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AUTHOR	Kiernan, Vincent
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ABSTRACT

In a secondary analysis of the 1992 National Science Foundation Survey of Public Understanding of Science and Technology, high levels of exposure to television news are associated with lower levels of knowledge of basic scientific facts. Data were gathered through a telephone survey of a national probability sample of the United States population, aged 18 or over. Interviews were conducted with 2,001 individuals, for a completion rate of 70%. High exposure to magazines and daily newspapers is associated with higher knowledge, even after accounting for education and interest in science news. Findings suggest that televised science news may be misunderstood by viewers. (Contains 15 references, and 1 table and 1 figure of data. An appendix presents the survey questions.) (Author/RS)

Media Exposure and Knowledge About Science

Vincent Kiernan

Graduate student, College of Journalism

University of Maryland, College Park

4600 Duke St., Apt. 1524

Alexandria VA 22304

703-370-3202

kiernan@wam.umd.edu

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Abstract

In a secondary analysis of the 1992 National Science Foundation Survey of Public Understanding of Science and Technology, high levels of exposure to television news are associated with lower levels of knowledge of basic scientific facts. High exposure to magazines and daily newspapers is associated with higher knowledge, even after accounting for education and interest in science news. The findings suggest that televised science news may be misunderstood by viewers.

Media Exposure and Knowledge About Science

Many members of the public have a poor grasp of scientific facts and principles, as several studies have documented both in the United States and abroad (Durant, Evans & Thomas, 1989; National Science Board, 1985; National Science Board, 1987; National Science Board, 1989; National Science Board, 1991). This low level of understanding is troubling to some analysts because they fear that an ill-informed public will be less able to make valid judgements on public-policy issues that contain a scientific or technical component (Hazen & Trefil, 1991; Miller, Suchner & Voelker, 1980).

However, fostering a higher level of science literacy requires a better understanding of how the public acquires its knowledge about science, whether from news media or from other sources. Information processing theories of mass communication may be helpful in this regard. Information-processing theories such as that of Graber (1988) maintain that an individual's cognitive processes are responsible for the fashion in which that individual selects and processes information from the news sources that are presented to the individual. Moreover, each news source exhibits characteristics that make its content easier or more difficult for the individual to process cognitively; thus, individuals may learn more effectively from some news sources than from others.

In this vein, Robinson and Levy (1986) reviewed studies of learning from television and concluded that there is little evidence that viewers learn from television news programming. They suggested that television news exhibits characteristics -- such as its fast pace and emphasis on pictures rather than text -- that may inhibit viewers' processing of the science-information content of television news. By contrast, print media may be easier to process cognitively, because a reader can read at his or her own pace and can reread portions of the text that are difficult.

Few studies have focused specifically on learning of scientific information from various media. Wade and Schramm (1969) found that individuals in a 1957 national survey who were able to correctly answer four science-knowledge questions were likely to rely principally on newspapers or magazines for news, rather than television or radio. They suggested that the vividness and immediacy of television journalism means that television is likely to be a source of science information that is tied to dramatic events in the news. By contrast, print media, which offer more perspective and interpretation than television, are more likely to be sources of a broader range of long-term science knowledge.

More recently, Robinson and Davis (1990) analyzed two sets of national survey data and concluded that television news is less effective than newspapers in informing media users. The two surveys did not deal with scientific information but instead with information about current events. Respondents in the two surveys told interviewers that television was their principal source of information about current events. However, newspaper readers were better able than television viewers to recall major news stories from the preceding week. The present study is an adaptation of the approach used by Robinson and Davis.

Data

The present study represents a secondary analysis of the 1992 National Science Foundation Survey of Public Understanding of Science and Technology. Data were gathered through a telephone survey of a national probability sample of the US population, aged 18 or over. Jon D. Miller of the Chicago Academy of Sciences executed the survey under contract to the US National Science Foundation. Data from this study have been reported in a biennial report which the National Science Foundation is required by statute to submit to the US Congress (National Science Board, 1993). The 1992 wave was the seventh in the series.

Survey respondents were identified through a national probability cluster design. Survey interviews were conducted by telephone from December 29, 1992, through April 9, 1993. Interviews averaged 26 minutes in length. Interviews were conducted with 2,001 individuals, for a completion rate of 70 percent (Miller, Pifer & Ressmeyer, 1994).

Participants were asked a variety of questions regarding their attitudes towards science. The survey inquired about respondents' use of various media, such as newspapers and television. Respondents also were asked a series of test questions designed to measure their level of science knowledge. The survey instrument also gathered social locator data, such as sex, age, employment and education.

The dependent variable for the present study, scientific knowledge, is operationalized by calculating the number of correct answers that each respondent provided for 19 science-knowledge questions that were asked in the NSF survey. These 19 questions are listed in the Appendix. Thirteen of the questions ask the respondent to state whether a particular statement -- such as "radioactivity is man-made" -- is true or false. Two of the questions checked respondents' knowledge by forcing them to make a choice, such as by asking "which travels faster: light or sound?" The final four questions were based on a hypothetical scenario about an inheritable disease. Respondents then were asked about the accuracy of four statements describing the probabilities of a couple passing the disease onto their children.

By definition, the knowledge score could take on any integer value from 0 to 19. In this sample, however, values ranged from 2 to 19, with a mean of 12.5, a median of 13.0, and a standard deviation of 3.4. If a respondent replied "don't know" or "unsure" to a particular question, it was counted as an incorrect answer. The distribution of scores is shown in Figure 1.

Independent variables in the present analysis include three measures of media exposure and the respondent's education and level of interest in science. Exposure to television news was measured by a question in which respondents were asked how many hours they watched television on an average day. Then they were asked: "About how many of these hours are news reports or news shows?" Answers to this follow-up question ranged from 0 to 21 hours, with a mean of 1.4 hours, a median of 1 hour, and a standard deviation of 1.2 hours. For the current analysis, this variable was recoded into a three-level variable distinguishing respondents who reported watching television news every day for less than one hour, for one to two hours, or for more than two hours. With this recoded variable, 23.5 percent of respondents had exposures of less than one hour, 63.3 percent had exposures of one to two hours, 10.6 percent had exposures of more than two hours daily, and 2.7 percent had missing values.

The survey measured newspaper use by asking respondents: "How often do you read a newspaper: Every day, a few times a week, once a week or less than once a week?" For the purposes of this analysis, the answers were recoded into a dichotomous variable, distinguishing those who read newspapers daily (55.9 percent) from those who did not (43.9 percent). Respondents who said "don't know" are considered as missing cases (0.3 percent).

For magazine use, the survey asked respondents: "Are there any magazines that you read regularly, that is, most of the time? What magazines would that be?" Interviewers then recorded the titles of as many as five magazines. For this analysis, the answers were recoded into a dichotomous variable, distinguishing those who read at least one magazine (66.8 percent) from those who do not read any magazines (33.2 percent).

Education level was measured in the survey through a question that asked respondents to provide "the highest level of education you completed." The original data set includes a variable in which this education-level information has been recoded into three levels: low (not a high school graduate, 20.1 percent), medium (high school graduate through some college, 60.1 percent), and high (college graduate or more, 19.8 percent).

The survey also assessed respondents' interest in various issues. One such issue was described as "issues about new scientific discoveries." Of the respondents, 36.1 percent said they were "very interested," 49.1 percent said they were "moderately interested," and 14.6 percent said they were "not at all interested." The 0.3 percent of respondents who answered "don't know" were considered missing cases in the current analysis.

Methods and results

The relationship between science knowledge and media exposure was investigated using multiple classification analysis (MCA), a technique in analysis of variance that estimates the differences in a dependent variable after adjusting for other variables. Estimates of the dependent variable are provided for every category of every independent variable (Nie, Hull, Jenkins, Steinbrenner & Bent, 1975).

Results of an MCA analysis of the NSF data set are reported in Table 1. The top line of the table indicates that the mean science-knowledge score for the entire sample was 12.5. The remainder of the table indicates knowledge-score means for subgroups in the sample with specific levels of each independent variable. The first column of numbers reports the number of respondents that fall into each category of each independent variable. The second column of numbers reports how that subgroup's raw mean knowledge score deviates from the sample's overall mean. The third column reports how the subgroup's mean knowledge score deviates from the overall sample mean, once MCA adjusts the subgroup's raw mean to account for all other independent variables.

Education had the greatest influence of all the independent variables on the knowledge scores: College graduates answered 4.0 more questions correctly than respondents without a high-school diploma ($p<.001$). Interest in science was the next most influential variable, with high-interest individuals scoring 1.5 higher than individuals with no interest in science ($p<.001$). Of the three media-exposure variables, television news exposure had the greatest influence, with heavy watchers scoring 1.4 lower than the least frequent viewers of television news ($p<.001$). By contrast, print media exposure was associated with higher scores: Magazine readers got 0.6 answer correct compared to non-readers ($p<.001$), and daily newspaper readers scored 0.4 higher than non-readers ($p<.01$).

Discussion

The results of the present study are consistent with those of Robinson and Davis (1990) in that print media were more effective than television in informing individuals. However, the results of the present suggest a more fundamental difference in how science information is conveyed by print and broadcast media. High-exposure television viewers did not simply learn less about science than high-exposure newspaper readers; the high-exposure television viewers had lower knowledge scores than low-exposure television viewers, suggesting that in a sense they actually lost science knowledge by viewing television news.

The NSF data can shed no light on the intriguing question of how this knowledge loss might occur, because the data include no information on the specific science content of the various media and only general measures of the exposures to those media. One possibility is that the television content contains more frequent scientific errors than did the news content, and that viewers learned incorrect information which was reflected in lower science scores. Another possibility is that the television content was no more incorrect than the print content but that television viewers misunderstood the information that was being conveyed. Jacoby and Hoyer (1982) found that televised information is generally miscomprehended at a rate of 23 to 36 percent per content unit. It may be that the characteristics of televised news, such as its emphasis on drama and its fast visual pace, may foster miscomprehension of scientific knowledge, but this is an area that requires further exploration.

The particular measure of science knowledge used in this study does suffer from limitations as an index of an individual's scientific literacy. The questions used in this study examine a particular type of scientific knowledge: that of basic facts or definitions. It does not measure the respondent's grasp of the scientific process, which might be more useful in equipping an individual to understand scientific controversies of public impact, such as risk-benefit issues.

Moreover, the particular measure of media exposure used in this study also suffers from limitations. As is the case with all time-use questions predicated on an "average day," the question about daily television usage may not be accurately answered by respondents, because they may over- or under-estimate their viewing time. Also, this measure does not reflect how closely the respondent attended to the television programming; if the respondent ignored the television -- by reading or working or doing housework, for example -- the television programming could be expected to have little if any effect on the respondent.

Further, the NSF data do not include any assessment of the science content of the media to which respondents were exposed. If television programming had less science content than print media, this alone could account for the knowledge differences identified in this study. Finally, it should be noted that the present study documents only an association; a study using one year of national survey data cannot definitely distinguish cause from effect. It is conceivable that individuals with lower levels of scientific knowledge selectively watch more television news than do individuals with higher levels of scientific knowledge.

Summary

High levels of exposure to television news are associated with lower levels of knowledge about basic scientific facts, while high exposure to magazines and newspapers is associated with higher levels of knowledge. These associations exist even after accounting for the respondent's level of education and level of interest in science. These results are consistent with the hypothesis that television exposure causes lower levels of knowledge of scientific facts in viewers. However, the present analysis cannot prove this causation, because the available data do not permit identification of cause and effect: It is conceivable that individuals with lower levels of scientific knowledge selectively watch more television than do individuals with higher levels of scientific knowledge.

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Appendix

The following survey questions were used to construct respondents' science knowledge scores. Correct responses are marked with an asterisk (*).

"Finally, I would like to ask you a few short quiz type questions. This will take about 3 minutes and we will be finished. OK? For each statement that I read, please tell me if it is true or false. If you don't know or aren't sure, just tell me and we will skip to the next question. Remember: true, false, or don't know."

Statement	True	False	DK
"First, the center of the Earth is very hot."	1622 (81%)*	119 (6%)	259 (13%)
"Radioactivity is man-made."	281 (14%)	1458 (73%)*	262 (13%)
"The oxygen we breathe comes from plants."	1712 (86%)*	219 (11%)	70 (3%)
"The father's gene decides the sex of a baby."	1298 (65%)*	418 (21%)	285 (14%)
"Lasers work by focusing sound waves."	529 (26%)	743 (37%)*	728 (36%)
"Electrons are smaller than atoms."	924 (46%)*	460 (23%)	617 (31%)
"Antibiotics kill viruses as well as bacteria."	1100 (55%)	696 (35%)*	205 (10%)
"The universe began with a huge explosion."	753 (38%)*	687 (34%)	561 (28%)
"The continents on which we live have been moving their location for millions of years and will continue to move in the future."	1583 (79%)*	204 (10%)	214 (11%)
"Human beings, as we know them today, developed from earlier species of animals."	902 (45%)*	829 (41%)	269 (13%)
"Cigarette smoking causes lung cancer."	1883 (94%)*	84 (4%)	33 (2%)
"The earliest humans lived at the same time as the dinosaurs."	769 (38%)	901 (45%)*	331 (17%)
"Radioactive milk can be made safe by boiling it."	184 (9%)	1332 (67%)*	484 (24%)

"Which travels faster: light or sound?"

Light: 1493 (75%)*

Sound: 400 (20%)

Both the same: 7 (0%)

Don't know: 101 (5%)

"Does the Earth go around the Sun, or does the Sun go around the Earth?"

Earth around Sun: 1423 (71%)*

Sun around Earth: 436 (22%)

Don't know: 412 (7%)

"Now think about this situation. A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness."

Statement	Yes	No	Not sure
"Does this mean that if their first three children are healthy, the fourth will have the illness?"	256 (13%)	1609 (80%)*	136 (7%)
"Does this mean that if their first child has the illness, the next three will not?"	185 (9%)	1663 (83%)*	152 (8%)
"Does this mean that each of the couple's children will have the same risk of suffering from the illness?"	1429 (71%)*	426 (21%)	145 (7%)
"Does this mean that if they have only three children, none will have the illness?"	175 (9%)	1666 (83%)*	159 (8%)

Author Note

I would like to thank Jon D. Miller for providing the data that were used in this secondary analysis and John P. Robinson for guidance in the execution of the analysis.

Table 1. Multiple classification analysis of science-knowledge scores.

	N	Unadjusted deviation	Adjusted deviation
All	1936	12.53	
Education[a]			
1 < High school grad	387	-2.25	-1.96
2 HS graduate	1170	-.03	-.03
3 College grad	379	2.39	2.08
TV news exposure[a]			
0 < 1 hr/day	470	.72	.58
1 1-2 hr/day	1257	-.05	-.08
2 >2 hr/day	209	-1.30	-.84
Daily newspaper use[b]			
0 No	851	-.37	-.21
1 Yes	1084	.29	.16
Magazine reading[a]			
0 No	649	-.76	-.38
1 Yes	1292	.38	.19
Science interest[a]			
1 Very interested	698	.61	.49
2 Moderately int	955	.01	-.06
3 Not interested	283	-1.55	-1.01

Note: The superscript [a] indicates that the difference between adjusted means for the highest and lowest categories is significant at $p<.001$. The superscript [b] indicates that the difference between adjusted means for the highest and lowest values of the variable is significant at $p<.01$.

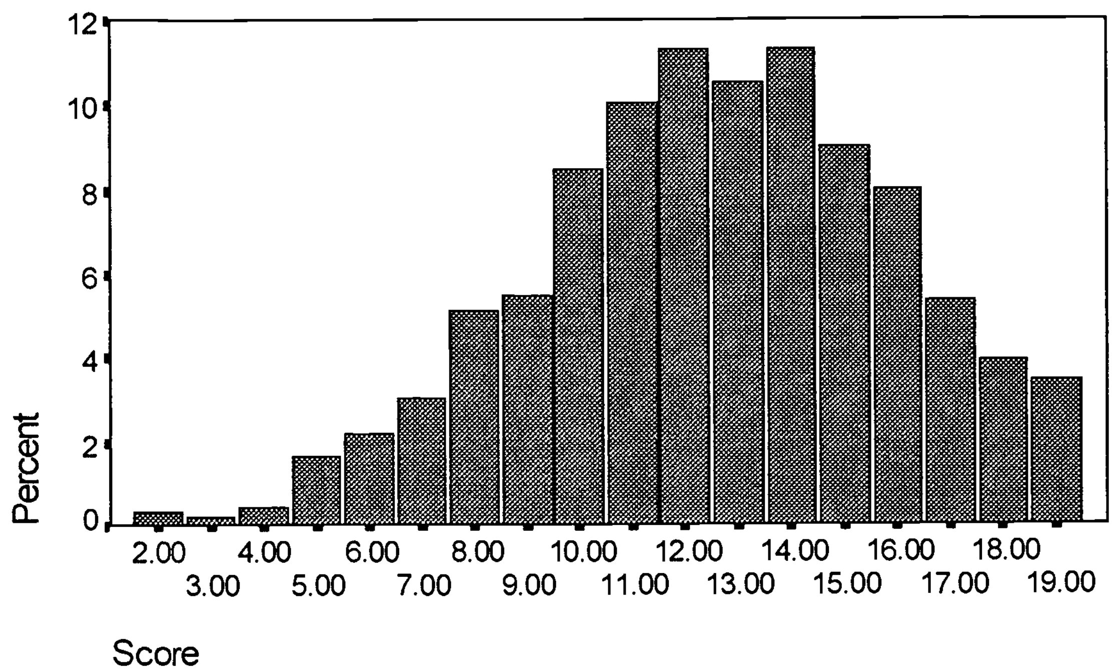

Figure 1. Distribution of science knowledge scores, with a minimum possible score of 0 and a maximum possible score of 19.

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