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33 BROWNS LANE • BELLPORT, NY 11713 • (631) 286-8925

Summative Evaluation of *Earth & Sky* Radio Series in the Commercial Radio Market

Report for
Earth & Sky
National Science Foundation

Submitted by
Multimedia Research

Allan J. Brenman, Ed.D.
Barbara N. Flagg, Ed.D.

with the assistance of
Nancy Beausoleil

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EXECUTIVE SUMMARY OF SUMMATIVE EVALUATION OF *EARTH & SKY* RADIO SERIES IN THE COMMERCIAL RADIO MARKET

Earth & Sky is a 90 second radio science series about environmental sciences, earth sciences and astronomy. Funding from the National Science Foundation is supporting this summative evaluation of *Earth & Sky* in the commercial radio markets. The evaluation focuses on whether listening to the series influences adults' knowledge of and interest in science and whether the series affects listeners' science-related activities.

The evaluation studied eight commercial radio stations where *Earth & Sky* has been airing for at least one year before the study. Each station agreed to run a contest just prior to the airing of *Earth & Sky* to obtain names and addresses of listeners.

Surveys were received by a total of 358 people who responded to the radio contest. Six weeks after the first survey mailing, a second mailing with a one dollar bill incentive enclosed was sent to people who had not returned their first survey. A total of 152 surveys were returned (43% return rate).

Generally, the results of this evaluation demonstrate that the goals of the series are being met for commercial radio listeners; that is, the series makes science accessible and interesting to the listening audience and generates excitement about science. Although only 90 seconds in length, the programs were perceived as affecting listeners' understanding of science and their further exploration of science topics.

Listeners find *Earth & Sky* appealing. Almost all respondents enjoyed listening to the series, agreed that they "perk up and pay attention" when the program plays and did not feel that the program's information was too technical. The more listeners enjoyed the program, the more they agreed that the series expanded their knowledge of science, that topics related to them, that listening to the series affected the way they look at the night sky and that they discussed program topics with others. Additionally, the more listeners reported enjoying the program, the more they disagreed that the topics did not relate to them and that the series has not increased their awareness of science news topics.

Earth & Sky did not have a strong impact on listeners' feelings about science. Four-tenths of listeners felt that *Earth & Sky* topics related to them, but only two-fifths agreed that they were more comfortable with science because of the series and two-fifths disagreed that listening to *Earth & Sky* makes them anxious about science. Listeners with high school or less education felt more positive impact on their comfort with science than those with post-college education.

Listeners learn science from *Earth & Sky*. When asked in an open-ended question how they feel about the series, the most frequent response concerned learning: 35% felt that program was "informative and educational," 31% felt the program was "interesting," and 25% felt it was "enjoyable." All but five listeners agreed that they had learned from listening to *Earth & Sky*, and 70% reported that they hear new information frequently. When asked what they learned, more than half wrote down something specific from the topics of astronomy, oceanography, meteorology, environmental science, and geology, in order of frequency of mention. At least 85% of listeners agreed that the series expanded their knowledge of science, and 79% disagreed that the series has not increased their awareness of science news topics. Only two gender effects were found in the impact of *Earth & Sky*: Women were significantly more likely than

men to report hearing new information more frequently on the series and to agree that the series has not increased awareness of science news topics.

Four-fifths of listeners reported thinking about information presented on *Earth & Sky* at a later date. Of the entire sample, 16% wrote in an open-ended question that they recalled looking at the stars or night sky, 14% recalled a specific topic, 4% said they discussed a topic, and 1% used the information in their teaching.

Earth & Sky prompts listeners to take further action related to a program topic. In response to agree-disagree statements, two-thirds of listeners agreed that they had discussed *Earth & Sky* topics with others and agreed that the series had affected the way they look at the night sky. In response to an open-ended question about further actions, listeners said they had looked at the night sky (17%), bought related material (3%) or discussed a topic (2%).

Finally, the few significant effects on those who felt that they were not knowledgeable in science is notable: Listeners with low perceived science knowledge scores compared to those with high scores reported listening to more programs in the past two weeks, reported hearing new information more frequently, were more likely to have thought about the information at a later date but less likely to have taken further action related to a program topic.

More specific findings for listeners of *Earth & Sky* follow:

* 93% of listeners were white, with 65% having some college education; 73% were either interested or very interested in science; 72% were employed and the average age was 44 years.

* 97% said that they had learned something from listening to *Earth & Sky*. Listeners recalled most frequently learning about astronomy.

* 94% reported listening to at least one show in the previous two weeks.

* 91% of listeners agreed that they "enjoyed listening" to the series.

* 91% described the show as either "interesting", "informative/educational" or "enjoyable".

* 85% agreed that the series had "expanded their knowledge of science".

* 84% felt that the *Earth & Sky* content was presented at an acceptable technical level.

* 83% agreed that they "perk up and pay attention" when they hear the program.

* 83% disagreed that "topics on *Earth & Sky* did not relate to them".

EXECUTIVE SUMMARY OF SUMMATIVE EVALUATION OF *EARTH & SKY* RADIO SERIES IN THE COMMERCIAL RADIO MARKET

* 81% said that they had thought about *Earth & Sky* information at a later date.

* 79% thought exposure to the show increased their awareness of science news topics.

* 67% discussed *Earth & Sky* topics with other adults or children.

* 66% agreed that listening to the series affected the way they looked at the night sky.

* 59% estimated hearing five or more programs in the previous two weeks.

* 42% disagreed with the statement Listening to *Earth & Sky* makes me anxious about science".

* 40% agreed that they feel more comfortable with science because of *Earth & Sky*.

* 39% felt the series had prompted them to take further action related to a program topic.

* 23% reported that they hear new information "all the time" on *Earth & Sky*.

* 4% agreed that "the information on *Earth & Sky* is too technical for them".

The findings for the commercial radio listeners were compared to a prior study of *Earth & Sky* public radio listeners in California in 1994. In demographic comparisons with the public radio sample, the commercial radio sample was younger, less educated, with fewer people employed full-time. In terms of background characteristics, the commercial radio sample was less interested in science and had a lower perceived knowledge in astronomy and meteorology. Further, commercial radio listeners as compared to public listeners reported that they "regularly" receive science information more often from radio and less often from newspapers.

Although commercial and public radio listeners differed in some of the demographic and background variables, the comparison revealed only two differences in the impact of *Earth & Sky* on the samples. Compared with public radio listeners, the commercial radio sample agreed significantly less that they "expanded their knowledge of science" by listening to the series and agreed significantly more that the "information on *Earth & Sky* was too technical for them." Thus, the two samples did not differ meaningfully in their assessment of the impact of listening to *Earth & Sky*. Both commercial and public listeners enjoyed the series, learned science from it and engaged in some post-listening activities.

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INTRODUCTION

Earth & Sky is a daily radio science series that began airing on September 30, 1991. The series, hosted by Deborah Byrd and Joel Block, consists of 90-second programs on a wide variety of topics mostly drawn from environmental sciences, earth sciences, and astronomy. Listener questions are solicited on air, and many are answered on future shows. The program is broadcast five days a week on more than 300 public and 200 commercial radio stations.

As described in the National Science Foundation (NSF) funding proposal, *"Earth & Sky's* educational goal is to spark public interest in science further. It attempts to promote curiosity about science by encouraging listeners to ask their own questions about the natural world."

Three summative evaluation studies of *Earth & Sky* have previously been supported by the National Science Foundation. The main goals of these evaluations were to determine whether listening to *Earth & Sky* on public radio influenced adults' knowledge of, interest in, and attitudes toward science and whether the series affected listeners' science-related activities. Results from these studies demonstrate that the producers of *Earth & Sky* have been successful in making science accessible and interesting to the public radio listening audience. Those who heard the program frequently reported thinking about a program topic at a later date and felt they often heard information that was new to them. The sample audiences for these studies were public radio members in Michigan, Florida and California.

Earth & Sky's current NSF funding supports, in part, an expansion into commercial radio markets. The summative evaluation reported here focuses on the commercial radio listeners as opposed to public radio listeners.

METHOD

Research Design

This study involved mailing a two-page survey to a random sample of people who were listeners of their local commercial radio station, which has been airing *Earth & Sky* for at least one year. Recipients were asked to fill out the survey and mail it back to the researcher.

The following specific research questions were addressed in the data analyses:

Do listeners find *Earth & Sky* appealing?

Does *Earth & Sky* affect listeners' feelings about science?

Do listeners learn science from hearing *Earth & Sky*?

Do listeners think about the information presented on *Earth & Sky*, at a later date?

Has the series prompted listeners to take further action related to a program topic?

Do demographic characteristics such as age, gender, ethnicity, education, and occupation relate to whether a listener enjoys the program, learns from it or takes further action after listening to the series?

Do background characteristics such as interest in science, level of science knowledge, and science learning habits relate to whether a person enjoys the program, learns from it or takes further action after listening to a program?

Survey

The survey was comprised of several sections (see Appendix A). All respondents answered sections 1, 2, and 3:

(1) Demographic questions established the sample's range of gender, age, ethnicity, occupational status, and highest level of education.

(2) Rating questions assessed science-related background including general interest in science, frequency of use of common sources of science information, and perceived level of science knowledge.

(3) Exposure questions determined whether a respondent had listened to *Earth & Sky* and the frequency of listening activity.

(4) Appeal, feelings about science and impact of *Earth & Sky* were addressed by ten statements with which respondents agreed or disagreed on a five-point scale and by an open-ended question about listeners' feelings about the series.

(5) Level of agreement with statements and open-ended questions explored whether listeners learned from the series, thought about information presented in the series, or took further action related to a program topic.

Sample

In order to obtain a list of people who listen to *Earth & Sky* on commercial radio, eight commercial radio stations agreed to run a contest on air for two weeks.[1] The contests were run between August, 1996, and March, 1997. All stations had been airing *Earth & Sky* for at least two years prior to running the contest and the program is heard at least once daily on each station.

[1]The contest was sponsored by funding independent of NSF.

Just prior to the airing of *Earth & Sky*, the listeners heard the following:

"Win a quick $40 [or $100 in Hawaii[2]]. Call 1-888-WIN-4040. Be the 20th caller and the money is yours, just for listening to [radio station call letters]. That number once again is 1-888-WIN-4040. Call now and win cash!"
When the listeners called the "888" telephone number they heard the following recording:

"Thanks for listening to [radio station call letters]. At the tone please slowly say, then spell your name, address and telephone number. If you are the 20th caller today, we will contact you and you will receive a money order for $40 [or $100] just for listening to [radio station call letters]. Good luck!"

A total of ten people won the contest and a money order was sent to each winner. Names and addresses were obtained from the information listeners left in response to the contest. Surveys were mailed out approximately two weeks after the contest was run. No reference to or identifying information about the commercial stations was included in the mailing, and the surveys were confidential. The recipients were asked to complete the survey and mail it back.

Approximately six weeks after the first survey was sent out, a second copy was mailed to people who did not respond to the first mailing. In this second survey, a $1.00 bill was enclosed with the sentence, *"A one dollar bill has been included as a way to thank you for taking the time to complete this survey."* Due to the large sample size of the first mailing to Hawaii, a second survey was not sent to listeners from that state.

When surveys were returned to the sender due to incorrect addresses, or if people did not leave their addresses in their phone message, an attempt was made to find correct addresses by using a computer database program called PROPHONE. If addresses were found, surveys were mailed out.

Analyses

To explore possible significant relationships amongst the variables, ANOVA, chi-square analyses, t-tests, and correlation analyses were performed. Only statistically significant findings at $p < .05$ are reported in the text. Only statistically significant correlation's above $r = .30$ are reported in the text as meaningful results. Only respondents who listened to *Earth & Sky* were included in the analyses. The sample consisted of 93% white listeners and 7% from a variety of races and ethnic backgrounds. Due to the small number of non-white listeners, no differences based on ethnicity have been included in the report.

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[2]A higher prize was offered listeners of Hawaii, the last station to run the contest, in order to motivate more people to call the "888" number.

RESULTS

Return Rate

A total of 533 surveys were mailed out for both mailings. Thirty-seven were returned unopened due to incorrect addresses. A total of 186 surveys were completed and returned. Of those surveys received, a total of 34 respondents reported that they were not listeners of *Earth & Sky*. Several of these respondents left messages on the tape saying they were called by a family member or friend who asked them to call the "888" number in order to be the 20th caller. These people were not necessarily listeners of the radio station where the contest was run and where *Earth & Sky* is aired. Thus, data analyses were carried out for 152 listeners. The return rate for the first mailing was 29% and for the second mailing, 32%. The overall return rate was 43%. Table 1 below presents the stations which participated in the contest and the number of surveys mailed and returned for each mailing.

Table 1. List of Stations, Type of Station and Mailing Data

Station			First Mailing		Second Mailing	
	Type of Station	Total % Surveys Returned	Number of Surveys Delivered	Number of Listener Surveys Returned	Number of Surveys Delivered	Number of Listener Surveys Returned
KTEM Texas	News/Talk	71%	7	4	3	1
KMTN Wyoming	Album Rock	62%	60	23	36	14
KMMS Montana	News/Talk	53%	55	13	42	16
KNBZ New York	News/Talk	53%	15	3	12	5
KNWZ California	News/Talk	43%	37	9	28	7
WHAR W. Virginia	News/Talk	39%	23	3	20	6
KIPA Hawaii	Adult Contemporary	32%	140	45	0	0
KMFB California	Diversified	19%	16	3	13	0
TOTAL		43%	353	103	154	49

Demographic Information

Table 2 presents demographic information for the whole sample of listeners. The respondent sample of commercial radio listeners included few minorities (7%) and more men (53 %) than women. The mean age for the respondents was 43.8 years, and the ages ranged from 18 to 82 years. The female respondents were significantly older than the male listeners (46.6 vs. 41.3 years, $p<.03$). Approximately one-third (32%) of the sample was 36 years and younger; another third (34%) was between 37 and 48 years; and another third (34%) was 49 years and older. The majority of respondents (72%) were employed, mostly at jobs considered to be in the lower level of occupational status (laborer or skilled worker). Retirees comprised another 17% of the sample. The majority of respondents (65%) also reported having some college education.

Table 2. Distribution of Demographic Variables for Listeners (N=152)

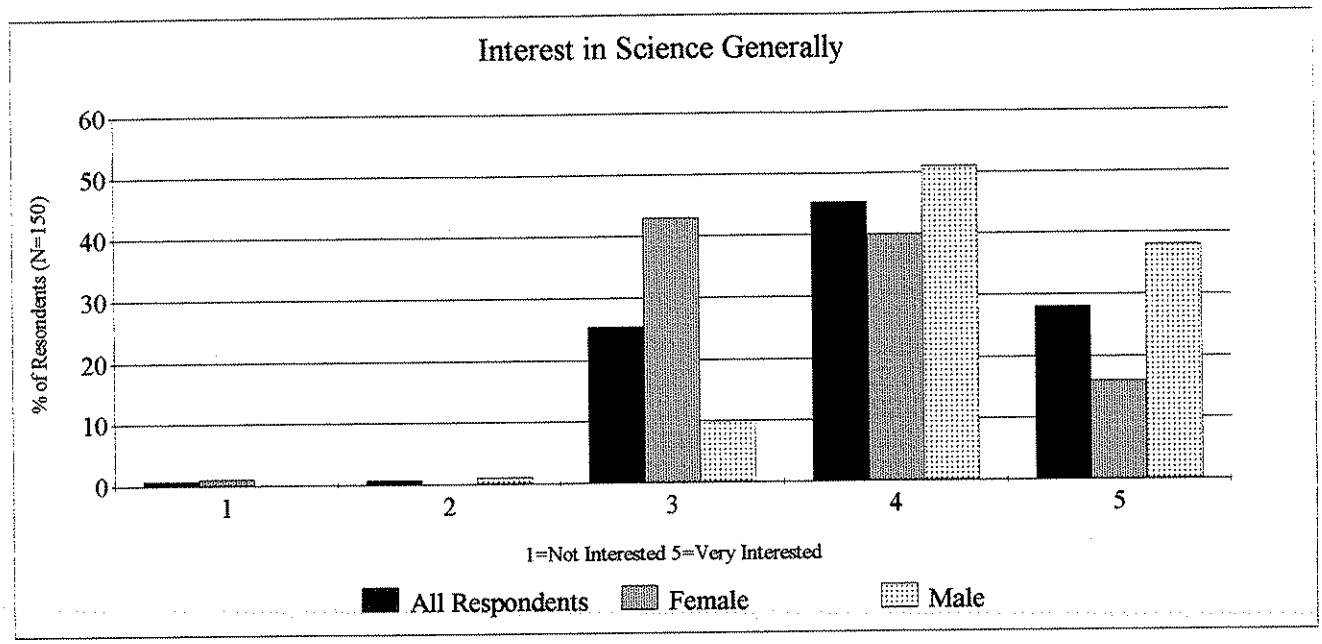
	Percentage (%)
Gender:	
Male	53.3%
Female	46.7%
Age: Mean (years)	43.8 years
Range	18-82 years
Ethnic Status:	
White	93%
Minority	7%
Employment Status:	
Employed:	72%
High Status*	31%
Medium Status	17%
Low Status	52%
Retired	17%
Unemployed	5%
Homemaker	3%
Student	3%
Education:	
Attended/Graduated High School	26%
Attended/Graduated College	65%
Post-College	9%

* "High" occupational status includes those with professional and managerial jobs; "medium" are technical jobs; and "low" are menial labor.

Science Interest and Knowledge

Science Interest

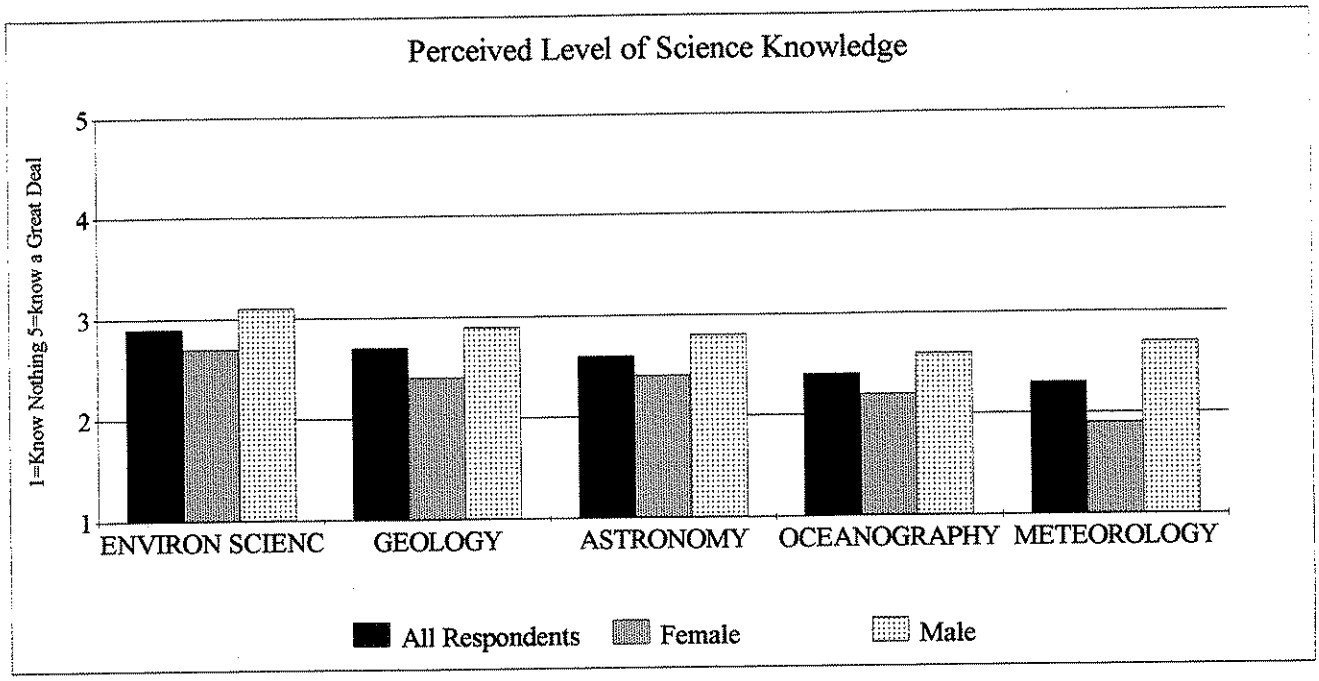
The sample was asked how interested they are in science, generally speaking. They responded using a five-point scale from not at all interested (1) to very interested (5). The graph that follows shows that 73% of the respondents indicated that they were either interested (4) or very interested (5) in science, whereas less than 2% were not interested in science. The average rating for the sample was 4.0 with a standard deviation of .79. Men reported a significantly higher mean interest (4.3) than women (3.7, $p < .001$). Also, those with "high" status jobs were significantly more interested in science ($p < .01$) compared to those with "low" status jobs (M=4.2, SD=.74, vs. M=3.8, SD=.79, respectively). Listeners with a post-college education had a significantly higher rating for science interest, compared to listeners with a high-school educational level or lower (M=4.5, SD=.52 vs. M=3.7, SD=.70, $p < .001$, respectively). No other demographic or background variable differences were found regarding interest in science.



Science Knowledge

Perceived science knowledge was measured by asking respondents to rate their level of knowledge in five areas of science related to the series: astronomy, geology, meteorology, oceanography and environmental science. A 5-point scale was used with (1) indicating that they know nothing and (5) meaning they know a great deal about that area of science. See following graph.

On average, respondents chose numbers representing less knowledge rather than more knowledge of the five areas of science. The results indicate that respondents felt they knew the most about environmental science, geology, astronomy and the least about meteorology and oceanography. Men, compared to women respondents, reported significantly higher estimated levels of knowledge in all of the five science areas ($p < .05$). There were no other significant differences in demographic variables regarding science knowledge.



A summated science knowledge score was calculated by adding the given responses for all five areas of science. The Cronbach alpha for this scale was .77, which means that the scale is an acceptably reliable measure. The range for the scale was from 0 to 20, and the actual scores ranged from 0 to 20 as well. The mean score for the sample was 7.9 (SD=3.5). The mean science knowledge score was significantly higher for men than for women (M=9.0, SD=3.3 vs. M=6.7, SD=3.1, $p < .001$, respectively). Those listeners who reported having a higher science interest also tended to have a higher summated science knowledge score ($r = .41$, $p < .05$). No other significant differences exist regarding the summated science knowledge score and the demographic variables. In order to discover effects of perceived science knowledge on appeal and impact, listeners with a low perceived science score (M=3.4, n=57) were compared to those with a high score (M=11.9, n=53). Significant results will be presented below.

Source of Science Information

The sample was asked to rate how frequently (never, sometimes, regularly) they receive science information from a variety of sources, including newspapers, television, magazines/journals, radio, books, science museums, and informal talks with people. Over 30% of the sample reported that they "regularly" receive science information from television (37%), radio (33%) and magazines/journals (30%). Over 60% said that they "sometimes" receive science information from talking with people (67%), newspapers (66%), books (61%), and radio (61%). More men than women reported that they "regularly" receive science information from books (23% vs. 9%, $p < .05$). No other demographic or background variables were significantly related to sources of science information.

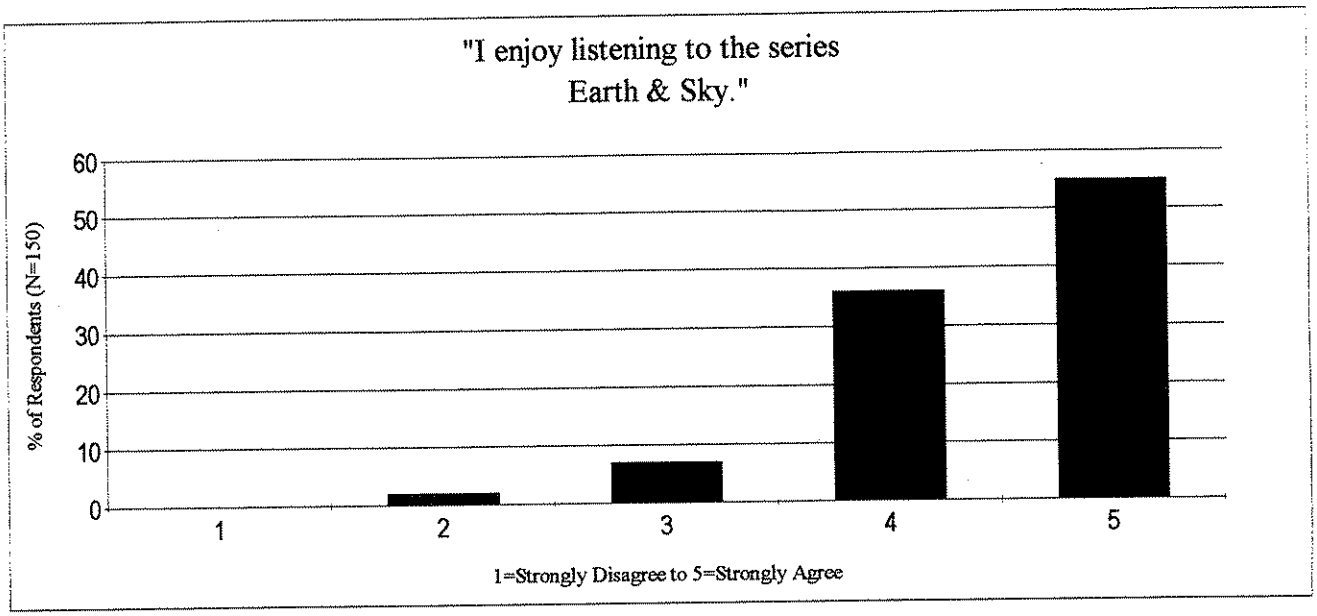
***Earth & Sky* Listening Habits**

Earth & Sky airs 5-15 times per week depending on the station. When asked how many times in the past two weeks they had listened to the series, 94% of the audience reported listening to at least one show and 59% estimated listening to five or more programs in the previous two weeks. The average number of shows heard by listeners in a given week was 6.4 (SD=4.5). Listeners with a low level of perceived science knowledge reported listening to significantly more programs in the past two weeks, (M=7.7, SD=5.4) compared to those with high knowledge scores (M=5.5, SD=4.1, $p < .02$). Listeners who were employed part-time reported listening to significantly more programs in the past two weeks compared to those with full-time employment (M=7.7, SD=4.2 vs. M=5.8, SD=4.3, $p < .02$). No other demographic or background variables significantly affected listening habits.

Appeal of *Earth & Sky*

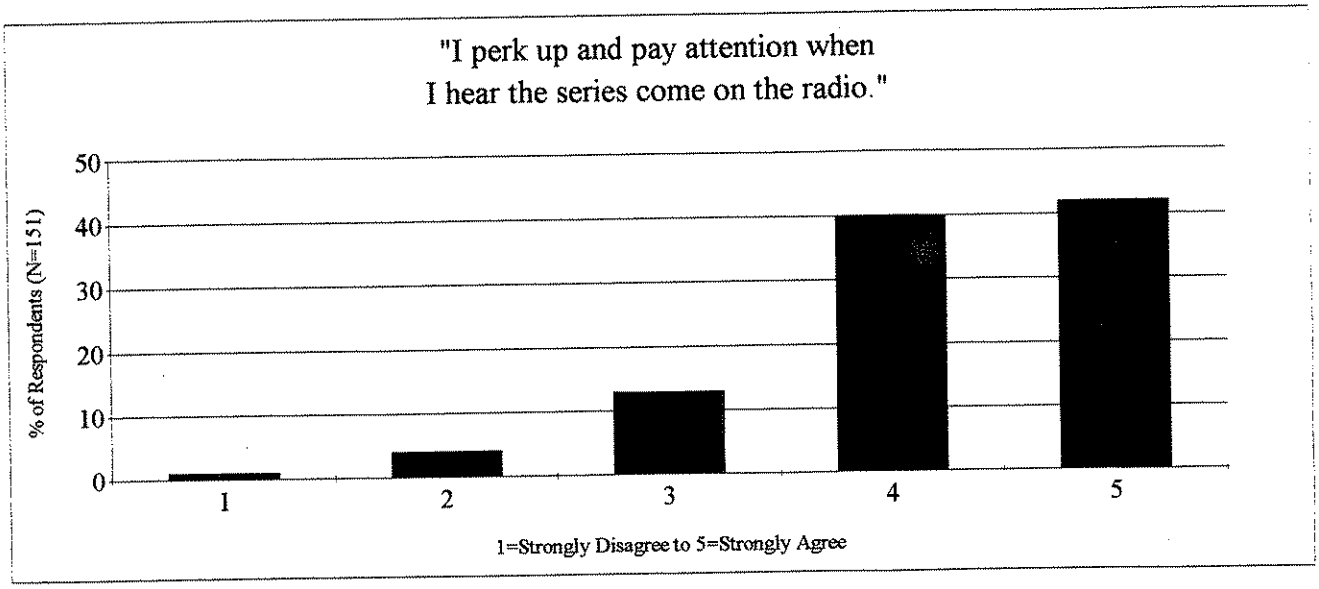
Listeners responded to statements reflecting feelings about the series using a 5-point scale, from strongly disagree (1) to strongly agree (5). In response to the statement, "I enjoy listening to the series *Earth & Sky*", 91% agreed or strongly agreed (see following graph). The mean rating was 4.5 (SD=.71). No differences between any demographic or background variables were found regarding enjoyment of the series. The more listeners reported enjoying the program, the more they felt the series expanded their knowledge of science ($r = .45$, $p < .001$), that listening to the series affected the way they look at the night sky ($r = .34$, $p < .001$), and that they discussed program topics with others ($r = .49$, $p < .001$). The more listeners reported enjoying the program, the more they disagreed that the topics did not relate to them ($r = -.46$, $p < .001$) and disagreed that the series has not increased their awareness of science new topics ($r = -.39$, $p < .001$).

Agreement with Statement:



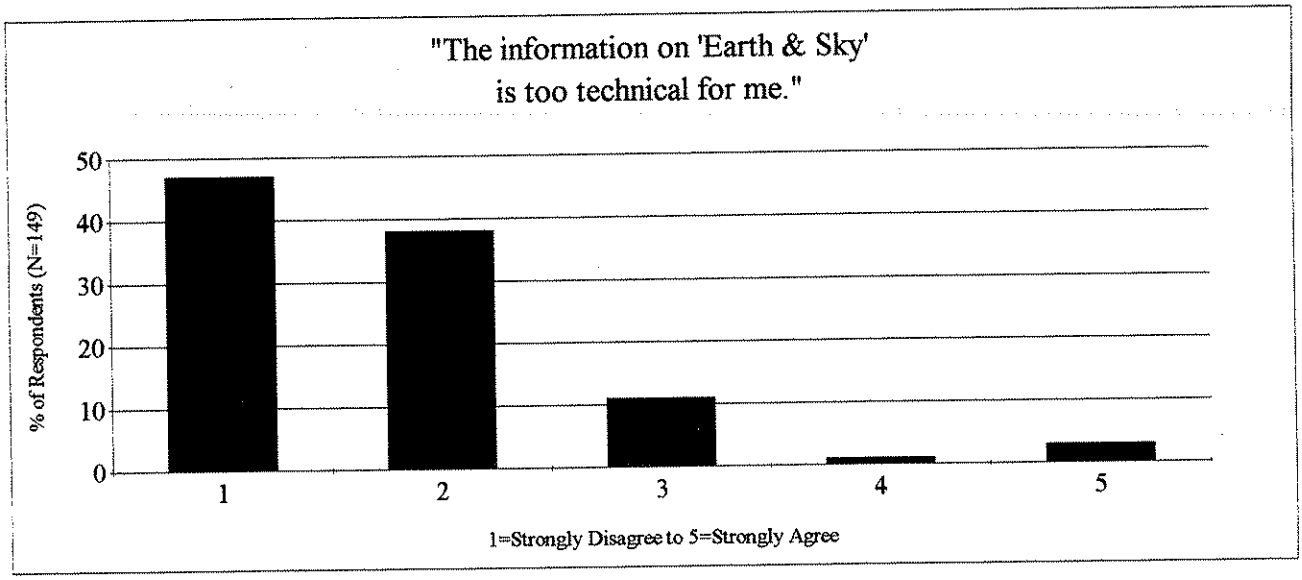
Further, when the series airs, 83% agreed or strongly agreed that they "perk up and pay attention" (see graph). The mean rating was 4.2 (SD=.86). Again, demographic and background variables did not relate significantly to responses to this statement.

Agreement with Statement:



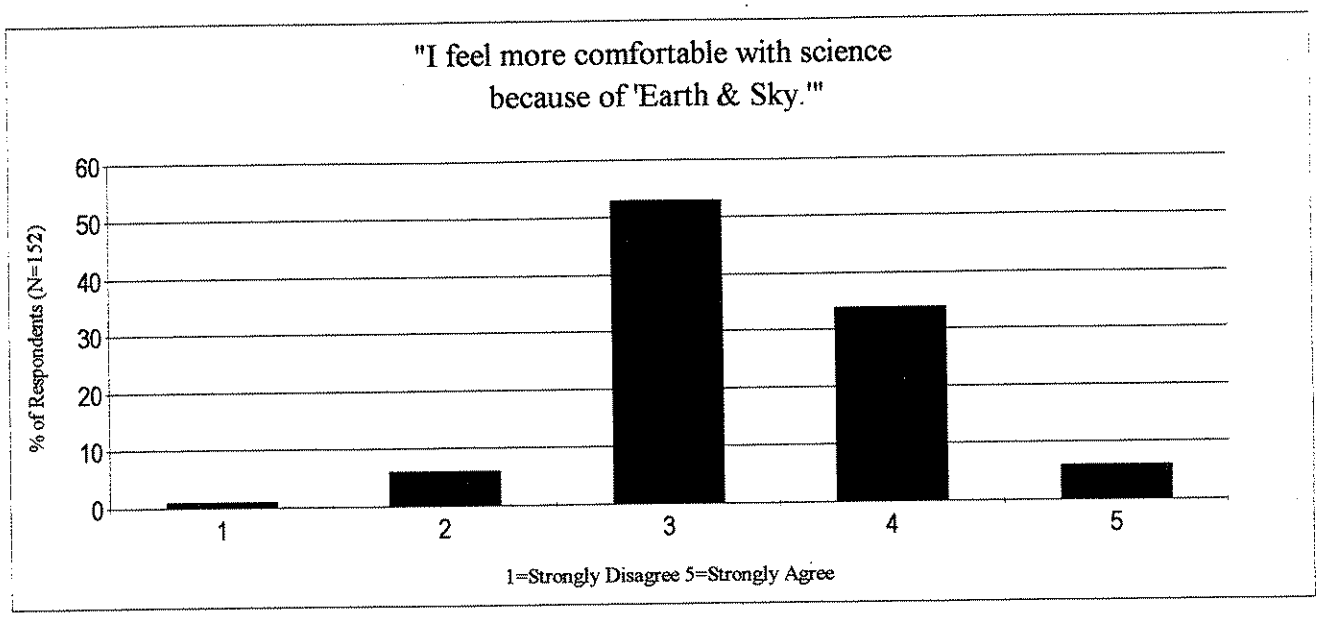
As a further assessment of appeal and interest, the survey included a statement to assess whether the content is presented at a comprehensible level. The majority of listeners (84%) disagreed or strongly disagreed with the statement, "The information on *Earth & Sky* is too technical for me." Refer to following graph. The mean rating was 1.7 (SD=.89). There were no significant relationships with demographic or background variables.

Agreement with Statement:



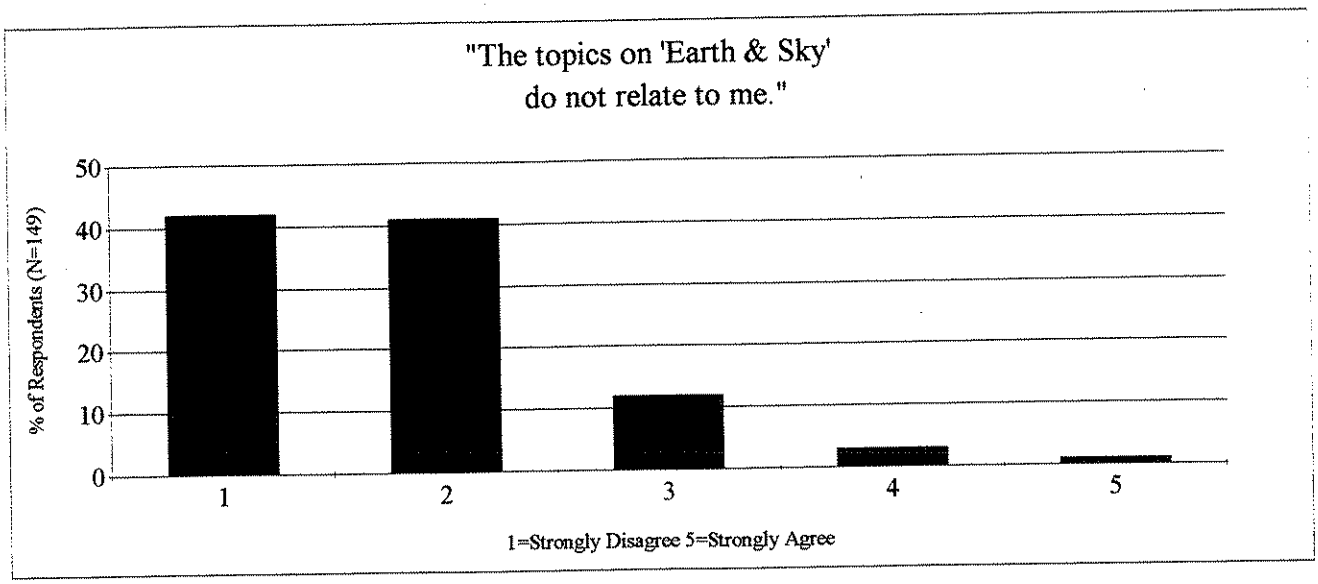
The survey included three statements aimed at listeners' feelings about science as a result of listening to *Earth & Sky*. In response to the statement, "I feel more comfortable with science because of *Earth & Sky*", over half (53%) reported that the program has no effect on their feelings but 40% agreed or strongly agreed with this statement. The mean rating was 3.4 (SD=.74). Those who reported feeling more comfortable with science because of *Earth & Sky* also felt that they "expanded their knowledge of science" (r =.40, p <.001) and that "listening to the series has affected the way they look at the night sky" (r =.32, p <.001). Listeners with a high-school level education or less had a mean rating that was significantly higher than those listeners with post-college education (M=3.6, SD=.76 vs. M=3.0, SD=.74, p < .04, respectively). No other significant relationships were found between this statement and demographic or background variables.

Agreement with Statement:



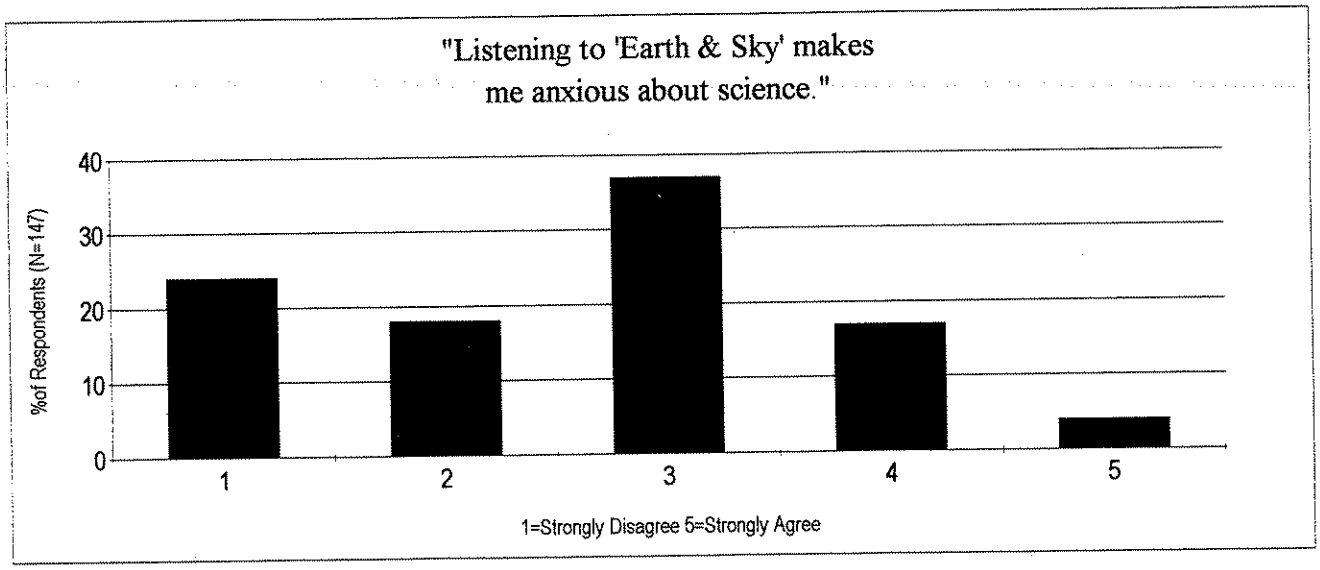
A majority of respondents (83%) strongly disagreed or disagreed with the statement that the topics on *Earth & Sky* did not relate to them. The mean rating for this statement was 1.8 (SD=.88). The more listeners disagreed with this statement, the more they reported "enjoying the program" ($r = -.46$, $p < .001$). Also, listeners who felt the topics did not relate to them also felt "the information was too technical" for them ($r = .43$, $p < .001$). Listeners with a high-school level education or lower had a mean rating that was significantly higher than listeners with some college education (M=2.0, SD=.99 vs. M=1.6, SD=.70, $p < .03$, respectively). No other significant differences in demographic and background variables were noted.

Agreement with Statement:



People were asked to respond to the statement, "Listening to *Earth & Sky* makes me anxious about science." Forty-two percent either strongly disagreed or disagreed with this statement; 37% felt the series neither made them more or less anxious about science and 21% agreed or strongly agreed. The average rating was 2.6 (SD=1.2). No differences between demographic or background variables and this statement were found.

Agreement with Statement:



The following is a profile of the group of listeners who felt anxious: the mean age was 46 years, 42% were female, 37% had a high-school level education or less, 77% were unskilled, 54% took further action related to a program topic.

In response to the open-ended question asking listeners how they feel about *Earth & Sky*, a majority of respondents wrote positive remarks. The responses were divided into several categories depending on the content of the remark. Over one-third (35%) wrote comments that reflected their feeling that for them the series was either "informative/informational or educational in nature". Another third (31%) said that they felt the program was "interesting", while one quarter commented that they felt it was "enjoyable". A few (4%) gave suggestions on "ways to improve the show", 2% had "neutral" comments and less than 3% wrote "negative reviews of *Earth & Sky*".

Some examples of responses to the open-ended questions include:

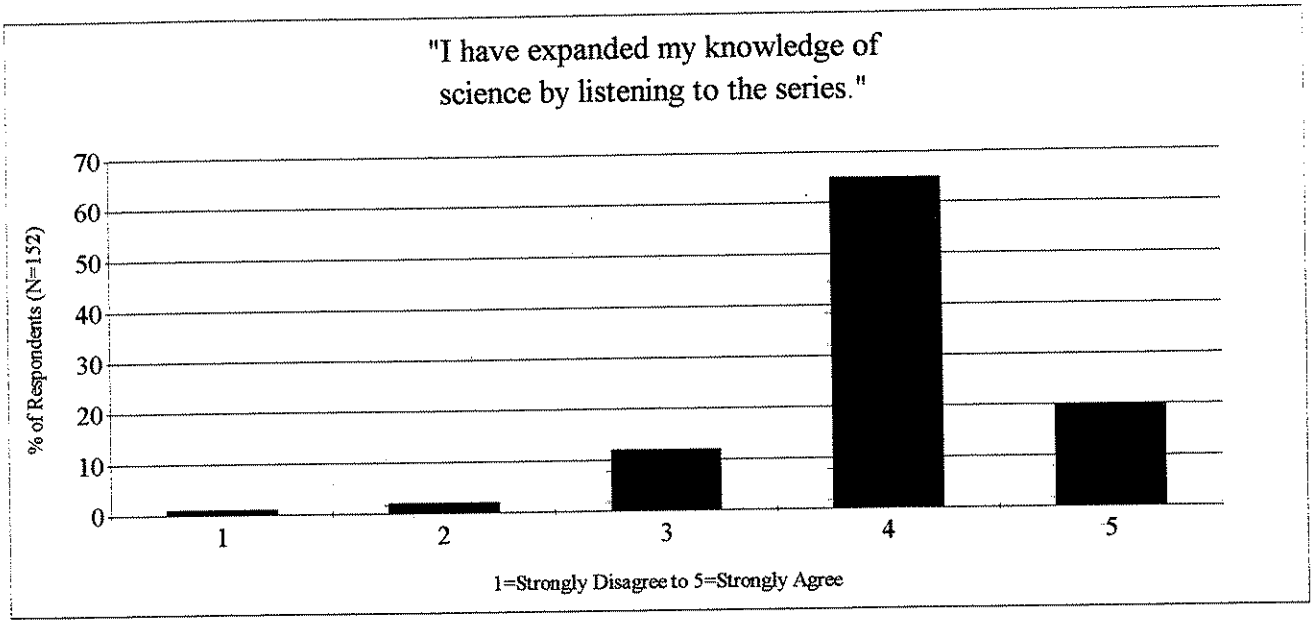
> "Excellent source of information."
>
> "They give a great amount of information in a very limited time frame."
>
> "I really like this show. Off-beat yet informative and it's cool to hear people ask their own questions."
>
> "Informative show, easy to listen to and comprehend. Educational interjection into one's day."
>
> "I really enjoy it. It's a great format and the 2 minute time frame is convenient. It fits into most people's schedules and suits our society's short attention span."
>
> "I find the information very informative, educational and interesting."
>
> "Very interesting, though some of the environmental information is not necessarily accurate."
>
> "I don't look forward to it but listen carefully when it's on."

Impact of *Earth & Sky* on Listeners

Learning Science from *Earth and Sky*.

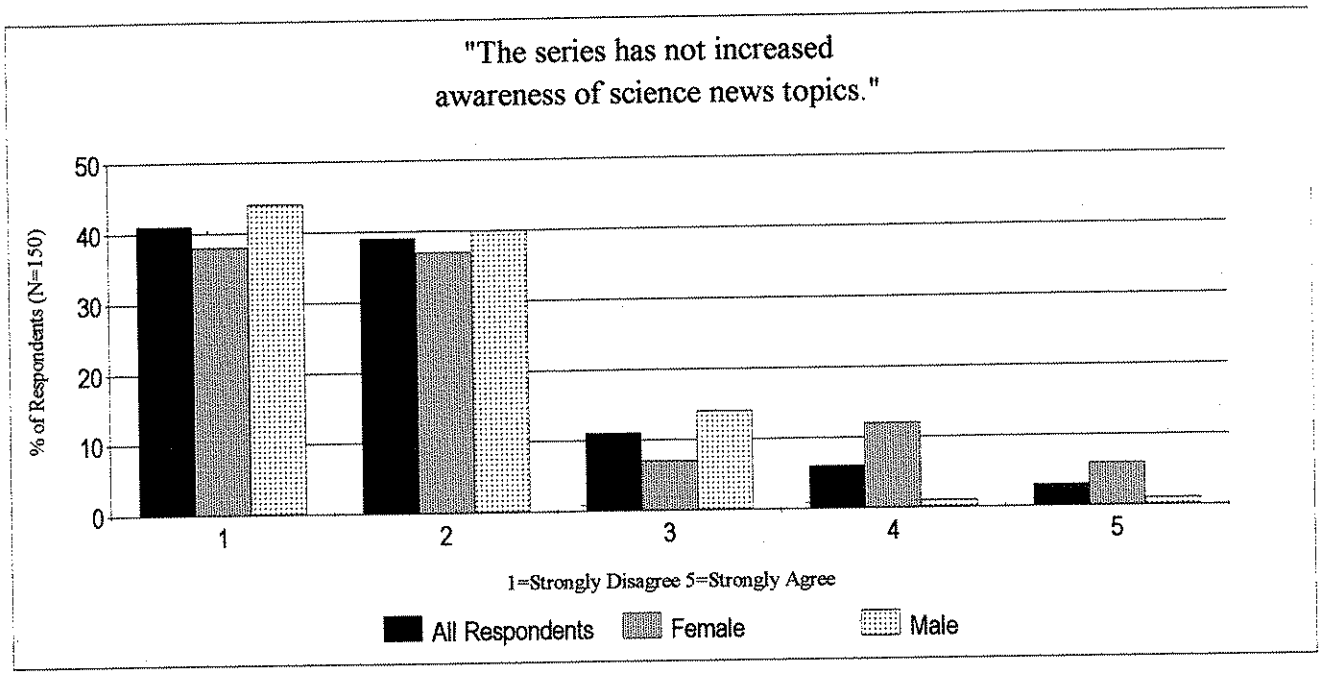
Several statements were included in the survey to evaluate whether listeners felt that the series affected their knowledge about science. Almost all (85%) agreed or strongly agreed that they "expanded their knowledge of science by listening to the series" (see following graph). The mean rating for this statement was 4.0 (SD=.72). The more listeners agreed that they had "expanded their knowledge of science", the more they: "enjoyed listening to the series" ($r = .45$, $p < .001$), felt the series "affected the way they look at the night sky" ($r = .33$, $p < .001$), and felt "more comfortable with science because of *Earth & Sky*" ($r = .40$, $p < .001$). No differences between demographic and background variables and this statement were found.

Agreement with Statement:



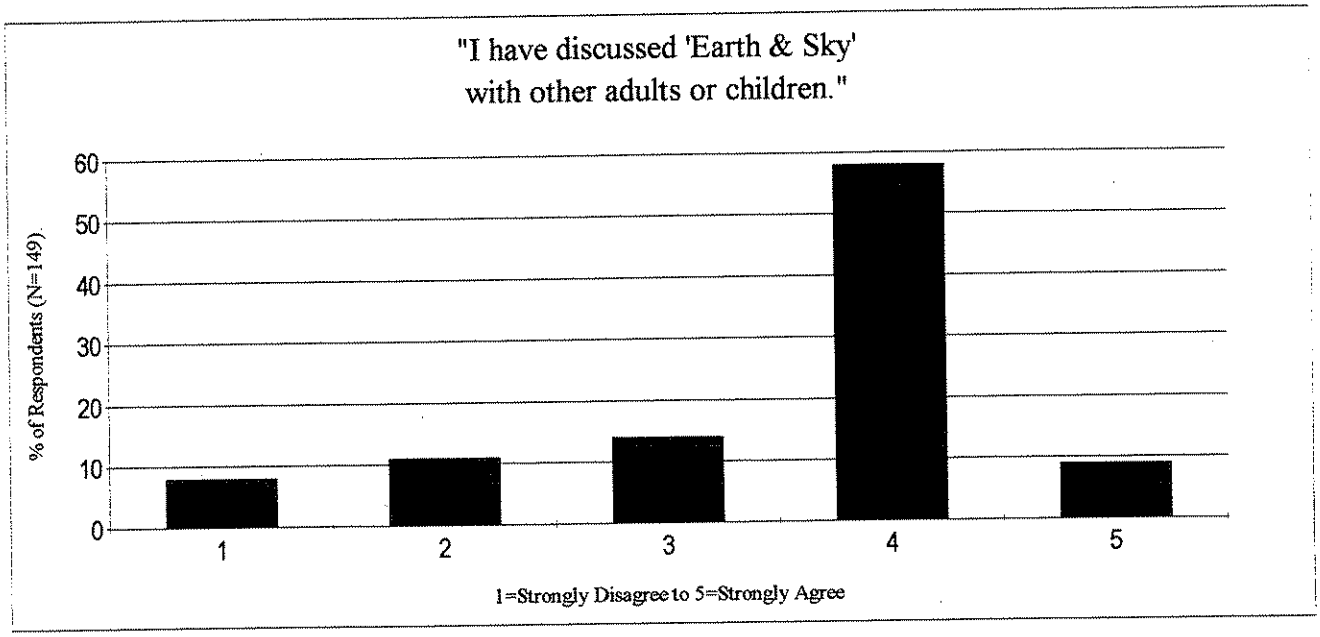
Over three-quarters (79%) of listeners disagreed or strongly disagreed with the statement, "the series has not increased my awareness of science news topics" (see graph below). The more a person "enjoyed listening to the series", the more they disagreed with this statement ($r = -.39$, $p < .001$). The women's mean rating of agreement was significantly higher than men's (2.1 vs. 1.8, $p < .05$, respectively). Besides differences in gender, no other significant differences were noted amongst the demographic and background variables and this statement.

Agreement with Statement:



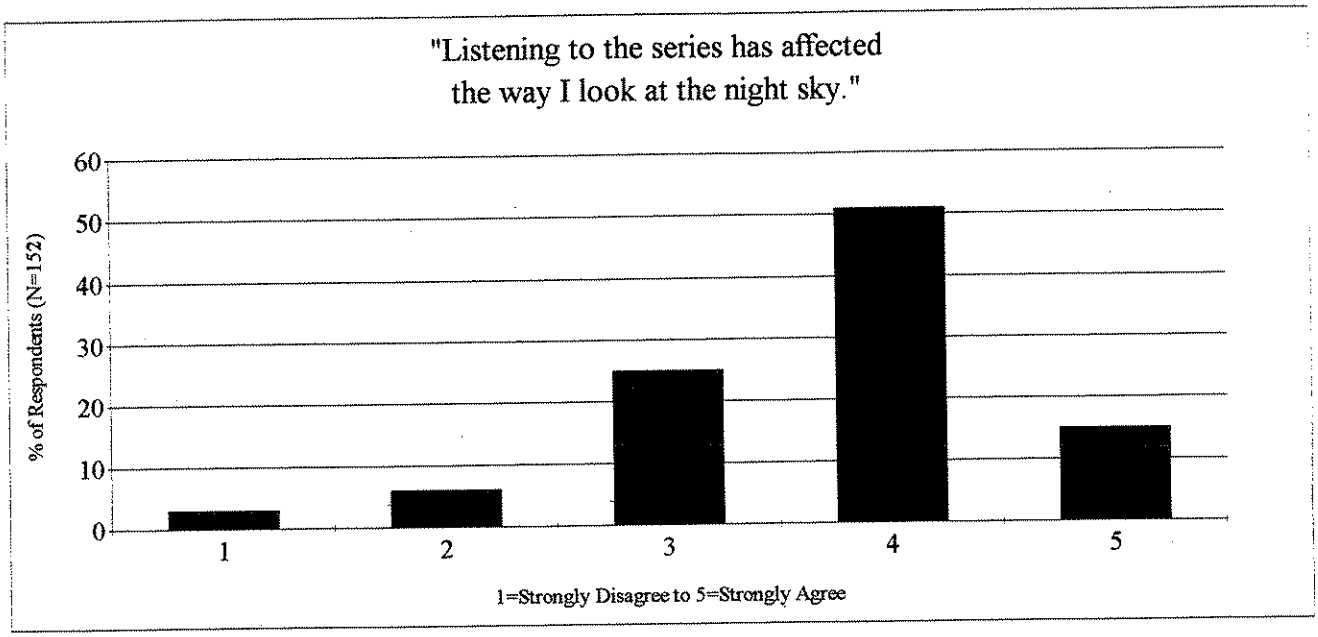
Approximately two-thirds of the listeners (67%) strongly agreed or agreed that they had "discussed *Earth & Sky* topics with other adults or children" (see following graph). The stronger a person felt about this statement, the more likely they were to feel they "expanded their knowledge of science by listening to the series" ($r = .31$, $p < .001$) and the more they seemed to "enjoy listening" to the program ($r = .49$, $p < .001$). The mean rating for this statement was 3.5 (SD=1.1). No differences amongst the demographic and background variables and this statement were found.

Agreement with Statement:

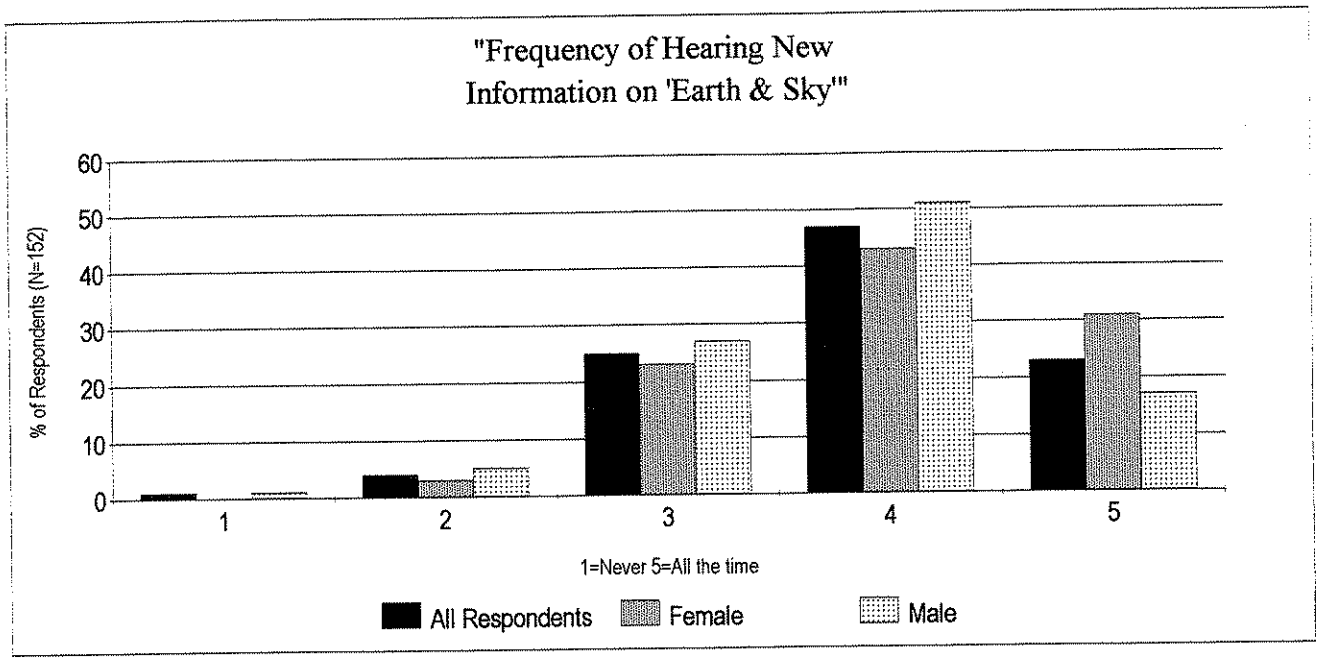


Two-thirds of listeners (66%) felt that the series affected the way they look at the night sky (see graph below). The mean rating for this statement was 3.7 (SD=.89). Those who felt this way were also more likely to "discuss *Earth & Sky* with other adults or children" ($r = .38$, $p < .001$), "perk up and pay attention when the series comes on the radio" ($r = .33$, $p < .001$), and feel they "expanded their science knowledge by listening to the series" ($r = .33$, $p < .001$). There were no significant differences between demographic and background variables and this statement.

Agreement with Statement:



In addition, 70% of listeners reported that they frequently hear new information on *Earth & Sky* (endorsed a 4 or 5 on the 5-point scale). The average rating for this statement was 3.9 (SD=.83). Also, women significantly more than men reported hearing new information on *Earth & Sky* (M=4.0, SD=.82 vs. M=3.8, SD=.84, $p < .05$, respectively). Listeners with full-time employment reported hearing new information significantly more often than those with part-time employment (M=4.0, SD=.79 vs. M=3.6, SD=.85, $p < .03$, respectively). Those with low perceived science knowledge had a significantly higher mean rating for this statement compared to listeners with a high perceived level of science knowledge (M=4.1, SD=.9 vs. M=3.7, SD=.8, $p < .002$, respectively). No other significant relationships between demographic and background variables, and hearing new information were found.



Listeners were asked to indicate whether they had learned from listening to *Earth & Sky* by circling "YES" or "NO". Almost all listeners (97%) circled YES, indicating that they had learned from listening to the series. When asked in an open-ended question to recall what they had learned, 59% of the listening sample answered this question and wrote down one or more specific topics from a program they heard. The topics were coded according to five categories representing the different areas of science presented in the program. Astronomy topics were most frequently mentioned (65%), followed by oceanography (8%), meteorology (7%), environmental science (6%), geology (5%), and other (9%). The "other" category refers to a response unrelated to science content.

Some examples reported by listeners include:

"...when some planet was going to be, where and when to view the latest lunar eclipse."

"...seasonal planet locations, asteroid showers and time and location."

"...mostly about astronomy, where stars are , looking for new phases, ice when planets are visible."

"...how time differs on other planets. That other planets have different speeds at which they rotate therefore their having shorter or longer days and year etc."

"...dolphins and how they identify their babies by sound and not smell."

"...when meteorite showers occur, why eclipses are happening."

"...where birds go during a hurricane."

"I particularly like the spots about cleaning up and keeping up our environment and discuss these topics with family and friends. We have had several community projects as a result of our discussions."

Some people did not write details of information they learned but indicated that listening to the series has had a positive influence on them, for example:

"I always learn something new."

"At this time I can't give you an example. The series has always reminded me of things that I had learned in my formal education."

"I've learned something from each *Earth & Sky*. Too numerous to recall now."

Thinking about *Earth & Sky* Information at a Later Date

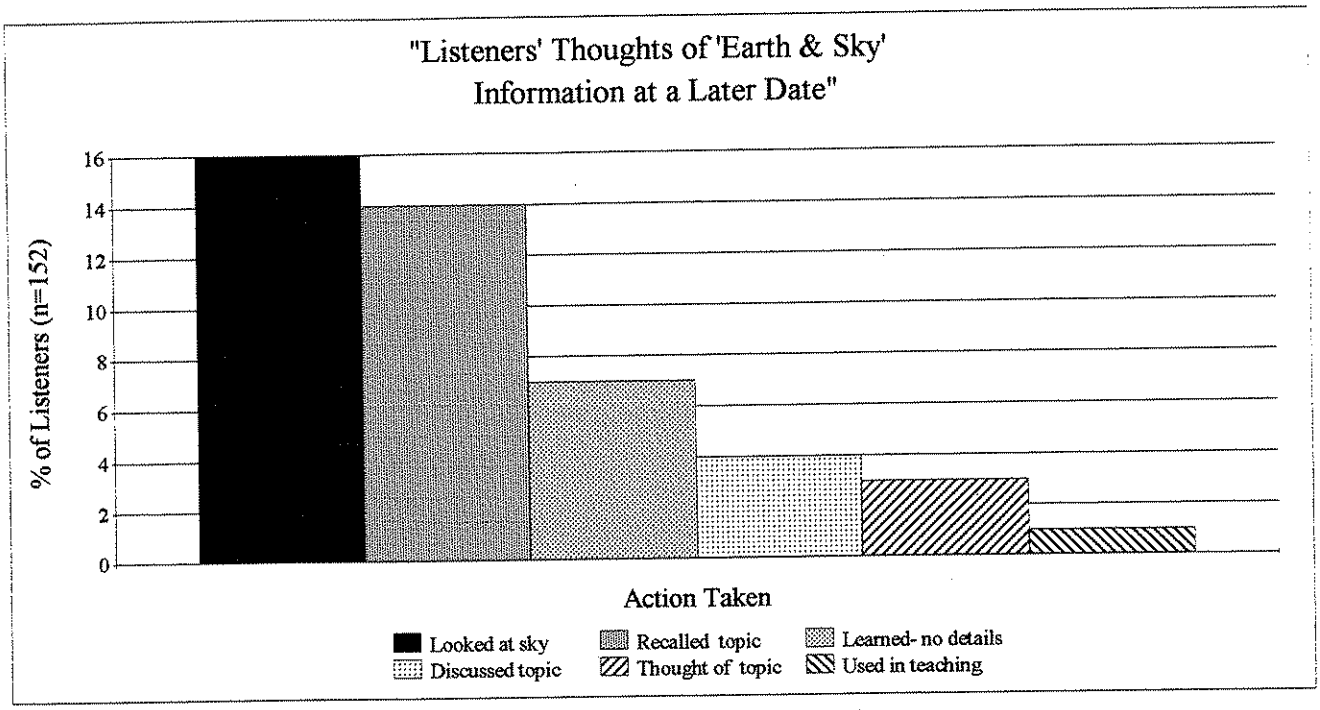
When asked if they had thought about the information presented on *Earth & Sky* at a later date, 81% of listeners reported that they had (percentage calculated from those that circled YES in relation to those who answered the question). Listeners who reported thinking about information at a later date (n=114) were compared to those who did not (n=27). A profile of those listeners who thought about information was created. As a group: the mean age was 42.9 years, 48% were female, 71% were employed, 93% were white and 53% held "high" status or professional jobs. The significant differences found between these two groups of listeners are presented in Table 3. No differences were found with regard to any demographic variables.

Table 3. Comparison between Listeners who Thought about Information at a Later Date and Those who Did Not

Statements	Mean(SD) for listeners who thought about information (n=114)	Mean(SD) for listeners who did not think about information (n=27)	Significance Level
I feel more comfortable with science because of Earth & Sky.	3.5 (.69)	3.0 (.81)	$p < .005$
I have expanded my knowledge of science by listening to the series.	4.1 (.61)	3.6 (.75)	$p < .001$
The topics on Earth & Sky do not relate to me.	1.6 (.74)	2.4 (1.0)	$p < .001$
Listening to the series has affected the way I look at the night sky.	3.9 (.76)	3.0 (.98)	$p < .001$
I have discussed Earth & Sky topics with other adults or children.	3.7 (.91)	2.4 (1.0)	$p < .0001$
The information on Earth & Sky is too technical for me.	1.7 (.82)	2.2 (1.1)	$p < .005$
I perk up and pay attention when I hear the series come on the radio.	4.4 (.76)	3.4 (.89)	$p < .001$
I enjoy listening to the series, Earth & Sky.	4.6 (.54)	3.8 (.80)	$p < .001$
The series has not increased my awareness of science news topics.	1.7 (.84)	2.7 (1.0)	$p < .001$
Knowledge of Environmental Science	3.0 (.99)	2.4 (.94)	$p < .002$
Knowledge of Geology	2.8 (.98)	2.3 (1.1)	$p < .02$
Summated Science Knowledge Score	8.3 (3.5)	6.2 (3.3)	$p < .002$

Significant differences were also found in the two groups' sources of science information. Listeners who did not think about program topics at a later reported "never" receiving science information from the following sources more than listeners who thought about topics: books (42% vs. 20%), newspapers (20% vs. 5%) and informal talks with people (38% vs. 12%).

When asked to be specific about their reflections, 45% of listeners wrote something, as indicated in the following graph. Sixteen percent of the entire sample wrote that they recalled looking at the stars or night sky and 14% wrote down a specific topic that they remembered.



The following represent typical responses of listeners' reflections:

"Try to visualize the motion orbits, etc. of planets and how they interact."

"Try to find out more information on comets."

"...tidbits pop into my head when camping and star gazing."

"Found myself looking for the comet, on clear nights."

" I sometimes notice the same information that I have already heard on *Earth & Sky* in other places more in depth."
"...where birds go during a hurricane - very interesting subject."

"Nothing specific. I just reflect on information given to process the logistics of it."

" I have often discussed *Earth & Sky* topics at a later date with friends."

"When someone is talking about a subject I sometimes know what they are

talking about or have an answer to a question because of it."

"I often don't remember topics off the top of my head. But if I hear just the topic again then I begin to recall all of the information I learned."

Taking Further Action Related to a Program Topic

To assess whether listening to *Earth & Sky* had a more action-oriented effect, listeners were asked in an open-ended question whether the series ever prompted them to take further action related to a program topic. Over one-third (39%) responded affirmatively (percentage calculated from those that circled YES in relation to those that answered the question). The profile for this group was as follows: the mean age was 41.8 years, 46% were female, 65% were employed, 91% were white, and 51% had high status or professional jobs. Those who took further action were compared to the group who did not. Table 4 presents the significant results from this comparison. No demographic differences were found between the two groups.

Table 4. Comparison Between Listeners who Took Further Action and Those who Did Not

Statements	Mean(SD) for listeners who took further action (n=55)	Mean(SD) for listeners who did not take further action (n=86)	Significance Level
I have expanded my knowledge of science by listening to the series.	4.2 (.63)	3.9 (.76)	$p < .04$
Listening to the series has affected the way I look at the night sky.	4.1 (.79)	3.5 (.91)	$p < .001$
I have discussed Earth & Sky topics with other adults or children.	4.0 (.56)	3.1 (1.2)	$p < .0001$
I perk up and pay attention when I hear the series come on the radio.	4.5 (.69)	4.0 (.93)	$p < .001$
I enjoy listening to the series, Earth & Sky.	4.7 (.49)	4.3 (.79)	$p < .001$
The series has not increased my awareness of science news topics.	1.6 (.92)	2.1 (1.1)	$p < .009$
Interest in Science	4.3 (.67)	3.8 (.80)	$p < .001$
Knowledge of Environmental Science	3.1 (1.1)	2.8 (.95)	$p < .04$
Knowledge of Geology	2.9 (.98)	2.5 (1.0)	$p < .03$
Knowledge of Meteorology	2.6 (.99)	2.1 (.91)	$p < .002$
Summated Science Knowledge Score	9.0 (3.7)	7.2 (3.3)	$p < .004$

Significant differences were also found in the two groups' sources of science information. Listeners who did not take action in relation to a program topic reported "never" receiving science information from the following sources more than listeners who took action: books (32% vs. 13%), magazines (17% vs. 6%). They also "regularly" received science information from informal talks with people less often (7% vs. 24%).

Looking at the stars or night sky was the most popular action taken (17%), see Table 5. At least 1% or more of the listeners bought, borrowed, or used a telescope or binoculars to view the sky, discussed a series topic with someone, bought an item related to a program topic, read related information, or bought a book on a related topic.

Table 5. Action Taken after Listening to *Earth & Sky*

Action Taken	Frequency (No. of Listeners)	Percentage (%)
No Action Taken	109	72%
Looked at sky	26	17%
Bought related material	5	3%
Discussed topic	3	2%
Bought/borrowed telescope	3	1%
Read related material	2	1%
Program topic mentioned	2	1%
Planetarium visit	1	<1%
Library visit	1	<1%

Some examples of actions taken by listeners include:

"To step outside at night and say LOOK! There it is!"

"I once drove out of the city to get away from lights so I could identify a very large comet that was the subject on your show."

"I have purchased the National Autobahn Society field guide to the night sky. Listening to different topics on the show often peeks my interest to investigate further and I do so by delving into my field guide."

"To order books on the subjects covered on the program."

"Read in newspaper about comet Hale Bopp. Look for science section in Sunday paper."

"I attended a lecture on the Hubbell telescope."

"I believe that *Earth & Sky* was instrumental in the decision to purchase a used telescope. In our busy hectic world, *Earth & Sky* reminds us to go out and enjoy our plant. To take advantage of what it has to offer and to not abuse our resources."

"Read Sagan's 'Demon Haunted World'."

Additional Comments

The survey included space for the respondent to add any other feedback about *Earth & Sky*. Of the whole sample, 23% wrote in the space provided. Of the comments received, 61% were positive, 4% were neutral, and 35% were suggestions. The following are typical of the "positive" feedback received:

> "This is a fun and informational program that I enjoy very much at the time and reflect on at later times. Thank you."
>
> " I enjoy the program it has clarified very simple topics, things that we hear all the time but don't really understand. Keep up the good work."
>
> "I am always interested to hear a new *Earth & Sky* segment and I would miss the program if I could not hear it again."

Typical "suggestion" comments are:

> "I'd like to see *Earth & Sky* expanded to 15-30 minutes, at least."
>
> "Please get more simple to understand, and stick to every day popular subjects."
>
> "*Earth & Sky* could be quite good. Don't worry about appealing to the most ignorant, since they aren't listening anyway, don't spend time on basic definitions instead, devote your efforts more towards explaining science to intelligent, thoughtful lay person."

Comparison with Public Radio Listeners

The results from the present study of commercial radio listeners were compared to those found in the study of public radio listeners in San Bernardino, California. In the latter study, conducted in 1994, 255 surveys were received by those who listened to *Earth & Sky*. The names were obtained from a list of public radio members for that particular radio station. A random sample was selected, and a survey, similar to the one used in the present study, was mailed out. Only one mailing was included in that study.

When the results from both studies were compared and analyzed, several differences were found. All the following differences were at the $p<.01$ level of significance. The mean age for commercial radio listeners were younger than the public radio sample (M=43, SD=14.5 vs. M=52, SD=13.5). There were also more unemployed people in the present sample, but more retired listeners in the California sample. Significant differences between the two samples were found in educational backgrounds. The public radio listeners completed a much higher level of education compared to commercial radio listeners.

Commercial radio listeners' interest in science was less than that found for listeners of public radio (M=3.9, SD=.81 vs. M=4.3, SD=.7). Listeners of commercial radio had lower perceived knowledge in astronomy (M=2.6, SD=.92 vs. M=2.8, SD=.86) and meteorology (M=2.3, SD=.98 vs. M=2.6, SD=.93), compared to public radio listeners of *Earth & Sky*. The samples also differed in their sources of science information. Significantly more commercial radio listeners reported "never" obtaining science information from books, magazines, and museums than public radio listeners. Commercial radio listeners also reported that they "regularly" receive science information from the radio more often, and less often from newspapers, compared to public radio listeners.

Although commercial and public radio listeners differed in some of the demographic and background variables, the comparison revealed only two differences in the impact of *Earth & Sky* on the samples. Compared with public radio listeners, the commercial radio sample agreed significantly less that they "expanded their knowledge of science" by listening to the series (M=4, SD=.72 vs. M=4.2, SD=.68) and agreed significantly more that the "information on *Earth & Sky* was too technical" for them (M=1.8, SD=.89 vs. M=1.5, SD=.74).

No other significant differences were found between the two sample with regards to demographic or background variables, and the appeal or impact of *Earth & Sky*.

SUMMARY & DISCUSSION

The goals of the radio series *Earth & Sky* are to make science accessible and interesting to the listening audience and to generate excitement and curiosity about science. The results of this evaluation demonstrate that these goals are being met for commercial radio listeners around the country. The program was found to be highly appealing, educational and enjoyable to listeners regardless of age, gender, educational background, interest in science or perceived science knowledge. A minimum of one show was heard by at least 94% of the listeners during two weeks prior to completing the survey, and 59% of the listeners estimated hearing five or more programs in that period.

Almost all listeners reported they "enjoyed listening" to *Earth & Sky* (91%) and that they "perk up and pay attention" when they hear the program (83%). In an open ended statement, 91% of listeners described the program as either "interesting," "informative/educational", or "enjoyable." Not only did listeners like *Earth & Sky*, the majority of listeners also felt that listening expanded their knowledge of science (85%), the content was presented at an acceptable technical level (84%), the program increased their awareness of science news topics (79%), and affected the way they looked at the night sky (66%). The more listeners enjoyed *Earth & Sky*, the more they reported that the program had expanded their knowledge of science.

One of the most unanimous results found was that almost all listeners (97%) reported that they had learned something from listening to *Earth & Sky*. Almost one-quarter of listeners reported that they hear new information "all the time" on *Earth & Sky*. Listeners also recalled some of the information they learned from listening to the program and most frequently mentioned learning about astronomy.

Finally, 81% of listeners reported that they thought about the *Earth & Sky* information at a later date, and over one-third (39%) agreed that the series had prompted them to take further action related to a program topic. The most common action taken was to observe the night sky. Two-thirds reported discussing program topics with other adults or children. Those that thought about the program and took action at a later date had higher perceived science knowledge scores than listeners who did not engage in these behaviors. Listeners who took action had a greater interest in science compared to listeners who took no action. No other demographic or background characteristics related to the behaviors mentioned above were found.

When results from this study were compared to those in a previous study of public radio listeners, few meaningful differences were found, despite the fact that public radio listeners were older, better educated, had a higher interest in science, and a great percentage were employed full-time. Despite these differences, the series had a similar positive effect on listeners from both commercial and public radio stations across the country. Both sample audiences reported enjoying the series, learning science from it and engaging in some activity after hearing program topics.

The results of this study demonstrate that *Earth & Sky* has a significant impact on listeners. Few demographic or background variables seemed to impact whether listeners enjoyed the program or learned from it. However, some effects of gender and educational level were noted. Women reported hearing new information more frequently than men and reported a lower estimated science knowledge, and lower interest in science. The program was also able to reach those with less education. Listeners with a high-school level education or less reported feeling more comfortable with science because of the series compared to those with post-college education.

Overall, this study found that commercial radio listeners in seven states found *Earth & Sky* to be very enjoyable, educational and accessible. Although only 90-seconds in length, those who hear the program enjoy it, learn from it and think about information presented at a later date.

APPENDIX

The National Science Foundation (NSF) is sponsoring a study of people's media habits. The results of this survey will help decide how your tax dollars are spent in the future. Returning your survey is essential, and all information will be kept strictly confidential. Please take a few moments to complete this survey, and then fold, tape, and mail it as soon as possible.

1. What is your gender? (Circle your answer.) Female Male 2. What is your age? ____ years

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

4. Are you? (Circle.) White Black Hispanic Asian Mixed Other

5. Are you? (Circle.) Employed (Full/part-time) Unemployed Homemaker Retired Student

   If employed, what kind of work do you do? _____

6. Generally speaking, how interested are you in science? (Circle one number).

Not at all Interested		Neutral		Very Interested
1	2	3	4	5

7. How often do you get science information from the sources listed below? (Circle one answer for each source.)

• Television	Never	Sometimes	Regularly
• Radio	Never	Sometimes	Regularly
• Newspapers	Never	Sometimes	Regularly
• Magazines or Journals	Never	Sometimes	Regularly
• Books	Never	Sometimes	Regularly
• Science museums	Never	Sometimes	Regularly
• Informal talks with people	Never	Sometimes	Regularly

8. Circle one number that tells how much you know about each of the following areas of science.

	Know Nothing				Know a Great Deal
• Astronomy	1	2	3	4	5
• Geology	1	2	3	4	5
• Meteorology	1	2	3	4	5
• Oceanography	1	2	3	4	5
• Environmental Science	1	2	3	4	5

9. Have you ever listened to the two-minute radio series, *Earth & Sky*? (Circle.) Yes No

   If you answered no, thank you for your cooperation and please fold, tape, and return this survey.

   If you answered yes, please continue to complete this survey.

10. About how many times in the past two weeks have you listened to *Earth & Sky?* _____

11. Overall, how do you feel about *Earth & Sky* ?

12. Indicate how much you agree or disagree with each of the following statements by circling one number .

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
• I feel more comfortable with science because of *Earth & Sky*.	1	2	3	4	5
• I have expanded my knowledge of science by listening to the series.	1	2	3	4	5
• The topics on *Earth & Sky* do not relate to me.	1	2	3	4	5
• Listening to the series has affected the way I look at the night sky.	1	2	3	4	5
• I have discussed *Earth & Sky* topics with other adults or children.	1	2	3	4	5
• The information on *Earth & Sky* is too technical for me.	1	2	3	4	5
• I perk up and pay attention when I hear the series come on the radio.	1	2	3	4	5
• Listening to *Earth & Sky* makes me anxious about science.	1	2	3	4	5
• I enjoy listening to the series, *Earth & Sky*.	1	2	3	4	5
• The series has not increased my awareness of science news topics.	1	2	3	4	5

13. Generally speaking, how frequently do you hear information on *Earth & Sky* that is new to you? (Circle.)

Never				All the time
1	2	3	4	5

14. Have you learned anything from listening to *Earth & Sky*? (Circle.) Yes No
If you answered yes, please give example(s) of what you have learned.

15. Have you ever thought about information presented on *Earth & Sky* at a later date? (Circle.) Yes No
If you answered yes, please give example(s) of your reflections on the *Earth & Sky* information.

16. Has listening to the series ever prompted you to take further action related to a program topic? Yes No
If you answered yes, please give example(s) of what further action you have taken related to a topic.

Thank you for your assistance! On the back of this survey, please add any other feedback about *Earth & Sky*.

The National Science Foundation (NSF) is sponsoring a study of people's media habits. The results of this survey will help determine how your tax dollars are spent in the future. Returning your survey is essential, because only a small random sample has been chosen. All information will be kept strictly confidential. Please take a few moments to complete this survey, and then fold, tape, and mail it as soon as possible.

1. What is your gender? (Circle your answer.) Female Male 2. What is your age? ___ years

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

4. What is your ethnic background? (Circle.) White Black Hispanic Asian Other

5. What is your main occupational status? (Circle.) Employed Unemployed Homemaker Retired Student

   If employed, what kind of work do you do? _____

6. Generally speaking, how interested are you in science? (Circle one number).

Not at all Interested		Neutral		Very Interested
1	2	3	4	5

7. How often do you receive science information from the sources listed below? (Circle one answer for each source.)

• Television	Never	Sometimes	Regularly
• Radio	Never	Sometimes	Regularly
• Newspapers	Never	Sometimes	Regularly
• Magazines or Journals	Never	Sometimes	Regularly
• Books	Never	Sometimes	Regularly
• Science museums	Never	Sometimes	Regularly
• Informal talks with people	Never	Sometimes	Regularly

8. Rate your level of knowledge in the following areas of science. (Circle one number for each area.)

	Know Nothing				Know a Great Deal
• Astronomy	1	2	3	4	5
• Geology	1	2	3	4	5
• Meteorology	1	2	3	4	5
• Oceanography	1	2	3	4	5

9. Indicate how much you agree or disagree with each of the following statements by circling one number.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
• Science can be understood and enjoyed on some level by everyone.	1	2	3	4	5
• The growth of science means a small group of people could control our lives.	1	2	3	4	5
• Science reveals much that is beautiful and wondrous about the universe.	1	2	3	4	5
• Most people are not able to comprehend the work of science because it is very complex.	1	2	3	4	5
• Exploration of oceans and of space have the potential to reveal the truth about the universe.	1	2	3	4	5
• I am comfortable learning about science.	1	2	3	4	5
• One of the bad effects of science is that it challenges people's ideas of morality and spirituality.	1	2	3	4	5
• Science is so difficult that only highly trained people can understand it.	1	2	3	4	5
• Science is making our lives healthier, easier and more comfortable.	1	2	3	4	5

10. Have you ever heard of the public broadcasting radio series, *Earth & Sky*? (Circle) Yes No
If you answered no, thank you for your cooperation and please fold, tape, and return this survey.
If you answered yes, please continue answering the following questions:

11. Have you ever listened to the public broadcasting radio series, *Earth & Sky*? (Circle) Yes No
If you answered no, thank you for your cooperation and please fold, tape, and return this survey.
If you answered yes, please continue answering the following questions:

12. About how long ago would you say you first started listening to *Earth & Sky*? ___ years ___ months

13. About how many times in the past two weeks have you listened to *Earth & Sky?* _____

14. Indicate how much you agree or disagree with each of the following statements by circling one number .

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
• I enjoy listening to the series, *Earth & Sky.*	1	2	3	4	5
• The information on *Earth & Sky* is too technical for me.	1	2	3	4	5
• I perk up and pay attention when I hear the series come on the radio.	1	2	3	4	5
• I have expanded my knowledge of science by listening to the series.	1	2	3	4	5
• Listening to the series has affected the way I look at the night sky.	1	2	3	4	5
• The series has not increased my awareness of science news topics.	1	2	3	4	5
• I have discussed *Earth & Sky* topics with other adults or children.	1	2	3	4	5

	Never				All the time
15. Generally speaking, how frequently do you hear information on *Earth & Sky* that is new to you? (Circle)	1	2	3	4	5

16. Have you learned anything from listening to *Earth & Sky*? (Circle) Yes No
If you answered yes, please give example(s) of what you have learned

17. Have you ever thought about information presented on *Earth & Sky* at a later date? (Circle) Yes No
If you answered yes, please give example(s) of your reflections on the *Earth & Sky* information.

18. Has listening to the series ever prompted you to take further action related to a program topic? Yes No
If you answered yes, please give example(s) of what further action you have taken related to a topic.

19. If you could have a question answered on *Earth & Sky*, what would you ask?

Thank you for your assistance! On the back of this survey, please add any other feedback about *Earth & Sky.*