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Talk of the Nation: Science Friday
Summative Evaluation
Study 2

Report for
Samanna Productions
National Public Radio

by
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Talk of the Nation: Science Friday (*SF*) is a weekly two-hour listener call-in talk show devoted to the understanding of complex scientific topics and methods. The series is hosted by science correspondent Ira Flatow and broadcast on National Public Radio to 200 stations nationwide as well as via satellite and the Internet. With support from the National Science Foundation, Multimedia Research presents the second study of a two-part summative evaluation on the impact of *Science Friday* on public radio listeners, focusing on the series' increased emphasis on public understanding of basic research.

The evaluation assessed what demographic or background characteristics relate to whether or not one listens to *SF* and to frequency of listening; what effects the series has on listeners and what kind of actions the series has prompted in listeners. A comparison was also made results of this study and the first study carried out in 2003. Questionnaires were mailed to random names drawn from member subscriber lists of public radio stations serving the areas surrounding Denver, CO, San Antonio, TX and Boston, MA. Of the 1200 questionnaires that adult public radio members received, 641 or 53% were returned for analysis. Given that 2.1 million listeners contribute to public radio according to CPB revenue report data and that there are about 21 million listeners according to Arbitron estimates, our contributor lists represent about 10% of the listening audience. Thus, we can generalize our results to all subscribers and to about 10% of the total public radio audience.

Who are Listeners of *Science Friday?*
Three-quarters of respondents report listening to *Science Friday*. Six of ten respondents tune into the series once per month or more often. Just 15% of respondents listen every week.

Our respondent sample is typical of a public radio member audience – more educated, better employed, older with fewer minorities compared to the general U.S. adult population. No demographic variable is significantly associated with listening behavior.

Compared with non-listeners, listeners of *Science Friday* rate themselves as significantly more interested in science generally and significantly more knowledgeable about science. In these differences, the effect size is moderate.

Major sources of science news include "radio" (55%), "magazines/journals" (44%) and "newspapers" (36%). Radio is chosen as a major source of science news by significantly more *SF* listeners (63%) than non-listeners (29%). This is a moderately strong association.

Beliefs About Science Research
Listeners agree significantly more than non-listeners with one of eight belief statements about science research:
> "It is important for me to understand the process of scientific discovery."

Listening to *Science Friday* is not related to respondents' thinking about the value of basic research. Explanations of the value or importance of basic research discuss basic research as the foundation of science (29%), as leading to discoveries or applications (14%), as a requirement for understanding our world (13%) and as enhancing knowledge (12%).

Listening to *Science Friday* is not related to respondents' thinking about the barriers or obstacles that prevent scientists from doing basic research. Respondents focus mainly on the obstacles of politics (20%), barriers of government policies (19%) and religion (14%), and the lack of reward or recognition (11%).

Appeal of *Science Friday*
Listeners rate the series as highly appealing. Nine out of 10 listeners agree or strongly agree that they "enjoy listening to the series," and 8 out of 10 agree or strongly agree that they "listen attentively" to the show. Those who report listening more frequently also report listening more attentively and enjoying the series more compared with those listening less frequently.

Seven out of 10 listeners agree or strongly agree with the statement that "Ira Flatow asks questions of guest scientists that I would ask." Six of ten listeners disagree or strongly disagree with the observation that "call-in questions of guest scientists detract from the value of the program."

Comprehension of *Science Friday*
Listeners rate the series as highly understandable. Nine of 10 listeners disagree or strongly disagree that the "information on *Science Friday* is too technical," and 8 of 10 disagree that "the process of research as presented by guest scientists is confusing." Eight of 10 listeners feel that "the series keeps them up to date about current science research," and 7 of 10 agree the "series has reinforced their understanding of the process of research." The series information is rated as "usually familiar" by a third of the listening audience, novel by less than a third and sometimes familiar and sometimes novel by slightly more than a third of listeners. Thus, the information on *Science Friday* is targeted at an appropriate level to reach effectively the mass public radio member audience.

As listening frequency increases, agreement increases significantly for two statements: "the series keeps me up to date about current science research;" and "the series has reinforced my understanding of the process of research."

Learning from *Science Friday*
Eight out of 10 listeners feel that *Science Friday* is successful or very successful at helping them understand "what research underpins significant new discoveries," "how scientists go about doing their research," and "how failures in research can be useful to achieve eventual success." Seven of 10 listeners say the series is successful at helping them understand "what barriers must be overcome to carry out successful research" and "what length of time it takes to reach reliable conclusions." More than 6 of 10 listeners feel the show is successful at presenting "what role corporations, private institutions and foundations play in research" and "what role research plays in government policy-making."

Impact of *Science Friday*
The series has successfully prompted listeners to take further action. Almost all (90%) report following up their listening with at least one action, and more than half (56%) report carrying out three or more actions as a result of the series. More frequent listening relates to a wider variety of actions away from the radio. The most frequent activities are discussing topics with others (81%), reading related information (56%), searching for more information about a topic (48%) and accessing a web site (39%). Other prompted activities include purchasing a book or other item related to a show topic (30%), using content in teaching (12%), and writing to *Science Friday*, a scientist, politician or other (4%). The percent of listeners who discuss topics with others was significantly greater than those who did not discuss topics.

One-fifth of listeners report using the *Science Friday* website in the previous year, mostly to listen to archived shows (61%) or search for books (48%). About one-fifth of website users read Ira Flatow's blog or download podcasts.

Comparison of 2006 and 2003 listeners
The two listener samples for 2006 and 2003 do not differ with respect to demographic or background variables. The percent of listeners and distributions of listening frequency do not differ nor do their appeal and comprehension ratings of the series. There are also no significant differences in actions prompted by the show. The only statistically significant result is moderate improvement from 2003 in the show's success in communicating what role research plays in government policy-making.

Conclusion

In conclusion, 75% of our public radio members listen to *Science Friday* and 61% tune in once a month or more often. Radio is identified as a significant major source of science news by listeners of *Science Friday* as compared to non-listening public radio members. Listeners rate the series as highly appealing and understandable. The majority of listeners feel that *Science Friday* successfully communicates about contemporary science research process. Additionally, the series prompts listeners to carry out a variety of actions outside of the two-hour program.

Related to *Science Friday*'s NSF grant goal to emphasize public understanding of contemporary research, the results indicate that more frequent listening relates to stronger agreement that the series updates listeners about current science research and reinforces understanding of research process. Comparing the 2006 listener sample to a similar sample of listeners in 2003 reveals one significant improvement related to communicating what role research plays in government policy-making.

SUMMATIVE EVALUATION OF *SCIENCE FRIDAY* RADIO SERIES
MULTIMEDIA RESEARCH • BELLPORT, NY
NOVEMBER, 2006

INTRODUCTION

Talk of the Nation: Science Friday (*SF*) is a weekly two-hour listener call-in talk show devoted to the understanding of complex scientific topics and methods. The series is hosted by science correspondent Ira Flatow and broadcast on National Public Radio to more than 200 stations nationwide as well as via satellite and the Internet.

With support of an NSF grant beginning in 2003, *SF* has increased its emphasis on public understanding of contemporary research. *SF*'s goals under this NSF grant include the following:[1]

- Finding the research roots at the bottom of each story;

- Exploring the cooperation among corporations, private institutions and research foundations, when appropriate, illuminating how each one plays a role in the research process;

- Following the research "bumps" in the road to illustrate that research success depends upon failures—not all research produces positive results;

- Illuminating the barriers to successful research;

- Helping listeners understand the thought process of researchers;

- Scaling the "ivory tower" by enabling listeners to question and talk directly with researchers;

- Helping listeners understand the role of basic research in policy-making.

This report presents the second study of a two-part summative evaluation on the impact of *Science Friday* on public radio listeners. The first study, similar to this one in design, was completed in September, 2003.[2]

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[1] NSF Proposal Number 0206324, Award Abstract, National Public Radio's "Talk of the Nation Science Friday."
[2] Flagg, B. N. (Sept., 2003). "Talk of the Nation Science Friday" Summative Evaluation: Study 1. Multimedia Research Report 03-012).

Research Design

This study involved mailing a one-page double-sided questionnaire, return envelope and $1 in-centive to a random sample of people who are subscription members of their local public radio station. Recipients were asked to fill out the questionnaire and mail it back to the researcher. The respondents were then divided for analysis into two groups -- those who listen to *Science Friday* and those who do not.

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

I.   What percent of the radio member audience listens to *SF* and how frequently?

II.   Do demographic characteristics including age, gender, education, and occupational status relate to whether a person listens to the program or how frequently a person listens?

III.   Do self-reported background characteristics including interest in science, level of science knowledge, preferred science news sources and beliefs about science research relate to listening to *SF* or frequency of listening?

IV.   Does understanding the value of basic research and the barriers to doing basic research relate to whether a person listens to the program or how frequently a person listens?

V.   How appealing is *SF* and do demographic or background variables relate to appeal?

VI.   How understandable is *Science Friday* and do demographic or background variables relate to comprehension?

VII.   How successful is *Science Friday* in helping listeners understand research and do demographic or background variables influence this understanding?

VIII. Has the series prompted listeners to take further action?

IX.   Do listeners in 2006 differ from listeners in 2003?

Questionnaire

The questionnaire was comprised of several sections. All respondents answered sections 1 – 4. Only *Science Friday* listeners answered sections 5 – 6.

1.   Demographic questions established the sample's distribution of geographical location, age, gender, ethnicity, occupational status, and highest level of education.

2.   Rating questions assessed science-related background including general interest in science, perceived level of science knowledge, main sources of science news, and beliefs about scientific research.

3.   Open-ended questions explored understanding of the value or importance of basic research and what obstacles or barriers prevent scientists from doing basic research.

4.   Exposure questions determined whether a respondent had heard of or listened to *Science Friday* and the frequency of listening activity.

5.   Appeal, comprehension and learning were addressed by 16 statements with which respondents agreed or disagreed on a five-point scale.

6.   Actions taken as a result of listening to the series were assessed through a check-off list of probable activities.

Sample

In June, 2006, double-sided questionnaires with a $1 incentive were sent to a randomly generated subset of 400 members of each of three public radio areas:[3]
- Colorado Public Radio, broadcasting around Denver, CO;
- Texas Public Radio, broadcasting around San Antonio, TX; and
- Boston University Public Radio, broadcasting around Boston, MA and Providence, RI.

The 1200 questionnaires were anonymous and confidential. Recipients were asked to complete the questionnaire and mail it back. All questionnaires received within 16 weeks of mailing were included in the study analyses. Demographics of the sample are included in the results section.

Analyses

Reported percentages are rounded off in text and tables. To explore possible significant relationships and differences, appropriate statistics were performed including chi-square analyses, Spearman rank-order correlations, t-tests, ANOVA, and effect size calculations. In recognition of the large sample size, only statistically significant findings at $p \leq .0001$ are reported in the text along with effect size. Effect size indicates the magnitude of an effect or the strength of a relationship by factoring out sample size. Cramer's V and phi ϕ coefficient are reported with chi-square analyses and Cohen's $\underline{d}$ is used with a t-test on means. Only significant findings that have at least "moderate" correlation ($r_s \geq .4$) or "moderate" effect sizes (Cramer's V or ϕ coefficient $\geq$ .2; Cohen's d $\geq$ .3) are reported in the text.

Demographic variables examined include age, gender, educational level and occupational status (professional, skilled, unskilled). Because of the relatively small number of minorities in this sample, results related to ethnic/racial background were not explored. Background variables examined include self-assessed interest in and knowledge of science, major sources of science news, science beliefs, understanding of basic research, listening or not listening to *Science Friday* and frequency of listening.

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[3] Our thanks to the following public radio administrators for their cooperation and participation in this study: Sean Nethery at KVOD, Joe Gwathmey at KSTX, and Corey Lewis at WBUR, Boston Public Radio.

Return Rate

Of the 1200 surveys delivered, 641 were completed and returned within a 16-week period following the mailing. This represents a very respectable 53% return rate. The returned questionnaires include 37% from Texas radio members, 32% from Massachusetts area members and 31% from Colorado radio members.

Listeners and Non-Listeners

> **I. What percent of the radio member audience listens to the series and how frequently?**
> Three-quarters of respondents report listening to *Science Friday*. Six of ten respondents tune into the series once per month or more often, whereas 15% of respondents listen every week.

Respondents were asked how often they listen to the public radio series, *Talk of the Nation: Science Friday*. Of the 641 respondents, 75% (n = 478) were listeners:
- 15% of respondents heard the series "every week;"
- 46% heard it "1-3 times per month;"
- 14% heard it "less than once per month;"
- 13% never heard it or did not hear it often enough to answer the feedback questions;
- 13% were not aware of the series.

Demographic Information

> **II. Do demographic characteristics including age, gender, education and occupational status relate to whether a person listens to the series or frequency of listening to the series?**
>
> Our respondent sample is typical of a public radio member audience – more educated, better employed, older with fewer minorities compared to the general U.S. adult population. No demographic variable is significantly associated with listening behavior.

Table 1 presents demographic information for the whole sample as well as for the subgroups of listeners and non-listeners. The respondent sample includes few minorities (9%) and more women (54%) than men (46%). The mean and median age for the respondents is 55 years, with a normal distribution from 21 to 93 years. Most respondents (70%) are employed, mostly at jobs considered to be in the high level of occupational status (67% executive and major professionals,

managers and small business owners). The majority of respondents (66%) also report having post-college education. Thus, our respondents, drawn randomly from three stations' membership lists, are more educated, better employed, older and include fewer people of color than the general U.S. adult population. However, the sample is typical of a public radio member audience; this sample's demographics are similar to random samples Multimedia Research has obtained recently from other public radio membership lists. Statistical analyses revealed no significant influence of gender, age, education and occupational status on whether or not respondents listened to the show or listening frequency.

Table 1 <u>Distribution of Demographic Variables</u> (each cell = 100%)

	All Respondents N=641	Listeners n=478 (75% of sample)	Non-Listeners n=163 (25% of sample)
State: CO	31%	25%	49%
TX	37%	44%	15%
MA	32%	31%	36%
Gender: Male	46%	45%	50%
Female	54%	55%	50%
Age: Mean	55	54	58
Median	55	54	58
Range	21-93	23-88	21-93
Ethnic Status:			
White	91%	91%	92%
Minority	9%	9%	8%
Employment Status:			
Employed:	70%	72%	63%
High Status[4]	67%	68%	63%
Medium Status	24%	23%	28%
Low Status	9%	9%	9%
Retired	24%	22%	31%
Homemaker	4%	4%	4%
Unemployed	1%	1%	< 1%
Student	1%	< 1%	1%
Education:[5]			
Graduated H.S.	2%	< 1%	4%
Some College	10%	10%	11%
Graduated College	22%	20%	29%
Post-College	66%	69%	56%

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[4] "High" occupational status includes those with professional and managerial jobs; "medium" are technical or skilled jobs; and "low" are unskilled or menial labor.
[5] Because "graduated H.S." has few respondents, the category is combined with "some college" for further statistical analysis.

Science Interest, Knowledge, Sources and Beliefs

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III. Do background characteristics including interest in science, level of science knowledge, preferred science news sources and beliefs about science research relate to whether a person listens to the series or frequency of listening?

Listeners of *Science Friday* rated themselves as statistically significantly more interested in science and significantly more knowledgeable about science compared with non-listeners. In these differences, the effect size is moderate.

Major sources of science news included "radio" (55%), "magazines/journals" (44%) and "newspapers" (36%). "Radio" was chosen as a major source of science news by significantly more *SF* listeners (63%) than non-listeners (29%). This is a moderately strong association.

Listeners agreed significantly more than non-listeners with one of eight belief statements about science research:

"It is important for me to understand the process of scientific discovery."

Background variables did not differ significantly for different levels of listening frequency.

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<u>Science Interest</u>

Respondents were 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). Of the sample as a whole, 75% were either interested or very interested (4, 5) in science.

The average rating (M) for the sample was 4.1 with a standard deviation (SD) of .9. These results are equivalent to other recent studies of public radio members.

As shown in the chart to the right, listeners are more interested in science than non-listeners. On average, listeners report a significantly higher interest in science (M = 4.2, SD = .8) than non-listeners (M = 3.8, SD = 1.0),[6] yielding a moderate effect (d = .38). Interest in science does not differ for the three levels of listening frequency (every week, 1-3 times per month, less than once per month).
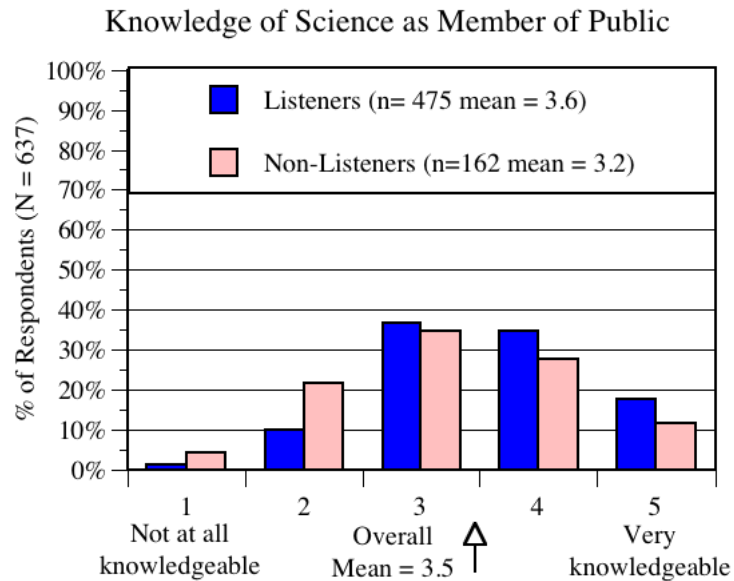

Interest in Science, Generally

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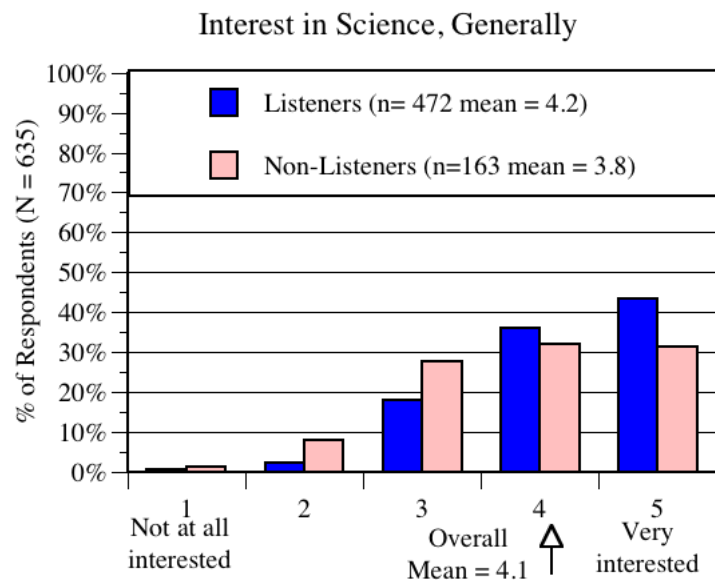
[6] $t(245)=4.08$, $p \le .0001$, Cohen's d = .38, $r^2 = .036$

Science Knowledge

Respondents rated their level of science knowledge as a member of the general public, using a five-point scale from not at all knowledgeable (1) to very knowledgeable (5). Of the sample as a whole, 52% ranked themselves as knowledgeable or very knowledgeable (4, 5, see chart). This is similar to percentages obtained in other public radio member studies. The average rating for the sample was 3.5 with a standard deviation of 1.0.

As shown in the chart to the right, listeners feel more knowledgeable about science than non-listeners. On average, listeners report a significantly higher knowledge in science (M = 3.6, SD = .9) than non-listeners (M = 3.2, SD = 1.0).[7] This is a moderate effect, as shown by Cohen's d = .37. Knowledge mean ratings did not differ for the three levels of listening frequency.

Knowledge of Science as Member of Public

Legend: Listeners (n= 475 mean = 3.6); Non-Listeners (n=162 mean = 3.2). Y-axis: % of Respondents (N = 637). X-axis: 1 Not at all knowledgeable, 2, 3 Overall Mean = 3.5, 4, 5 Very knowledgeable.
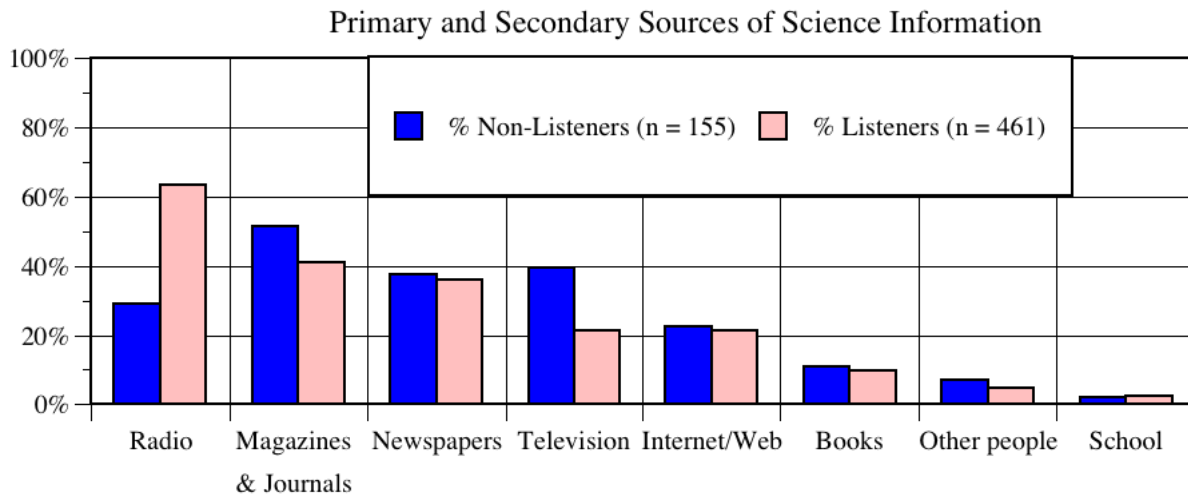
Science News Sources

Respondents were asked to indicate their primary and secondary source of science news, given eight possible sources. The largest percentage of both listeners and non-listeners reported that "magazines/journals" were their primary source of science news: Listeners (29%); Non-Listeners (31%). This result is consistent with previous Multimedia Research studies of public radio audiences. Respondents also identified their secondary source of science information from the same list. Listeners of *Science Friday* indicated "radio" as their most frequent secondary choice (38%), whereas the most frequent secondary choice for non-listeners was "television" (23%).

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[7] $t(251)=3.96$, $p \leq .0001$, Cohen's d = .37, $r^2 = .033$

The chart below <u>combines</u> the votes for primary and secondary sources of science news and gives an overall picture of where the public radio members feel they obtain most of their science news.

Primary and Secondary Sources of Science Information

Combining primary and secondary responses, more than half of public radio members said their primary or secondary source of science news was "radio" (55%) and less than half said "magazines/journals" (44%). Newspapers were a major source of science news for 36% of all member respondents and television for 26%.

<u>Listeners</u> of *Science Friday* considered their major sources of science news to be "radio" (63%), "magazines/journals" (41%), "newspapers" (36%) and "television" (21%). <u>Non-listeners</u> indicated their major sources of science news as "magazines/journals" (52%), "newspapers" (37%), "television" (39%) and "radio" (29%). Listeners were significantly more likely than non-listeners to list "radio" as one of their two sources of science news.[8] There is a moderately strong relationship (ϕ = .3) between listening to *SF* and identifying radio as a major source of science news. No relationship was found between listening frequency and preferred science news sources.

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[8] χ^2 (1, N = 616) = 55.10, $p \leq$ .0001, Phi coefficient = 0.3.

Beliefs about Science Research

Beliefs about science research were assessed by asking respondents to rate their agreement or disagreement with a randomly presented series of four positive and four negative statements, using a 5-point scale where (1) indicates strongly disagree and (5) indicates strongly agree. Mean agreement for each statement is presented in Table 3, with non-listeners' means in brackets.

Listeners believed more strongly than non-listeners that "it is important to understand the process of scientific discovery;" a statistically significant and moderate effect was found.[9] Mean belief ratings did not differ for different levels of listening frequency.

Table 3 Beliefs about Science Research:

Belief Statements	Strongly Disagree				Strongly Agree
	1	2	3	4	5
Positive Statements	[Non-Listener Mean] Listener Mean				
Failures are as important as successes in learning the truth in science.					[4.4]4.5
It is important for me to understand the process of scientific discovery. Significant relationship with listening[9]				[3.9] 4.3	
Basic scientific research is tedious and time-consuming.				[3.7]3.7	
Scientists are open to new evidence even when it conflicts with findings that have stood through many tests.				[3.7]3.7	
Negative Statements					
Significant new discoveries need not be replicated by independent researchers to be accepted.	1.8 [2.0]				
Breakthroughs in science typically involve a brilliant person working alone.		2.0[2.0]			
Science research should have no role in government policy-making.		2.0 [2.2]			
Really important research discoveries are made accidentally.			[2.6] 2.8		

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[9] t (235)=3.96, $p \leq .0001$, Cohen's d = .43, r^2 = .21

Understanding of Basic Research

IV. Does understanding the value of and barriers to doing basic research relate to whether a person listens to the program?

Listening to *Science Friday* is not related to respondents' thinking about the value of basic research. About one-quarter of the sample was not able to explain the value or importance of basic research, but those who could focused mainly on basic research as the foundation of science (29%), as leading to discoveries or applications (14%), as a requirement for understanding our world (13%) and as enhancing knowledge (12%).

Listening to *Science Friday* is not related to respondents' thinking about the barriers or obstacles that prevent scientists from doing basic research. About one-fifth of the sample was not able to describe barriers to basic research, but those who did focused mainly on the obstacles of politics (20%), barriers of government policies (19%) and religion (14%), and the lack of reward or recognition (11%).

Understanding the Value or Importance of Basic Research

The following open-ended question was presented to all respondents:

> Basic science research can be defined as research that has no immediate applied or commercial value. What, if anything, do you see as the value or importance of basic research?

One-quarter (23%) of the sample did not provide an answer to this question. Demographic and background variables did not relate to whether or not an answer was provided.

Every answer was coded by keyword or keyphrase and combined into logical categories. For example, all answers mentioning foundation, fundamental, basis, building block, starting point or groundwork were coded under the category of "foundation of science." Categories receiving 5% or more of respondents' interest are presented in Table 4 with example answers. Listeners did not differ from non-listeners in the tallies for any category, nor did listening frequency relate to frequency of response categories.

Basic research was valued mainly because it is the foundation of science (29%), leads to discoveries or applications (14%), increases our understanding of the world (13%) or enhances knowledge (12%).

Table 4. Distribution of Categories Coded for Value of Basic Research

Categories Code words and Phrases Example answers of value or importance of basic research	All N= 641	Listeners n=478	Non Listeners n=163
Foundation of Science **Foundation, fundamental, basis, building block, starting point, ground-work** "Provides foundation for the applied sciences" "Fundamental to the creation of evidence-based practice." "It is the basis of most 'practical' research." "Used as building blocks towards something more valuable."	29%	31%	25%
Leads to Discoveries or Applications **Leads to discoveries/breakthroughs/advances** **Leads to applied research/applications/useful findings** "It leads to other discoveries." "It may lead to other avenues of study and research." "Basic research can lead to breakthroughs that are important." "It can lead to applications."	14%	13%	14%
Increases Understanding of the World **Increases/improves Understanding of the world/universe/us/natural proc-esses** "To increase our understanding of our world." "To improve our understanding of nature and the universe." "Understand processes of earth, universe, life."	13%	13%	10%
Enhances Knowledge **Enhances/furthers/increases/expands/contributes Knowledge** "Expands knowledge pool." "It furthers the whole magnum of scientific knowledge." "Increases knowledge." "Contributes to our bank of scientific knowledge"	12%	12%	10%
May have Application in the Future **May have application/applied value/progress in the fu-ture/eventually/ultimately/long-term/later** "Knowledge that is discovered now may have use in the future." "We may find the information learned may be applied later." "Future applications." "Eventually it improves quality of life."	10%	9%	12%

Understanding the Obstacles or Barriers that Prevent Basic Research

The following open-ended question was presented to all respondents:

What obstacles or barriers, besides money, do you think <u>prevent scientists from doing basic research</u>?

One-fifth (20%) of the sample did not provide an answer to this question. Every answer was coded by keyword or keyphrase and combined into logical categories. For example, all answers mentioning politics, politicians, political, public policy or lobbyists were coded under the category of "politics." Categories receiving 5% or more of respondents' interest are presented in Table 5 with example answers. Listeners did not differ from non-listeners in the tallies for any category. Barriers mentioned most frequently were politics (20%); government policies (19%), religion (14%) and lack of reward or recognition (11%).

Table 5. Distribution of Categories Coded for Obstacles that Prevent Basic Research

Categories Code words and Phrases Example answers of obstacles or barriers preventing scientists from doing basic research	All N= 641	Listeners n=478	Non Listeners n=163

Politics
Politics, politicians, political, public policy, lobbyists
    "Political posturing and use of science for political gain."
    "Politics, politics, politics!"
    "Lack of political support."
	20%	20%	20%

Government Policy
Government policy/restraints/restrictions/intervention/regulation
    "Government interference such as restricting research on stem cell therapy, reproductive technology and climate change."
    "Government regulations."
    "Lack of inspiration and leadership by government leaders."
	19%	20%	16%

Religion
Religious groups/beliefs/views/ideology/customs/bias
    "Opposition for religious reasons."
    "Religious fundamentalism of all stripes."
    "Religious belief systems get in the way, in my opinion."
	14%	15%	11%

Lack of Reward or Recognition
Lack of reward/status/recognition/prestige/glamour
    "It's usually not very glamorous and often requires a large investment of time and effort for what appear to be small returns."
    "Little recognition for findings and hard work put into the research."
    "Lack of positive reinforcement."
	11%	12%	14%

Lack of Immediate Value or Profit
Lack of immediate value/benefits/reward/profit/payoff
    "Basic research may be overlooked in favor of research with greater potential for immediate gratification."
    "Emphasis on rapid results."
    "Low forecasted benefits."
	8%	8%	7%

Public Attitude
Public lack of respect/appreciation/interest/support
    "Lack of interest on the part of the public."
    "Public apathy."
	8%	7%	10%

Lack of Time
Lack of time, time constraints/consumption/pressure
    "Time constraints."
    "Time, research is very extensive and time consuming."
    "It may take too much of their career."
	7%	7%	8%

Lack of Education
Education, schools, training, qualified personnel
    "Lack of early education to generate interest in basic science."
    "Lack of knowledgeable and driven personnel."
    "Weak science education in public schools."
	7%	7%	6%

Policies within Academics or Companies
Policies and politics of employers
    "The tenure system within universities, publish or perish."
    "Job pressures and priorities set by organizations by employers."
	7%	8%	5%

Lack of Public Understanding
Public misunderstanding/ignorance
    "Lack of understanding by general public."
    "Public ignorance."
	5%	5%	3%

Appeal of Science Friday

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V. How appealing is *Science Friday* and do demographic or background variables relate to appeal?

Listeners rate the series as highly appealing. Nine out of 10 listeners agree or strongly agree that they "enjoy listening to the series," and 8 out of 10 agree or strongly agree that they "listen attentively" to the show. Those who reported listening more frequently also reported listening more attentively and enjoying the series more compared with those listening less frequently.

Seven out of 10 listeners agree or strongly agree with the statement that "Ira Flatow asks questions of guest scientists that I would ask." Six of ten listeners disagree or strongly disagree with the observation that "call-in questions of listeners detract from the value of the program."

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Listeners responded to statements reflecting feelings about the series using a 5-point scale from strongly disagree (1) to strongly agree (5). Four statements relating to appeal appear in Table 6 with their mean ratings. ANOVA and Spearman rank correlations were conducted on the ratings of the appeal statements for the demographic and background variables.

Table 6. Agreement with Statements on Appeal of *Science Friday*

Means	% who "agree" or "strongly agree"	Statements
4.4	94%	I enjoy listening to the series, *Science Friday*
4.0	81%	I listen attentively when I hear the series come on the radio.
3.8	74%	Ira Flatow asks questions of guest scientists that I would ask.
	% who "disagree" or "strongly disagree"	
2.4	58%	The call-in questions from listeners detract from the value of the program.

Almost all listeners (94%) agree or strongly agree that they "enjoy listening to the series, *Science Friday*." A significant effect resulted for listening frequency.[10] Those who listened more frequently rated their enjoyment higher (M(Every week) = 4.8; M(1-3 times/month) = 4.4; M(< 1/mo) = 4.1). Eta-squared of .12 means that of all the variance that exists in the agreement ratings for this statement, 12% is associated with differences in listening frequency.

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[10] $F(2, 474) = 11.490$, $p \leq .0001$, $\eta^2 = .12$.

Eight of ten listeners (81%) say they "listen attentively" to the series. A significant effect re-
sulted for listening frequency.[11] Those who listened more frequently reported listening more at-
tentively (M(Every week) = 4.5; M(1-3 times/month) = 4.0; M(< 1/mo) = 3.7). Of the variance
in the agreement ratings for this statement, 10% is associated with differences in listening fre-
quency.

Seven of ten listeners (74%) agree or strongly agree that the host asks questions that they would
ask of the guest scientists. Six of seven listeners (58%) disagree or strongly disagree that the
call-in questions detract from the series. Ratings did not relate significantly to demographic or
background variables for these statements.

Comprehension of *Science Friday*

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**VI. How understandable is *Science Friday* and do demographic
or background variables relate to comprehension?**

    Listeners rate the series as highly understandable. Nine of 10 listen-
ers disagree or strongly disagree that the "information on *Science Friday*
is too technical," and 8 of 10 disagree that "the process of research as
presented by guest scientists is confusing." Eight of 10 listeners felt that
"the series keeps them up to date about current science research," and 7
of 10 agreed the "series has reinforced their understanding of the process
of research." The series information was rated as "usually familiar" by a
third of the listening audience, novel by less than a third and sometimes
familiar and sometimes novel by slightly more than a third of listeners.
Thus, the information on *Science Friday* is targeted at an appropriate
level to reach effectively the mass public radio member audience.
    As listening frequency increased, agreement increased significantly
for two statements: "the series keeps me up to date about current science
research;" and "the series has reinforced my understanding of the proc-
ess of research."

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Listeners responded to statements reflecting comprehension of the series using a 5-point scale
from strongly disagree (1) to strongly agree (5). Five statements relating to clarity and compre-
hension appear in Table 7 with their mean ratings. ANOVA and Spearman rank correlations
were conducted on the ratings of the statements to assess influence of demographic and back-
ground variables.

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[11] $F(2, 474) = 27.155, p \leq .0001, \eta^2 = .10.$

Table 7. Agreement with Statements on Comprehension of *Science Friday*

Means	% who "agree" or "strongly agree"	Statements
4.0	82%	The series keeps me up to date about current science research.
3.8	71%	The series has reinforced my understanding of the process of research.
3.1	34%	I am usually familiar with most of the information given in the series.
	% who "disagree" or "strongly disagree"	
1.8	87%	The information on *Science Friday* is too technical for me.
2.1	81%	The process of research as presented by the guest scientists is confusing.

Eight of ten listeners agreed or strongly agreed that "the series keeps me up to date about current science research." A significant effect resulted for listening frequency.[12] Those who listened more frequently agreed more with the statement (M(Every week) = 4.3; M(1-3 times/month) = 4.0; M(< 1/mo) = 3.6). Eta-squared of .11 means that a relatively small portion (11%) of the variance in the ratings is associated with differences in listening frequency.

Seven of ten listeners agreed or strongly agreed that "the series has reinforced their understanding of the process of research." A significant effect resulted for listening frequency.[13] Those who listened more frequently agreed more with the statement (M(Every week) = 4.2; M(1-3 times/month) = 3.8; M(< 1/mo) = 3.5). Eta-squared of .10 indicates that 10% of the variance in the ratings is associated with differences in listening frequency.

In response to the statement "I am usually familiar with most of the information given in the show," 34% of listeners agreed, 38% were neutral, and 29% disagreed. This distribution indicates that the series' information is targeted at a level to reach the mass radio audience effectively – the information is usually familiar to a third, novel to less than a third and sometimes familiar and sometimes novel to the slightly more than a third of the audience.

Almost nine out of ten listeners disagreed or strongly disagreed with the statement that "the information on *Science Friday* is too technical for me."[14] Eight of ten listeners disagreed or strongly disagreed with the statement that "the process of research as presented by the guest scientists is confusing."[15]

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[12] $F(2, 466) = 12.514$, $p \leq .0001$, $\eta^2 = .11$.
[13] $F(2, 469) = 25.173$, $p \leq .0001$, $\eta^2 = .10$.
[14] This statement may be reconsidered in the following way: 87% of listeners agree that the information on *Science Friday* is not too technical for them.
[15] This negative statement may be reconsidered in the positive as follows: 81% of listeners agree that the process of research as presented by the guest scientists is clear.

> **VII. How successful is *Science Friday* in helping listeners understand research and do demographic or background variables influence this understanding?**
>
> Eight out of 10 listeners felt that *Science Friday* is successful or very successful at helping them understand "what research underpins significant new discoveries," "how failures in research can be useful to achieve eventual success" and "how scientists go about doing their research." Seven of 10 listeners felt the series is successful at helping them understand "what barriers must be overcome to carry out successful research" and "what length of time it takes to reach reliable conclusions." More than 6 of 10 listeners felt the show is successful at presenting "what role corporations, private institutions and foundations play in research" and "what role research plays in government policy-making." Responses were not significantly or meaningfully related to demographic or background variables.

Using a 5-point scale from not at all successful (1) to very successful (5), listeners rated statements about the success of *Science Friday* in helping them understand a research story. Five statements relating to *SF*'s success at presenting a research story appear in Table 8 with respondents' mean ratings. Responses were not significantly or meaningfully related to any demographic or background variables.

Table 8. Agreement with Statements on Success of *SF* in presenting a research story

Means	% choosing "successful" or "very successful"	Statements about *SF*'s success in helping listener understand the following about a research story
3.98	82%	what research underpins significant new discoveries
3.96	80%	how failures in research can be useful to achieve eventual success
3.93	79%	how scientists go about doing their research
3.87	75%	what barriers must be overcome to carry out successful research
3.80	70%	what length of time it takes to reach reliable conclusions
3.71	67%	what role corporations, private institutions and foundations play in research
3.73	66%	what role research plays in government policy-making

Prompting to Action by *Science Friday*

VIII. Has the series prompted listeners to take further action?

The series has successfully prompted listeners to take further action. Almost all (90%) reported following up their listening with at least one action, and more than half (56%) reported carrying out three or more actions as a result of the series. The most frequent activities are discussing topics with others (81%), reading related information (56%), searching for more information about a topic (48%) and accessing a web site (39%). The percent of listeners who discuss topics with others was significantly greater than those who did not discuss topics.

Those who hear the show more frequently were more likely to report that the show had prompted them to a wider variety of actions compared with less frequent listeners.

One-fifth of listeners reported using the *Science Friday* website in the previous year, mostly to listen to archived shows or search for books.

Respondents were asked whether listening to *Science Friday* had ever prompted them to take any of seven further actions, as shown in Table 9. A single sample chi-square test shows that the percent of listeners who discuss topics with others (81%) was significantly greater than those who did not (19%).[16]

Table 9. Actions Prompted by Listening to *Science Friday*

Has listening to *Science Friday* ever prompted you to . . .	Listeners (n = 478)
discuss the topics with others	81%
read related information in books, magazines, newspapers	56%
search for more information about a topic	48%
access an Internet web site, including *Science Friday*'s	39%
purchase a book or other item related to a show topic	30%
use content in teaching	12%
write to *Science Friday*, a scientist, politician or other	4%

Weekly listeners take significantly more actions on average (3.2) than those hearing the show less than once per month (1.9); this is a large effect, as indicated by d = -.84.[17] Those listening 1-3 times per month also report significantly more actions on average (2.8) than those listening less frequently.[18] This is a moderately large effect, as indicated by d = -.53.

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[16] χ^2 (1, N = 478) = 185.78, $p \leq .0001$
[17] t (180)=-5.67, $p \leq .0001$, Cohen's d = -.84, r^2 = .148
[18] t (149)=-4.43, $p \leq .0001$, Cohen's d = -.53, r^2 = .068

Respondents were encouraged to describe other unlisted actions that have been prompted by their listening to *Science Friday*. A small but varied set of actions were elicited, including:

    Called in with a question (2 respondents)
    Changed product use, purchased certain food type
    Purchased Sirius satellite radio to have access to the program

Of the listening sample, 20% report specifically using the *Science Friday* website in the last year. A single sample chi-square test shows that the user group was significantly smaller than the non-using group (80%).[19] Use of the website is not related to any demographic or background variables. Table 10 summarizes how respondents used the website features. The majority of users listen to archived shows (61%) or search for books (48%), and another 20% read Ira Flatow's blog.

Table 10. Features Used on *Science Friday* Website

How have you used *Science Friday*'s website in the last year?	% of Users (n = 98)
Listen to archived shows	61%
Search for book(s)	48%
Read Ira's blog	20%
Download podcast(s)	18%
Download teaching materials	7%
Visit lounge	3%
Comment on Ira's blog	2%

Comparison of 2003 and 2006 Listening Samples

> **IX. Do listeners in 2006 differ from listeners in 2003?**
>
> The percent of listeners and distributions of listening frequency do not differ for the two years. The two listener samples do not differ with respect to demographic or background variables nor in terms of their appeal and comprehension ratings of the series. There were also no significant differences in actions prompted by the show. The only statistically result is moderate improvement from 2003 in the show's success in communicating what role research plays in government policy-making.

Findings for the studies of 2003 and 2006 were compared. The percent of listeners for the two years does not differ significantly nor do the distributions of listening frequency.

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[19] χ^2 (1, N = 478) = 159.36, $p \leq .0001$

The two listening samples do not differ with respect to demographic variables (gender, age, education, occupational status) or background variables (interest in science, knowledge of science, preferred science news sources, beliefs about science research).

There are no differences between the samples in terms of their appeal and comprehension ratings of *Science Friday*. There were no significant differences in actions prompted by the series. One significant difference appeared in ratings of the series' success in helping listeners understand research. On a scale of one to five, respondents rated *SF*'s success in helping them to understand "what role research plays in government policy-making." In 2003, the mean rating was 3.5, whereas in 2006 the mean rating was 3.7.[20] This is a significant difference and moderate effect ($\underline{d}$ = .3), showing improvement over time in communication of this content by the radio series.

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[20] t (963)=4.54, $p \leq$ .0001, Cohen's $\underline{d}$ = .3, r^2 = .02