups also differed in their knowledge of applications of nanotechnology. Significantly more of the treatment group mentioned *Sci-Tech Today* covered applications of nanotechnology to solar energy, water filtration and anti-bacterial uses, whereas more of the control group noted electronics applications. The treatment group also described significantly more applications than the control group, indicating greater depth of application knowledge. Only one open-ended question did not provide support for the knowledge question; the treatment and control groups did not differ significantly in their descriptions of what the prefix “nano” means.

RESULTS: ATTITUDE TOWARD RISK AND BENEFIT

Will the treatment group differ from the control group in their ratings of benefit and risk of nanotechnology for the United States society as a whole?

Participants responded to two survey questions assessing risk and benefit attitudes on a 1 to 7 Likert scale, as shown in Table 13. The treatment group rated nanotechnology as significantly more beneficial than the control group,¹⁸ but there was no significant difference between the mean ratings for risk.¹⁹

Table 13. Risk/Benefit Ratings (T = Treatment N = 30; C = Control N = 32)

Risk/Benefit Attitudes	Low risk/ benefit 1	2	3	4	5	6	High risk/ benefit 7
In general, how beneficial do you consider nanotechnology to be for the United States society as a whole?	T: Mean = 6.1 C: Mean = 5.2						
In general, how risky do you consider nanotechnology to be for the United States society as a whole?	T: Mean = 2.6 C: Mean = 3.1						

In summary, the framing of nanotechnology benefits in the *Sci-Tech Today* segments significantly boosted viewers' ratings of benefits over the control group's ratings. However, the discussions of nanotechnology risks in *Sci-Tech Today* did not generate a significant difference in risk ratings when compared to the control group.

¹⁸ A two-sample t-test was used to test the effects of *Sci-Tech Today* segments on risk and benefit ratings, revealing a significant difference between groups only for benefits means, $t(55) = 3.236, p = 0.0021$. T Mean = 6.1, $SD = 0.92$; C Mean = 5.2; $SD = 1.35$.

¹⁹ These same questions were asked in a national survey study, in which the average American is relatively neutral about risk and benefit (benefit mean = 4.2; risk mean = 3.7; means provided by Currall via email, 8/18/08.). Currall, S. C., King, E. B., Lane, N., Madera, J. & Turner, S. (2006). What drives public acceptance of nanotechnology? *Nature Nanotechnology*, 1, 153-155. In August, 2005, Zogby International conducted a representative telephone survey of 503 adults.

RESULTS: MOTIVATION FOR LEARNING ACTIVITIES

Will the treatment group be motivated more than the control group to further their awareness and understanding of nanotechnology and its applications?

This research question addresses whether or not viewing *Sci-Tech Today* segments motivates learning activities that could further viewers' awareness and understanding of nanotechnology and its applications. In examining the question, the study looked at (1) whether nanotechnology stories elicited curiosity in treatment viewers compared with other categories of news stories; (2) whether the nanotechnology stories excited viewers about nano applications; (3) whether the treatment and control groups differed in their participation in a variety of learning activities that expand awareness and understanding of nanotechnology; and (4) whether the two groups differed in their motivation to look for news-related online information.

Curiosity to Know More

Immediately after viewing each newscast, respondents were asked what, if anything, in the newscast they would like to know more about. In response to the first week's newscast, 23% of the treatment group wanted to know more about carbon nanotubes forming nanoscale images of Obama. Week 1 treatment members wrote for example:

I would like to know more about the nano technology.

I would like to learn more about nanotechnology.

Nanobama.com – the MOS story.

The nanotechnology piece.

The week 2 story about silver nanoparticles engendered curiosity about nanotechnology in 40% of the treatment group; for example:

It told what products were using it but did not say what the benefits were just the negatives in not using it and letting it get into the water supply.

How dangerous nano particles are in the environment.

I would like to learn more about the nano-particles and the regulations for them.

Nano-silver: why it was developed and how extensively is it being used in our manufacturing plants. Has it been used by the automobile industry?

I would like to know more about the Nano Technology and the impact it has as an antibiotic.

Probably the Nano Silver particles and the products they are in and in what concentration.

I'm going online after this to check the nanotech web site.

One-third (33%) of the treatment group were stimulated by the week 3 story on nanotechnology and water purification; for example:

I would like to hear further information about the water purifier.

How far has Nano water purification system gone in Rwanda?

I would like a follow up on the cost of the nanotechnology water purification system and its success in Rwanda.

In terms of the water story, I was curious to hear whether this is a product to go on the market or just for NASA.

More information about cutting-edge information.

I would like to see more in-depth investigative story about the nano technology. Maybe a longer piece discussing the good and bad, potential danger of this technology.

I would like to know more about the water filtering system made by Seldon Technology company.

I might actually go to the website for the Vermont company to learn more about what they are doing.

Also, one-third (33%) of the treatment group expressed interest in more information about the week 4 story about nanotechnology and solar energy. Connecting the science story to a financial benefit was important in raising viewer curiosity; for example:

- Tax cuts and costs of the nano panels.*
- The solar energy panels for my home because of the tax credit in 2009.*
- The ways in which and the progress of making solar energy easier and more affordable.*
- Solar cell technology and the tax credit for home owner for putting it on their house.*
- Nano particles being used to create the solar energy.*
- Konarka's Solar Panels.*
- I was disappointed in the solar story because I would have liked to know more about the content.*

Table 14 presents the percent of the treatment group that wanted to know more about *Sci-Tech Today* stories compared to other categories of news stories over the four week period. Over the four week period, the treatment group was just as likely to want to know more about the nanotechnology stories as about national news or local news, but significantly more likely to want to know more about nanotechnology compared with the sports and weather category.²⁰ So the *Sci-Tech Today* stories motivate viewer curiosity as much as other news.

Table 14. Newscast Items About Which Viewers Want to Know More (Treatment N = 30)

What, if anything, in the newscast would you like to know more about?	<i>Sci-Tech Today</i> %	National News %	Local News %	Sports & Weather %
Category noted at least once over four weeks	60%	50%	40%	7%

Excitement about Topic

After viewing all four newscasts, 84% of the treatment group respondents agreed that seeing *Sci-Tech Today* segments excited them about future applications of nanotechnology (see Table 15).

Table 15. Reactions to *Sci-Tech Today* (Treatment N = 30)

Agree-Disagree Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Seeing <i>Sci-Tech Today</i> made me excited about future applications of nanotechnology.	7%	0%	10%	57%	27%

²⁰ McNemar Test of Paired Proportions, as applied here, assesses the equality of two proportions associated with two different dichotomous variables (here *Sci-Tech Today* vs. the sports & weather category). $p = 0.0001$.

Participation in Nanotechnology Learning Activities

The treatment and control groups indicated whether or not they participated in six different activities over the four-week period of newscasts. Participation in the activities listed in Table 16 reveal an interest and motivation to further one's awareness and understanding of nanotechnology. The treatment group was significantly more likely than the control group to report participating in four of the six activities, indicating they: (1) paid attention to news about nanotechnology²¹ (which may refer only to seeing the *Sci-Tech Today* segments); (2) thought about nanotechnology and its applications;²² (3) discussed with others nanotechnology and its applications;²³ and (4) looked for information about nanotechnology and its applications.²⁴ Thus, exposure to *Sci-Tech Today* motivated subsequent learning activities related to nanotechnology.

Table 16. Learning Activities Related to Nanotechnology²⁵

During the previous four weeks, have you participated in any of the activities listed below?	% "yes" of Treatment N = 30	% "yes" of Control N = 32
Paid attention to news about nanotechnology	70%	16%
Thought about nanotechnology and its applications	60%	16%
Discussed with others nanotechnology and its applications	43%	6%
Looked for information about nanotechnology and its applications	40%	6%
Noticed nanotechnology in consumer products	7%	13%
Purchased a product developed with nanotechnology	3%	3%

²¹ Fisher Exact test, $p \leq 0.0001$

²² Fisher Exact test, $p = 0.0005$

²³ Fisher Exact test, $p = 0.0008$

²⁴ Fisher Exact test, $p = 0.002$

²⁵ Response options included "yes," "no," and "don't know." "Don't know" was used almost exclusively by respondents for "purchased a product developed with nanotechnology," perhaps meaning that respondents were unsure about whether any purchased products were developed with nanotechnology. For purposes of analysis, "don't know" responses were combined with "no."

Motivation to Look for News-Related Online Information

Significantly more treatment group viewers (50%) than control group viewers (22%) reported that they looked online for information related to the newscasts.²⁶ Those whose newscasts included the *Sci-Tech Today* stories were more motivated to look for more news online. When asked what website(s) they visited to find further information related to the NECN newscasts, 17% of the treatment group mentioned going to sites whose URLs were cited verbally and posted on-screen in the *Sci-Tech Today* segments:

Understandingnano.com - To check on the nano technology : the different aspects it entails.

Just the nano information web site today [understandingnano.com]. I was not impressed.

NECN and nanotechproject.org – I went to necn to find out more about nanotechnology and I went to the second website to find out more about what products have silver nano particles in them.

Seldontech.com energystar.gov

Another 27% of the treatment group and 6% of the control group noted specifically looking at necn.com to follow up on news stories, but others of both groups reported using the more general sites of msn, cspan, google or yahoo.

When asked specifically about visiting websites for which URLs were noted in the *Sci-Tech Today* stories, 40% of the treatment group visited at least one of the sites. Every URL mentioned in the newscasts was visited by at least one member of the treatment group, with the most (23%) viewers having visited energystar.gov for information about solar panel tax credits (see Table 17).

Table 17. *Sci-Tech Today* Websites Visited by Treatment Group Viewers

Check off whether or not you visited any of the listed websites after viewing the NECN newscasts.	% of Treatment N = 30
www.energystar.gov	23%
www.nanotechproject.org	17%
www.understandingnano.com	13%
www.nanobama.com	13%
www.seldontech.com	3%

Additional post-newscast web statistics were reported informally via email to Carol Lynn Alpert and John Neely of MoS by representatives of three of the five websites listed in Table 17:

Alex Parlino of nanotechproject.org wrote “*The Wilson Center Project on Emerging Nanotechnologies reports nearly a hundred click-throughs [in the 48 hours following broadcast] to nanotechproject.org from the NECN story page. This would not include people who accessed the PEN website directly after seeing the url on TV.*”

Earl Boysen of understandingnano.com wrote “*The Understandingnano.com Website had a jump of approximately 55 visitors above the normal level on Feb 12. I think this jump is probably due to the website being mentioned on your news segment.*”

Alan Cummings of seldontech.com wrote “*I checked the day after, I think we got 300 hits; but I am trying to confirm that number. This would represent a spike for us.*”

²⁶ Fisher Exact test, $p = 0.033$.

In summary, the data support the conclusion that viewing *Sci-Tech Today* segments motivates learning activities that further awareness and understanding of nanotechnology and its applications. *Sci-Tech Today* segments were equal to national and local news stories in stimulating a curiosity to know more about the topics, and 84% of viewers agreed that seeing the segments excited them about future applications of nanotechnology. Viewing the *Sci-Tech Today* segments also motivated significantly more treatment group viewers than control group viewers to pay attention to news about nanotechnology as well as to think about, discuss and look for information about nanotechnology and its applications. Finally, the newscasts with integrated *Sci-Tech Today* segments motivated significantly more viewers to look for news-related information online, with 40% of the treatment group visiting a nanotechnology website announced on-air.

RESULTS: SUPPORT FOR SCIENCE & TECHNOLOGY NEWS

Will the treatment group support the inclusion of science and technology segments in local newscasts?

This research question looks at whether or not those who view the local newscasts with science and technology news integrated into the half-hour support the inclusion of these segments. Because news producers may hesitate to include science segments for fear they will disengage lay viewers, the study looked at whether the treatment and control groups differed in interest and clarity ratings of NECN newscasts and differed in intention to continue viewing NECN newscasts. Additionally, with respect to the treatment group only, the study examined whether nanotechnology was considered as “interesting” as other news categories and how much the treatment group felt that science and technology segments are a positive feature in a local newscast.

Interest and Clarity Ratings

After watching each NECN broadcast, viewers rated their interest in and the clarity of the half-hour newscast on a 1 to 5 Likert scale. Tables 18 and 19 (next page) present mean interest and clarity ratings for each viewing group for each week. Group was not a significant factor in either the interest or clarity ratings, so the addition of *Sci-Tech Today* segments appears to neither add to nor detract from interest in or clarity of the overall newscast.

Table 18. Newscast Interest (T = Treatment N = 30; C = Control N = 32)

Overall, how interesting was this half-hour of the NECN newscast?	1 Not at all interesting	2	3	4	5 Very interesting
Week 1	T: Mean = 3.3 C: Mean = 3.7				
Week 2	T: Mean = 3.2 C: Mean = 3.5				
Week 3	T: Mean = 4.0 C: Mean = 4.0				
Week 4	T: Mean = 3.7 C: Mean = 3.7				

Table 19. Newscast Clarity (T = Treatment N = 30; C = Control N = 32)

Overall, how clear was the information in this newscast?	1 Not at all clear	2	3	4	5 Very clear
Week 1	T: Mean = 4.2 C: Mean = 4.2				
Week 2	T: Mean = 4.1 C: Mean = 4.2				
Week 3	T: Mean = 4.2 C: Mean = 4.4				
Week 4	T: Mean = 4.0 C: Mean = 4.2				

Intention to Continue Viewing NECN Newscasts

All respondents were asked if they would continue viewing NECN newscasts on their own after viewing the four half-hours for the study. The treatment and control groups did not differ in their decision: 56% of the treatment group and 66% of the control group said they would continue viewing NECN. All those who already viewed NECN daily or frequently before starting the study said that they would continue viewing NECN newscasts. Of those who watched NECN infrequently prior to the study, 55% said they would continue to view. Of those who had never watched NECN previously, 23% suggested that they would view NECN again. One member of the treatment group noted that the *Sci-Tech Today* content was a reason to continue viewing NECN: *I intend to view it sometimes - because I am interested in knowing more about the nano technology.* The *Sci-Tech Today* segments appeared to neither add to nor detract from a motivation to view NECN.

Interesting Items in Newscasts

Immediately after each newscast, viewers were asked to describe any items that were interesting to them. Almost half (47%) of the treatment group recalled as “interesting” the first week’s story about carbon nanotubes forming nanoscale images of Obama. Viewers noted the interdisciplinary aspect of this story; for example:

I liked the story about the Nano Obama. It provided an interesting story that I probably wouldn't get on another station. I would have liked to see the scientist involved.

I thought the SciTech features about nanotechnology was interesting because it linked science and art (and current events, too!).

The science segment on nanotechnology was cool. It was a good blend of topical content (tiny sculptures of Obama) with cutting-edge technology.

I found the Scitech today piece very interesting, regarding the Nanobama story. The content of the report was interesting and of course, I'll want to check out the nanobama.com site.

I really enjoyed the “SCI-TECH” portion of the broadcast because I really like hearing about new technologies that I can further research myself.

The week 2 story about silver nanoparticles was noted as “interesting” by 63% of the treatment group. Viewers noted the availability and risk of silver nanoparticles in consumer products; e.g.:

The Sci-Tech segment on silver particles nanotechnology was interesting (especially as it affects the environment).

The Science series was the most interesting and unique portion of the news, next to the weather. It was very interesting and informative. I learned something new about the nano technology, particularly the concern over the silver particles containing nano in it that is found in toys.

The SciTech portion, very interesting re nano technologies, specifically silver nanoparticles in consumer products. Educational to consumers.

The Nanotechnology report makes me aware that some commercial products out there actually contain the silver nano particles, and what are the health benefits and harms they can cause.

Nanosilver – used in everyday items, toys and drinks – can be a health risk.

Three-quarters (73%) of the treatment group reported as “interesting” the nanotechnology water purification story in Week 3. Viewers liked the demonstration and the practical relevance; e.g.:

I really liked the nano water story. I specifically liked the fact that he actually did a demo and drank the water. Great demonstration.

I thought the SciTech segment was particularly interesting AND relevant. To see that there [is] an affordable technology for cleaning water in places like Rwanda is uplifting (not to mention seeing a guy drink out of the Charles River!).

I found the segment on the water purifier to be relevant and interesting.

The science and tech piece was interesting because of the new and practical technology, but it was a bit long.

Water filtration nano-tech piece. Water is going to replace oil as the world's most valuable resource in our lifetimes, so learning about ways to make it last longer is great.

The week 4 story about nanotechnology and solar energy was mentioned by 63% of the treatment group. Viewers noted the practical relevance and economic information; for example:

I actually enjoyed this week's science today...it was relevant (both from an environmental and economic perspective). It was well explained, interesting, and just the right amount of time.

Segment on solar panel interesting...relevant w/energy & cost concerns.

Nanoparticles being used to make solar panels – which leads to saving energy. Those with this form of energy will receive tax breaks.

The piece of nanotechnology and how it might make solar panels and solar energy within reach of a lot more people. It was interesting because it illustrates everyday uses of this complex technology.

I liked the SciTech piece on solar heat. Hearing about the tax incentives makes me think I might consider it for my home.

Ongoing nano technology – I think this is good for the general public to hear what options are available and soon to be available.

Table 20 shows the percent of the treatment group that described *Sci-Tech Today* stories as interesting compared with other categories of news stories. The treatment group was significantly more likely to mention the nanotechnology stories as “interesting” as to mention a national news story,²⁷ local news story,²⁸ or sports & weather.²⁹ These results indicate that science and technology news segments can be more appealing than other news in attracting and holding viewers’ attention and interest, at least in the first four weeks of weekly exposure. As one treatment viewer noted, *The science section seems to be my favorite. You do not see these on other channels.*

Table 20. Interesting Items in Newscasts (Treatment N = 30)

What did you think was interesting in the newscast and why? Feel free to mention more than one item.	<i>Sci-Tech Today</i> %	National News %	Local News %	Sports & Weather %
Category noted at least once over four weeks	93%	57%	66%	47%

Science & Technology as a News Feature

To obtain further feedback about the value of science and technology segments in a newscast, treatment group viewers were asked to agree or disagree with two statements. Table 21 presents the distribution of agreement for each statement:

- 86% agreed that they would like to see segments about other science topics; and
- 80% liked having the segments as a local newscast feature.

Thus, the treatment group was very supportive of including science and technology news with other news.

Table 21. Science & Technology as a News Feature (Treatment N = 30)

Agree-Disagree Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like to see <i>Sci-Tech Today</i> segments about other science topics.	3%	0%	10%	43%	43%
I like having <i>Sci-Tech Today</i> as a feature in a local newscast.	3%	3%	13%	33%	47%

In summary, the science and technology segments neither added to nor detracted from the full half-hour newscast or from a motivation to view NECN news. For the treatment group, the science and technology news stories were noted as “interesting items” significantly more frequently than the individual categories of national news, local news, and sports & weather. A large majority of viewers liked these segments as a feature in the newscast and would like other science topics to be covered.

²⁷ McNemar Test of Paired Proportions, $p = 0.003$.

²⁸ McNemar Test of Paired Proportions, $p = 0.038$.

²⁹ McNemar Test of Paired Proportions, $p = 0.0005$.

RESULTS: ATTITUDE TOWARD THE MUSEUM OF SCIENCE

Will the treatment group show a positive attitude toward the Museum of Science, related to its involvement with *Sci-Tech Today*?

In response to an open-ended question, 80% of the treatment group could identify the Museum of Science as where the *Sci-Tech Today* segments were filmed. In response to agree-disagree statements (see Table 22), 80% agreed that the MoS-produced *Sci-Tech Today* segments increase the value of the museum to the community, and 40% agreed that the segments increased their interest in visiting MoS.

Table 22. Science & Technology as a News Feature (Treatment N = 30)

Agree-Disagree Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The fact that the Museum of Science, Boston, produced <i>Sci-Tech Today</i> increases the value of the museum to the community.	3%	7%	10%	57%	23%
Seeing <i>Sci-Tech Today</i> segments increased my interest in visiting the Museum of Science, Boston.	7%	17%	37%	23%	17%

The treatment and control groups did not differ significantly in their recency of visiting MoS (Table 23) nor in their stated likelihood of visiting in the future (Table 24).

Table 23. Recency of Visiting MoS

How recently have you visited the Museum of Science, Boston?	% of Treatment N = 30	% of Control N = 32
Never	3%	6%
More than one year ago	70%	59%
Within the last year	27%	34%
	100%	100%

Table 24. Likelihood of Visiting MoS

How likely are you to visit the Museum of Science, Boston, in the next six months?	% of Treatment N = 30	% of Control N = 32
Very or Somewhat unlikely	43%	41%
Neither unlikely nor likely	13%	19%
Very or Somewhat likely	43%	41%
	100%	100%

In summary, the large majority of viewers recognized that the *Sci-Tech Today* segments were coming from MoS and felt the segments increase the value of MoS to the community. However, being exposed to *Sci-Tech Today* was not sufficient in and of itself to raise the treatment group's intention to visit MoS significantly over and above the control group's intention to visit; two-fifths of each group felt a visit likely in the next six months.

DISCUSSION

The most recent national survey study reveals that three-quarters of the American public have little to no awareness of nanotechnology.³⁰ Professionals in the field agree that now is the time to begin to work toward engaging and educating the public about nanotechnology, while the field is still in its developmental stage.³¹ Much of the effort to reach the general public with the topic of nanotechnology has focused on exhibits and programs in museums as well as direct civic engagement techniques.³² However, most Americans report that they receive most of their science news and information from television;³³ thus, those who wish to address nanoliteracy in a substantial way must seriously consider television as an outreach mechanism. In support of this direction, Miller, Augenbraun, Schulhof and Kimmel (2006) write:

“A television news story about nanotechnology, for example, may provide new information about objects at the nano level and introduce the terms *nanotechnology*, *nanoparticle*, and *nanoscale* into a viewer's vocabulary. The first exposure to a new concept or term is unlikely to generate long-term retention or interest by itself, but repeated exposures to this concept and to these new terms may provide the seed for a new schema or for an addendum to an existing schema.” (p. 220).³⁴

The latest Pew “State of the News Media” report finds that local television news is the nation's most popular source for news.³⁵ Yet television news outlets have eliminated or cut their science staff,³⁶ making it more difficult to integrate current science into viewers' news diets.

³⁰ Peter D. Hart Research Associates, Inc. (Sept 16, 2008). Awareness of and attitudes toward nanotechnology and synthetic biology: A report of findings. Available at <http://www.nanotechproject.org/publications/archive/synbio/>

³¹ Subcommittee on Nanoscale Science, Engineering, and Technology Committee on Technology, National Science and Technology Council. (2007, December). The National Nanotechnology Initiative Strategic Plan. Available at <http://www.nano.gov/html/about/strategicplan.html>. Toumey, C. & Baird, D. (2008). Nanoliteracy: Nurturing understandings of nanotechnology and societal interactions with nanotech. In A. Sweeney & S. Seal (Eds). Nanoscale Science and Engineering Education (pp. 577-589). Stevenson Ranch CA: American Scientific Publishers.

³² For examples, see www.itsananoworld.org; www.toosmalltosee.org; www.nisenet.org/catalog; <http://www.mrsec.psu.edu/museum/third/>; www.sc.edu/usetimes/articles/2004-02/citizens_nanotech.html; www.sciencecafesf.com/category/nanotechnology/

³³ Horrigan, J. (2006, November). The Internet as a resource for news and information about science. Pew Internet & American Life Project. Available at <http://www.pewinternet.org/Reports/2006/The-Internet-as-a-Resource-for-News-and-Information-about-Science.aspx>

³⁴ Miller, J. D., Augenbraun, E., Schulhof, J., & Kimmel, L. G. (2006). Adult science learning from local television newscasts. Science Communication, 28(2), 216-242.

³⁵ Pew Project for Excellence in Journalism. (2009) The state of the news media: An annual report on American journalism. Available at www.stateofthenewsmedia.org/2009/index.htm

³⁶ Brainard, C. (2008, December). CNN cuts entire science, tech team. Columbia Journalism Review. Online at http://www.cjr.org/the_observatory/cnn_cuts_entire_science_tech_t.php

The *Sci-Tech Today* segments by the Museum of Science, Boston, attempt to fill this gap by providing up-to-date science news through a regional cable news station, New England Cable News. By including the emerging field of nanotechnology in these segments, MoS is also contributing to early endeavors of informal science educators to engage and inform the public. Evaluating the impact of the *Sci-Tech Today* nanotechnology segments integrated into the newscast setting is the purpose of the controlled experiment reported here.

The study had three general goals: (1) to assess the effectiveness of *Sci-Tech Today* segments in engaging, educating and motivating the public to learn more about nanotechnology; (2) to appraise local news viewers' support for science and technology news; and (3) to explore the perceived value of the Museum of Science's involvement in production of *Sci-Tech Today*.

By many measures, the *Sci-Tech Today* segments were very successful in engaging, educating and motivating viewers to learn more about nanotechnology

Attracting an audience and engaging their interest in the topic is the first objective of an informal science educator and the first objective of a commercial newscaster. The four *Sci-Tech Today* segments in this study achieve this objective. Immediately after seeing the NECN newscasts each week, half to three-quarters of *Sci-Tech Today* segment viewers identified as interesting the respective nanotechnology stories, indicating high engagement with the topic. Viewers described the unique and informative content, the demonstrations, the practical applications, the benefits and risks of nanotechnology, and the interdisciplinary aspect of the field. These viewers were significantly more likely to name the nanotechnology stories as interesting compared to a national news story, local news story, or sports and weather. Despite the unfamiliar topic of nanotechnology, or perhaps because of it, the segments were more interesting and memorable than other news categories. There was nothing in the study design that would have directed viewers' attention to these segments, so viewers were spontaneously highlighting the *Sci-Tech* segments in their recall of the newscasts. It is possible that the novelty of this topic would wear off if MoS' *Sci-Tech Today* segments were consistently about nanotechnology, but for the four weeks of exposure in this study, the segments successfully engaged the adult viewers.

The first step toward educating adults about nanotechnology is to raise their awareness of the existence of this field of endeavor. After the four weeks of newscast viewing, significantly more of those who saw the *Sci-Tech Today* segments reported having heard more about nanotechnology than those who did not view the segments and reported that television was their major source of nanotechnology information. Those who had not seen the nanotechnology segments matched the average American in their self-assessed awareness of nanotechnology. Two-thirds of the treatment group reported that they had heard a lot or some about the topic compared with 28% of the control group. As predicted by Miller et al: "Exposure through local television newscasts to stories about new scientific terms or ideas may be a comfortable and effective means for some adults to first learn about new terms and concepts" (p. 220).³⁷

³⁷ Miller, J. D., Augenbraun, E., Schulhof, J., & Kimmel, L. G. (2006). Adult science learning from local television newscasts. *Science Communication*, 28(2), 216-242.

The segments also significantly increased viewers' knowledge of nanotechnology over and above viewers who had no exposure to the segments. The segment viewers demonstrated significantly more knowledge about nanotechnology and its applications, deeper knowledge, and more confidence in their knowledge. Viewers of these four *Sci-Tech Today* segments acquired knowledge about the scale of nano, that scientists engineer materials and technologies at the nanoscale, and that nanotechnology has beneficial applications in solar energy, water purification and bacterial control.

It might be supposed that exposure to the *Sci-Tech Today* segments, which presented information about both benefits and risks of nanotechnology, would lead the treatment group to rate both benefit and risk higher than the control group. Whereas the treatment group rated nanotechnology as significantly more beneficial for the United States society as a whole, the two groups did not differ in their ratings of risk. Scheufele and Lewenstein found a similar result in a national survey study in which those who said they were more aware of nanotechnology were also more positive about benefits but did not differ with respect to risks from those who were not aware.³⁸ The authors suggest that the positive framing of nanotechnology in the national media may account for these attitudes. One-quarter of *Sci-Tech Today* viewers noted risk issues in their open-ended survey responses, particularly in relation to week two's show about silver nanoparticles, but that awareness did not influence them to rate risk differently than the control group.

Viewing *Sci-Tech Today* segments also motivated viewers to engage in learning activities that further awareness and understanding of nanotechnology and its applications. Viewers were more likely than non-viewers to report paying attention to news about nanotechnology as well as thinking about, discussing and looking for information about nanotechnology and its applications. Exposure to the segments also motivated significantly more viewers to look for newscast-related information online, with 40% of the treatment group visiting a nanotechnology-related website announced on-air.

Viewers support the inclusion of science and technology segments in local newscasts

Cable television news shows infrequently present science and technology stories. Upon analyzing news content in 2008, the Pew Project for Excellence in Journalism found that for cable television the topic of science/technology ranked 24 out of 26 broad story topics in percent news coverage.³⁹ Part of the omission of science and technology might be explained by managers' sense that viewers are turned off by the topic, but this study's findings contradict the notion that viewers disengage upon seeing science news. The addition of *Sci-Tech Today* segments to the local newscast did not add to nor detract from viewers' ratings of interest in or perceived clarity of each overall newscast nor viewers' motivation to continue viewing the NECN evening newscast. Those who viewed *Sci-Tech Today* segments were very supportive of including science and technology news with other news and supportive of broadening the science topic coverage.

³⁸ Scheufele, D. A., & Lewenstein, B. (2005). The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research*, 7, 659-667.

³⁹ Pew Project for Excellence in Journalism. (2009) *The state of the news media: An annual report on American journalism*. Topline report. www.stateofthenewsmedia.org/2009/chapter%20pdfs/Topline%202008%20data.pdf

The Museum of Science benefits from association with the *Sci-Tech Today* segments

A large majority of those who saw the nanotechnology segments recognized that they were filmed in the Museum of Science and agreed that these MoS-produced segments increased the value of the museum to the community. Two-fifths of viewers felt the segments increased their interest in visiting MoS; however, viewers' intention to visit in the next six months was not significantly different from those who did not view the segments. It is likely too much to expect that short weekly TV news segments will increase museum visitation numbers, but the *Sci-Tech Today* segments are identified with the MoS brand and are seen as a valuable addition to the viewers' news experience.

In conclusion, the four *Sci-Tech Today* nanotechnology segments in this study successfully fostered awareness and understanding of nanotechnology and its applications in adult viewers of a regional newscast. These results likely generalize to comparable newscast settings with similarly-produced segments about nanotechnology. The segments appeared in the early evening newscast, involving live, but partially scripted and choreographed interaction between the news anchor and the museum correspondent. All four segments mentioned practical applications of nanotechnology, and all noted either regional tie-ins to local industries and universities or connections to current news stories, like the Obama inauguration or a Massachusetts Dept. of Environmental Protection workshop on safe development of nanotechnology. All segments featured specially-prepared images, props, animations and/or video roll-ins. Two segments presented demonstrations, enhanced with two-camera switching allowing cutaways to close-ups. This study did not attempt to assess the contribution of production features to the impact of the segments, but one might assume that similar carefully-crafted and well-produced stories would also make a significant impact in other local news broadcasts.

APPENDIX

Most Memorable Aspect of *Sci-Tech Today*

The *Sci-Tech Today* segments were not identified as the focus of the study for either the treatment or control groups, so in the final survey both groups were asked whether or not they had seen, in any of the four newscasts, *Sci-Tech Today*, “a short segment integrated into some NECN evening newscasts.” As expected, none of the control group recalled seeing the segments, whereas all but one of the treatment group did recall the segments. The one treatment member who did not recall seeing *Sci-Tech Today* reported being “not at all interested in science and technology news” and did not note any science information in any open-ended question responses.

To provide feedback for the producers, the remaining 29 treatment group members were asked to think back on the *Sci-Tech Today* segments and report in an open-ended response what was most memorable for them. Most respondents only wrote a short content title, e.g., *water purification* or *solar energy creation* or *nano obama*. The responses were sorted according to show content. Table 25 presents percent distributions and quotes of the longer responses. Stories of practical applications of nanotechnology for water filtration and solar energy were the most memorable aspects of *Sci-Tech Today*; these were also the more recent shows.

Table 25. Most Memorable Aspect of *Sci-Tech Today* (Treatment N = 29)

Thinking back on the <i>Sci-Tech Today</i> segments, what was most memorable for you?	<i>Sci-Tech Today</i> %
Week 1: Nanobama <i>When he showed how they grew pictures of the Presidents' face.</i>	7%
Week 2: Nano, Silver and You <i>The silver nanotechnology segment.</i>	3%
Week 3: Man Drinks Water Out of the Charles <i>The Charles river clean up story. I liked the demo. When they used the nano technology to create a filter to clean a tank of dirty water.</i>	41%
Week 4: Making Solar Energy More Affordable <i>It seemed more relevant to connect the innovations from nanotechnology to help with taxes and utilities. When I started this it didn't interest me at all now at the end I find myself very interested in the developing of nanotechnologies. If I have to pick one it's today's – solar energy.</i>	45%
Non-specific nanotechnology information <i>The information on nanotechnology and its applicability to everyday uses.</i>	14%
Production values <i>The host's unfortunate mini-boom mic and local cable access production values.</i>	7%