



MULTIMEDIA RESEARCH

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Summative Evaluation of  
*Earth & Sky* NASA-Sponsored Radio Shows

Report for  
Earth & Sky, Inc.

by  
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## INTRODUCTION

*Earth & Sky (E&S)* is a short-format science radio series airing daily on more than 1,000 commercial and public radio stations and translators in the U.S. as well as on satellite and Internet radio outlets. The series is also widely heard beyond U.S. borders. Produced by a small non-profit, Earth & Sky, Inc. of Austin, TX, the series is hosted by Deborah Byrd and Joel Block and consists of 90-second programs on a wide variety of topics mostly drawn from environmental sciences, earth sciences and astronomy. In the previous three years, the National Aeronautics and Space Administration (NASA) has supported the development, broadcast and Internet archiving of 144 shows. This report presents a summative evaluation assessing the appeal and learning impact on listeners of a small subset of *Earth & Sky* NASA shows.

## METHOD

### Research Design

The summative evaluation utilized an online survey with a posttest-only control group experimental design (see Table 1). In this study, adults across the nation were randomly assigned to a treatment group and a control group. Random assignment permits us to omit a pretest that might predispose participants to listen for certain content in the shows. During two weeks of weekdays, the treatment group listened to nine daily NASA shows focused on the topic of Antarctica, while the control group listened to nine shows about whales. On the tenth day, both groups answered the same online survey questions.

Table 1. Research Design for *E&S* NASA Shows Summative Evaluation

Listeners randomly assigned to group:		
Listening Days	Treatment Group listens to NASA Antarctica shows:	Control Group listens to whale shows:
<b>M</b>	<i>Will Antarctica shrink or grow as climate warms?</i>	<i>Satellites used to track whales in Arctic</i>
<b>T</b>	<i>Will global warming make Antarctica icier?</i>	<i>Major ecosystem shift in Arctic seas</i>
<b>W</b>	<i>Global warming cools parts of the Earth</i>	<i>Experts study dialects in blue whale songs</i>
<b>T</b>	<i>Lakes under Antarctic ice linked to sea level rise</i>	<i>Expert calls killer whales "sentinel species"</i>
<b>F</b>	<i>Twin GRACE satellites monitor changes in gravity</i>	<i>Remember "save the whales?" We haven't yet.</i>
<b>S/S</b>	-	-
<b>M</b>	<i>Signs of huge Antarctic meteorite impact found</i>	<i>Shipping lanes moved to save whales</i>
<b>T</b>	<i>Penguin oasis depends on marine plants</i>	<i>Eskimos can continue 2,000-year whale hunt</i>
<b>W</b>	<i>Small temperature changes, big effects on life</i>	<i>Survival odds slim for stranded marine animals</i>
<b>T</b>	<i>More on unprecedented melt in West Antarctica</i>	<i>Strategies for luring lost whales back to sea</i>
<b>F</b>	Completion of online survey	

## NASA Programs

The NASA-sponsored *E&S* programs cover a wide variety of topics: for example, hurricanes, plants, climate and land use, ocean life, clouds, cities, carbon dioxide, air pollution, and disease. Programs focusing on Antarctica were chosen for the treatment group because this was a frequently covered topic in the NASA show list, and nine 90-second shows permitted a reasonable exposure such that changes in knowledge in one content area might be measurable.

The *E&S* programs for the control group focused on whales because this was also a frequently covered topic, not sponsored by NASA, and nine shows were available.

## Procedure

Participants were recruited for the evaluation of *Earth & Sky* at twelve sites across the nation listed below:

Western U.S.	Mid U.S.	Eastern U.S.
Portland, OR	St. Paul, MN	Harvard, MA
Sacramento, CA	Chicago, IL	Boston, MA
Denver, CO	Austin, TX	Long Island, NY
Boulder, CO		Philadelphia, PA
		Miami, FL

Field coordinators at each site recruited from 8 to 12 adults, 18 years and older, with equal gender distribution, and 20% minority representation. In addition to these demographic requirements, each recruited participant had to be a public radio listener and interested in hearing science news but not to the extent of actively seeking out science news through subscriptions to science magazines, e-newsletters, blogs or other publications. The goal was to gather representatives of the less science-attentive public radio listening audience. Additionally, the recruited participants had to have an email account, access to the Internet, and be able and willing to listen daily to 90-second audio files during the two week period of the evaluation. Recruits were told that the study was an evaluation of 90-second daily *Earth & Sky* radio shows but were not told the content of the shows or about the sponsorship of NASA.

The 100 recruited participants were randomly assigned, stratified by gender, to either the treatment group or the control group. Participants were not aware of the group to which they were assigned.

Daily over a period of nine weekdays, each group received an emailed note from *E&S* with either a URL link to that day's show or an MP3 attachment of the show. Because of logistical difficulties both with email delivery and with *E&S*'s Internet server, the distribution technique changed in the middle of the study from a URL link to an attachment. It was stressed to participants that daily listening was important to mimic the typical *E&S* listening experience; 14% of the total sample reported missing a day but catching up quickly on the next day. On the tenth day, all participants completed an online post-questionnaire. Upon completion, an honorarium of a \$30 gift certificate was emailed.

## Post-Questionnaire

The self-administered web-based post-questionnaire was the same for both treatment and control groups. The survey included questions on demographic and background variables; program appeal and clarity; post-listening behavior; and knowledge of scientific methods, Antarctica and whales. The treatment group answered Antarctica questions first followed by whale questions, and the control group's order was reversed. Recognizing that participants might be hesitant to answer questions referring to content that they were not exposed to, the questionnaire explained that there were other people who listened to a set of shows on content different from their shows and that they should try to answer the content questions as best they could.

## Sample

The treatment and control groups included 50 participants each who completed the post-questionnaire. However, when asked how many of the nine shows they actually listened to, nine participants in the treatment group and thirteen in the control group reported that they did not listen to all nine programs for a variety of reasons unrelated to the programs' content. These participants were dropped from the data set as not complying with the required protocol.

The treatment and control samples do not differ statistically in their demographic and background characteristics, as presented in Table 1. Both groups have slightly more women than men, with equivalent age distributions. Minorities comprised approximately one-quarter of each sample. Both samples have similar distributions of educational levels and interest in hearing about current science news. Note that two-thirds of both samples 'never hear' *Earth & Sky*.

Table 1. Demographic and Background Characteristics

Classification Variables		Treatment Group % of N = 41	Control Group % of N = 37
Gender	Male	49%	46%
	Female	51%	54%
Age		Range: 23-79 yrs Mean= 42.5 yrs Median = 40 yrs	Range: 25-73 yrs Mean = 44.6 yrs Median = 46 yrs
Race/Ethnicity	White, not of Hispanic origin	71%	78%
	Minority	29%	22%
Highest level of education	High school graduate or less	0%	5%
	Some college or technical	7%	11%
	College graduate	46%	41%
	Courses or degrees beyond college	46%	43%
Frequency of hearing "Earth & Sky"	Hear it at least weekly	0%	5%
	Hear it every once in a while	32%	30%
	Never hear it	68%	65%
Interest in hearing about current science news generally	Very interested	46%	49%
	Somewhat interested	54%	51%
	Not particularly interested	0%	0%
	Not at all interested	0%	0%

## APPEAL OF NASA EARTH & SKY SHOWS

Listeners of the NASA Antarctica shows were asked what they liked most and what they did not like about the *E&S* shows.

### What was liked about *E&S* shows

*“I found each episode very interesting, with solid scientific information. The length of 90-seconds is quite good, considering the length of people’s attention span these days. The scientists who speak have clear voices and are easy to understand. The information is provided in “laymen” terms – easy to understand by most of us non-scientific people. I looked forward to each day, learning something new about Antarctica and the effects of global warming.”*

Listeners were asked to write what they liked most about the *E&S* shows they listened to. These open-ended responses were sorted by keyword and keyphrase into categories. Presented below are the percentages of the treatment sample (N = 41) and illustrative responses for each category obtaining more than 10% of the sample. Listeners liked that the shows are informative, interesting, concise and to the point. They liked the topics and the expert interviews.

- 41% liked that the shows are informative; e.g.,  
I found it to be informative on subjects that I haven’t been familiar about.  
I liked that I learned about Antarctica because I didn’t know much about it in the past.  
I learned more about what scientists are discovering about various effects of global warming on sea and animal life in Antarctica, and how it may be a barometer to project widespread changes due to global warming worldwide.  
Informative info on issues involving Antarctica.
- 37% found the shows interesting; e.g.,  
The 90 sec spots peaked my interest and I wanted to hear more.  
Interesting topics about science I don’t know very well.  
They were all interesting. Antarctica is important and climate changes should be studied as these programs indicated. The problems likely to be experienced by penguins interested me especially.  
The issue of global warming is very timely now so it was interesting.
- 22% liked that the shows are concise and to the point; e.g.,  
I like the fact that the shows were short and to the point.  
It got to the heart of the matter. It was not wasted on details and opinions that would have no direct impact of the issue itself.  
I liked the brevity of the information presented.  
I like that the shows are short and to the point.
- 17% liked the topics; e.g.,  
I liked the topics.  
I really liked listening to the news about global warming.  
Quick thought provoking topics.

- 17% enjoyed the expert interviews; e.g.,  
I like hearing all the diverse opinions on global warming from the different researchers.  
I liked that of all the programs we listened to, various opinions were aired.  
I liked the industry experts/scientists who provided commentary; it mixed things up a bit.
- 15% noted that the shows are understandable; e.g.,  
Clear and easily understood language used to explain very complex concepts.  
I like how the science is presented in a light, non-jargon way.  
I didn't feel alienated by the language or structure of each story. I would have even listened to a longer program.

### **What was not liked about *E&S* shows**

*“The segments were too short to give any comprehensive information. There was no need for two people giving the information and then a third, an expert, adding information in a 90-second period. To me the subjects were not that interesting. A few new facts but it seemed like I had heard about it or read about it before. I thought the delivery of information was done in a monotonous way that didn't encourage me to pay attention.”*

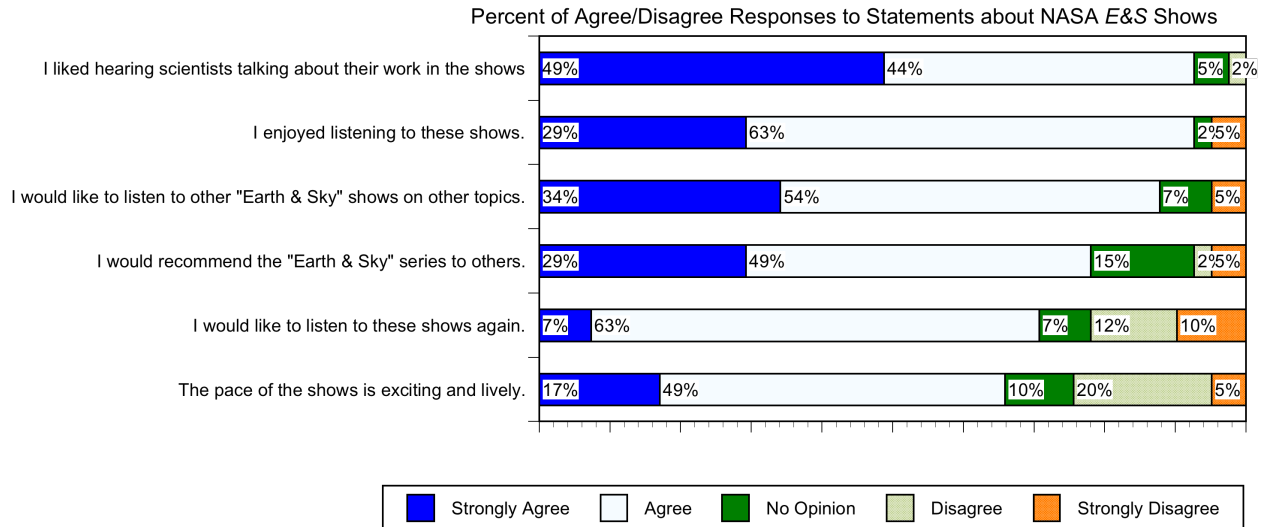
Listeners were asked to write what they did not like about the *E&S* shows they listened to. These open-ended responses were sorted by keyword and keyphrase into categories. Presented below are the percentages of the treatment sample (N = 41) and illustrative responses for each category obtaining more than 10% of the sample. The main complaint about *E&S* is that it is too short with too little detail.

- 41% felt the shows are too short with too little detail; e.g.,  
The shows are very short and often do not go into enough detail in order to grasp the full impact of the information.  
At times, the shows seem too short to introduce the topic, have testimony from an expert and explain or elaborate on the findings.  
The shows were very short, and I found myself still waiting for more at the end of each show.
- 12% described the shows as monotonous; e.g.,  
Boring. All sounded the same. Speakers sometimes monotonous.  
Overall, a little too monotonous.  
It seemed a little monotonous at times.

## Appeal of *E&S*

Listeners rated their level of agreement with several statements about show appeal. The chart below presents ratings for six agree/disagree statements about appeal of *E&S*.

- Nine out of ten listeners liked hearing scientists talking about their work (93%), enjoyed listening to the shows (92%), and would like to listen to *E&S* shows on other topics (88%).
- Eight out of ten listeners (78%) would recommend the *E&S* series to others.
- Seven out of ten would like to listen to these shows again (70%) and found the pace of the shows exciting and lively (66%).



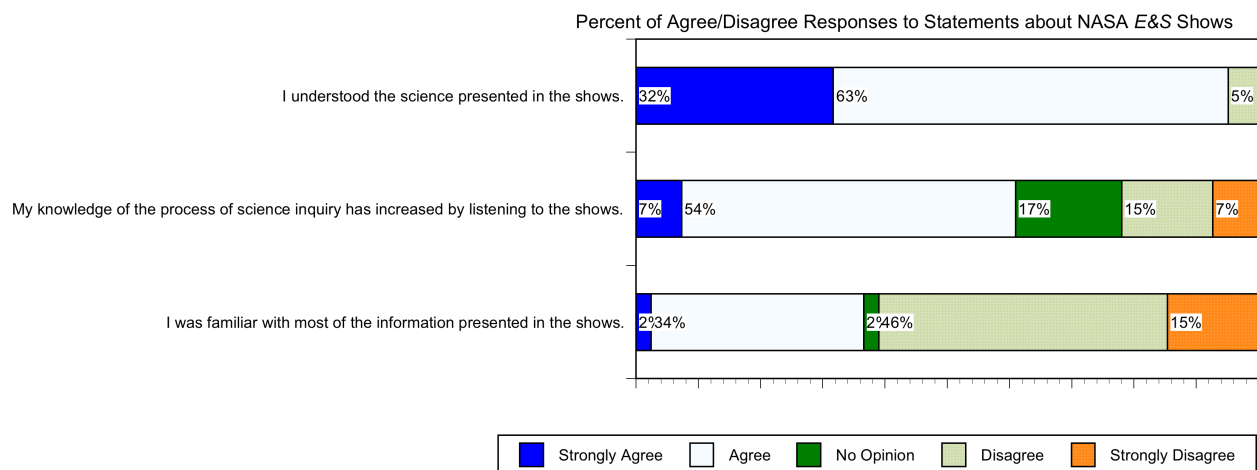


## CLARITY OF *EARTH & SKY* NASA SHOWS

Listeners of the NASA Antarctica shows were asked to rate their level of agreement with several statements about the information presented in the shows.

The chart below presents ratings for three agree/disagree clarity statements.

- 95% of listeners understood the science presented in the shows.
- 61% felt that their knowledge of the process of science inquiry was increased by listening to the shows.
- 36% were familiar with most of the information presented in the shows, indicating that most listeners were being exposed to new information.



## LEARNING IMPACT OF NASA *EARTH & SKY* SHOWS

### Most important to know about Antarctica

Respondents described what they felt is most important for people to know about Antarctica. Six categories fully describe the data set:

1. What happens in Antarctica impacts the whole planet
2. Antarctica's ecosystem is fragile and vulnerable to small changes in climate
3. Ice in Antarctica is melting at an increasing rate
4. Antarctica is a key barometer for effects of climate change
5. Climate change is affecting Antarctica
6. Antarctica is icy and cold.

Each category was coded dichotomously according to whether or not an open-ended response fit into the category. Each respondent is included in only one category. Table 2 presents the percent of treatment and control group respondents falling into each category. The treatment group was significantly more likely than the control group to say that it is most important for people to know that what happens in Antarctica impacts the whole planet; indeed, almost half (46%) of the Antarctica show listeners put this idea forward; otherwise, there were no differences between the groups.

Table 2. Category Percentages for What is Most Important for People to Know about Antarctica

Category	Treatment Group	Control Group	Significance Test
What happens in Antarctica impacts the whole planet	46%	5%	$\chi^2(1, N=78) = 16.57$ , Fisher Exact test $\leq 0.0001$
Ice in Antarctica is melting at an increasing rate	15%	27%	No significant difference
Antarctica is a key barometer for effects of climate change	15%	3%	No significant difference
Antarctica's ecosystem is fragile and vulnerable to small changes in climate	12%	22%	No significant difference
Climate change is affecting Antarctica	12%	30%	No significant difference
Antarctica is icy and cold.	0%	11%	No significant difference

## Methods and Technologies

Respondents were asked in an open-ended question to list methods and technologies used by scientists in the shows to gather images, collect data or come to conclusions. In the nine Antarctica shows, the mentioned methods included satellites, computer modeling, radar imaging, and observations of changes in animal life. Close to half (44%) of the NASA listeners noted the use of satellites, and one-quarter (24%) mentioned observations of changes in animal life. Two-fifths (39%) of listeners could not recall any of the methods or technologies used.

## Knowledge of Antarctica

Respondents were asked a series of multiple choice questions to establish their knowledge of the Antarctica content. All response alternatives were randomly ordered for each respondent.

- Which of the following can be found in Antarctica?
  - a. Glaciers
  - b. Mountains and valleys
  - c. Volcanoes
  - d. Lakes
  - e. Meteorite impact crater
  
- Which animals can we find today on land or in the water in Antarctica?
  - Polar bears
  - Nematodes
  - Penguins
  - Krill
  
- Indicate whether each statement is true, false, or you don't know.
  - As ice breaks off the edges of the Antarctic continent, sea level rises.
  - Some scientists predict that Antarctic sea ice will increase as global warming increases.
  - An ice shelf is attached to the land but floats out on the ocean.
  - Antarctica is all ice with no solid ground.
  - Global warming means there will be warmer temperatures everywhere on Earth.
  - Climate conditions in Antarctica only affect the climate around Antarctica itself.

Each correct answer received one point, with a potential total of 15 points for this content test. The treatment group who listened to nine shows about Antarctica produced a mean score of 10.4 (SD = 2.2), and the control group who listened to nine shows about whales produced a significantly lower mean score of 8.8 (SD = 2.3).<sup>1</sup> Thus, the Antarctica shows significantly increased listeners' knowledge of the topic.

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<sup>1</sup>  $t(74) = 3.025, p = 0.0034$ .

## BEHAVIORAL IMPACT OF *EARTH & SKY* NASA SHOWS

*“I have actually repeated facts that I have heard on “Earth & Sky” to friends and family. There was one show that focused on the satellites orbiting the earth monitoring earth’s gravitational pull (whose names at this point I cannot recall). I was so interested I looked up additional information on the subject. The topic of global warming has been popping up everywhere in my daily life. Yet no one seems to be presenting the data as proof that it’s really happening with supporting facts. I feel like “Earth & Sky” is taking that extra step by saying yes there is proof and here it is. So I have been taking more steps in my own personal life style to conserve energy and to drive less. I have an entirely different perspective on traveling from point A to point B and feel like I can now share my new knowledge with others.”*

### General impact

Listeners of the NASA Antarctica shows were asked to comment about any impact that listening to the shows had on them:

- 32% felt that the shows increased their awareness and knowledge of Antarctica and global warming; e.g.,  
I am more aware how global warming will soon impact one ecosystem that (I believe) we are heading towards. I felt better informed about things I care about, and I appreciated how much I was able to learn in 90 seconds. Listening to the shows raised my awareness of issues I already knew about. They kept me more mindful of the interrelatedness of ecosystems. It also made me think about how mindless our government has been in addressing these issues.  
The shows gave me surprising new knowledge about the impact of melting ice on our oceans, which I never would have ‘guessed.’
- 10% reported searching for more information; e.g.,  
I went to find more information on some of the topics.  
I looked into nematodes and their habitats. I also looked into the effects of global warming on the Antarctic. When you ended with the website, I felt more compelled to visit.
- 7% said the shows increased their interest and curiosity; e.g.,  
The show increased my curiosity towards wanting to know much more about the effects of global warming on this part of the world as well as the rest of the world.  
It created interest in the various topics.

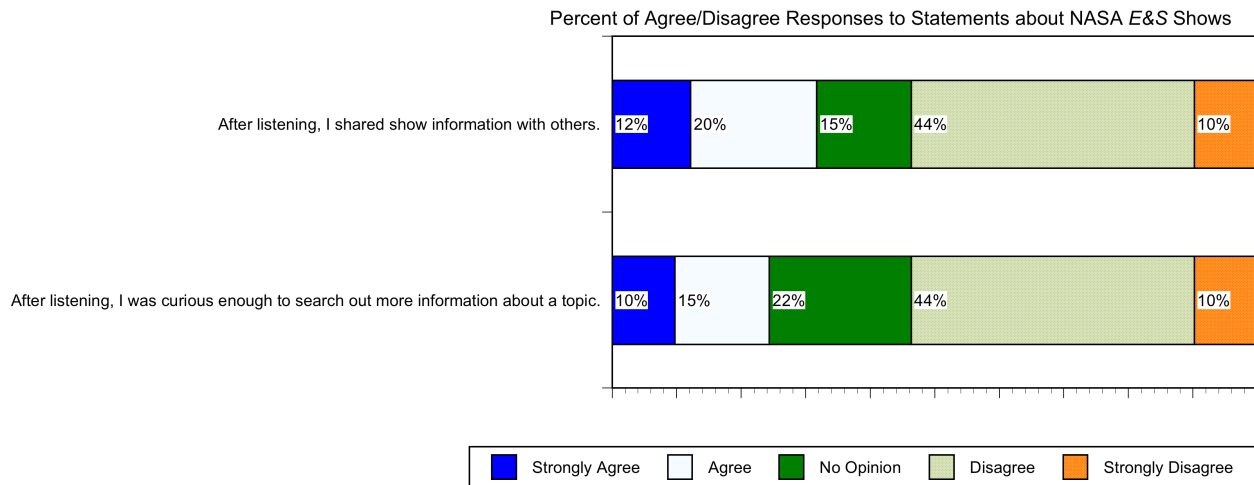
One minority respondent described a very specific impact on English skills:

I like listening to NPR because it help[s] me to improve my English. I really enjoyed the show because it gave me vocabulary that I didn’t know, and I had to research or ask for the meaning of some words. It helps me to increase my English vocabulary and listening skills.

## Behavioral impact

Listeners rated their level of agreement with several statements about the impact of the shows. The chart below presents ratings for two agree/disagree statements about post-listening behavior.

- 32% of listeners shared show information with others after listening.
- 25% of listeners searched out more information about a topic that they heard in the *E&S* shows.



## RECALL OF NASA SPONSORSHIP

Listeners of the NASA Antarctica shows were asked to recall which government agency sponsored the *E&S* programming. To avoid an order effect, the multiple-choice response alternatives were presented in a different random order for each respondent. Two-thirds of the Antarctica listeners recognized that NASA was the sponsor of the shows:

- 66% NASA: National Aeronautics and Space Administration
- 15% NOAA: National Oceanic and Atmospheric Administration
- 10% - no idea
- 7% NSF: National Science Foundation
- 2% USGS: United States Geological Survey

Two respondents were concerned enough about NASA's sponsorship to address it in their closing open-ended comments:

I was disturbed that NASA was sponsoring it. I don't think it's a very good use of their time and our money. Underwriting and content provided by NASA seems a conflict of interest. I would find it less suspect if underwriting was made by a private foundation.

## DISCUSSION

In the previous three years, 144 90-second *Earth & Sky* radio shows have been produced under sponsorship of the National Aeronautics and Space Administration. The impact of these shows was explored with a posttest-only experimental design comparing a treatment group that listened to nine daily NASA shows focused on the topic of Antarctica and a control group that listened to nine daily non-NASA shows about whales. Participants were randomly assigned to groups, which did not differ on the variables of gender, age, ethnicity, education, frequency of hearing *Earth & Sky*, and interest in hearing about current science news generally. Two-thirds of both groups ‘never hear’ *Earth & Sky*, so our study results generalize to adults who are interested in current science news but who are mostly not familiar with *E&S* programming.

Sponsorship. Two-thirds of the Antarctica listeners recognized and recalled that NASA was the sponsor of the *E&S* shows.

Appeal. Listeners liked that the Antarctica *E&S* shows are informative, interesting, concise and to the point. They liked the topics and the expert interviews. Nine out of ten listeners liked hearing scientists talking about their work, enjoyed listening to the shows, and would like to listen to *E&S* shows on other topics. Eight out of ten listeners would recommend the *E&S* series to others. Seven out of ten listeners would listen to these Antarctica shows again and found the pace of the shows exciting and lively. The main complaint of two-fifths of the listeners was that the shows are too short with too little detail.

Clarity. Slightly more than one-third of the listeners were familiar with most of the information presented in the shows, indicating that most listeners were being exposed to new information; however, the information is clearly presented. Almost all (95%) of the sample said that they understood the science presented in the shows, and almost two-thirds (61%) felt that their knowledge of the process of science inquiry was increased by listening to the shows. So listeners felt they understood and learned new information, which is confirmed by the questions directly assessing their learning.

Learning Impact. Listening to the Antarctica shows significantly increased listeners’ knowledge of the topic when compared to the control group, who did not listen to these shows. Additionally, listeners were significantly more likely than the control group to report that it is most important for people to know that what happens in Antarctica impacts the whole planet. Listeners also recalled the scientific methods used, including satellite data (44%) and observations of changes in animal life (24%).

Behavioral Impact. One-third of listeners reported sharing show information with others after listening, and one-quarter searched out more information about a topic that they heard in the *E&S* shows. For a 90-second daily radio show exposure, this is a strong impact on post-listening behavior.

The study reveals that the NASA *Earth & Sky* shows are very appealing and understandable and significantly increase listeners’ knowledge of Antarctica and the impact of climate change.