PUBLIC KNOWLEDGE AND ATTITUDES SCALE CONSTRUCTION: DEVELOPMENT OF SHORT FORMS

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Executive Summary

Since 1979, the National Science Foundation (NSF) has conducted a biennial Survey of Public Attitudes Toward and Understanding of Science and Technology. Response rates for this survey have typically been 70 percent or higher. However, for two recent administrations of the survey, 1999 and 2001, response rates have declined to 66 percent and 39 percent, respectively. Additionally, NSF has found an overrepresentation of the highly educated and an underrepresentation of those with little education.

One method of improving response rates is to lower respondent burden by reducing the survey length. The goal of this study was to develop new scales based on fewer survey items that are functionally equivalent to the scales used in the current survey. Two possible short forms were developed for each of the following four scales: Factual Knowledge of Science, Public Understanding of Scientific Inquiry, Index of Scientific Promise, and Index of Scientific Reservation. Both Classical Test Theory and Item Response Theory were used to identify items for removal from the scales. The final short forms were developed based both on the quantitative results as well as content considerations. The functional equivalence of the short and long forms was evaluated.

This study developed several short forms that are suitable replacements for the long forms. However, with the removal of items from a scale, there is always some loss of information and the appropriate short form should be selected based on the goals of a particular study. The primary objectives of this study were to develop short forms that reduced survey administration time while still preserving relationships, such as demographic differences, found with the existing scales. Based on these criteria, we

recommend what we refer to as the Version 2 short form for the Factual Knowledge of Science scale. This short form reduced the number of items by 40 percent, including the removal of both open-ended items, and still maintained enough items to cover each of the content areas on the long form. It had a reliability coefficient nearly identical to the long form and demonstrated the same group-level differences.

Among the Public Understanding of Scientific Inquiry short forms, we suggest Version 2 which removed 50 percent of the items (3 out of 6) on the long form. In particular, the removal of one of the more difficult open-ended items which asks about the meaning of scientific study could reduce respondent burden. Although this short form had a lower Cronbach's alpha than the long form, it had a small error rate (4 percent) for classifying respondents as understanding or not understanding scientific inquiry when compared to the long form.

While both short forms for the Index of Scientific Promise performed well, the Version 1 short form is recommended because it removes an item concerning scientists and therefore includes only items related to science in general. The long form for the Index of Scientific Reservation included only a very small number of items and, as a result, both short forms only removed one of the three items from the index. We suggest the Version 2 short form because it has mean scores similar to those for the long form.

Future research should focus on refining the short forms and perhaps developing new items to address some of the concepts (e.g., reservations about science). In addition, because the primary motivation of this study was to improve survey response rates, future studies should field test the scales developed here to determine whether shorter scale length does in improve response rates when compared with the long forms.

1. Background

Since 1979, the National Science Foundation (NSF) has conducted a biennial Survey of Public Attitudes Toward and Understanding of Science and Technology with results reported in the Science and Engineering Indicators (SEI) report. The purpose of this survey is to assess basic knowledge of science and the scientific process, public attitudes toward science and technology, and public perceptions of scientists and sources of scientific information. Additionally, data collected on the NSF survey are compared to other sources in order to gauge public opinion toward science and technology, relative to other disciplines (e.g., medicine, military, education, press).

The data collection for this survey is a telephone interview survey using a random-digit sample of adults. Response rates for this survey have typically been 70 percent or higher. However, for the two most recent administrations of the survey (i.e., 1999 and 2001), response rates have declined to 66 percent and 39 percent, respectively. Additionally, NSF has found an overrepresentation of the highly educated and an underrepresentation of those with little education. The combination of declining survey response rates and questions about representativeness led the NSF Division of Science Resource Statistics (SRS), sponsor for the survey of Public Attitudes Toward and Understanding of Science and Technology, to explore ways of improving response rates.

One method of improving response rates is to lower respondent burden by reducing the survey length. The goal of this study was to develop new scales based on fewer survey items that are functionally equivalent to the scales used in the current survey. Two possible short forms were developed for each of the following four scales: Factual Knowledge of Science, Public Understanding of Scientific Inquiry, Index of

Scientific Promise, and Index of Scientific Reservation. Our approach included both Classical Test Theory and Item Response Theory approaches to scale reduction. This report describes the development of the short forms and their equivalence to the long forms and provides recommendations concerning the use of the short forms in future rounds of the survey.

2. Methods

This study utilized data from the 1997, 1999, and 2001 administrations of the NSF Survey of Public Attitudes. Table 2.1 outlines the demographic characteristics of the respondents in each survey year. As noted earlier, the number of respondents has declined over time. In 1997 and 1999, there were similar distributions of respondent characteristics; however, the 2001 sample contained a greater proportion of highly educated respondents relative to the other 2 years.

Table 2.1. Demographic Profiles of Respondents by Year

Characteristic	1997 (N = 2,000)	1999 (N = 1,882)	2001 (N = 1,574)
Gender			
Male	46.5%	47.9%	47.9%
Female	53.5%	52.2%	52.1%
Age			
18-24	14.5%	14.0%	15.3%
25-34	22.6%	23.3%	17.2%
35-44	20.6%	20.9%	22.1%
45-54	15.7%	15.7%	16.5%
55-64	9.4%	10.1%	12.2%
65+	16.6%	15.6%	14.4%
Education Level			
Less than H.S.	21.0%	21.4%	17.0%
H.S. graduate	51.1%	49.6%	48.5%
4-year college degree	8.3%	9.4%	11.2%
Graduate degree	19.1%	18.4%	22.3%
Math/Science Education			
Low	55.6%	55.8%	52.7%
Medium	25.5%	25.5%	28.7%
High	19.0%	18.6%	18.6%

Note: All percentages in this table are weighted. Throughout this report, all analyses except the confirmatory factor analyses and item response theory analyses are weighted.

The current study evaluated the following four scales/indices that are constructed from items included in the survey: (1) Factual Knowledge of Science, (2) Public Understanding of Scientific Inquiry, (3) Index of Scientific Promise, and (4) Index of Scientific Reservation. The purpose of this study was to develop two possible short forms for each of these scales/indices. Each short form should be functionally equivalent to the long form to allow for consistent comparisons over time.

A similar procedure was used for developing the short forms for each scale or index. First, the items on the long form were classified into a set of content areas based on the type of information they assess. Next, quantitative analyses were used to evaluate the psychometric properties of the items constituting the long form. Items that functioned poorly or appeared to be redundant to other items (e.g., covered the same content area or had similar difficulty levels) were identified as candidates for removal from the scale/index. Balancing the quantitative results and content considerations, two possible short forms were developed. The functional equivalence of the short and long forms was evaluated by examining their relationship with each other and their ability to detect group-level differences. The specific analysis techniques used were tailored to each scale or index, as described below.

2.1 Factual Knowledge of Science

The Factual Knowledge of Science (FKS) scale is a scientific achievement test consisting of 18 items designed to assess knowledge of various scientific facts. As shown in Table 2.2, the FKS scale contains 13 true/false questions, 3 questions with two or three response options (including one correct response), and 2 open-ended items.

Responses to each of the items were classified as "correct" or "incorrect." For the 16 closed-ended items, "don't know" responses were considered to be incorrect.

Table 2.2. Factual Knowledge of Science (FKS) Items

Item	Response Options
1. The center of the Earth is very hot.	*True*, False
2. All radioactivity is man-made.	True, *False*
3. The oxygen we breathe comes from plants.	*True*, False
4. It is the father's gene which decides whether the baby is a boy or a girl.	*True*, False
5. Lasers work by focusing sound waves.	True, *False*
6. Electrons are smaller than atoms.	*True*, False
7. Antibiotics kill viruses as well as bacteria.	True, *False*
8. The universe began with a huge explosion.	*True*, False
9. The continents on which we live have been moving their location for millions of years and will continue to move in the future.	*True*, False
10. Human beings, as we know them today, developed from earlier species of animals.	*True*, False
11. Cigarette smoking causes lung cancer.	*True*, False
12. The earliest humans lived at the same time as the dinosaurs.	True, *False*
13. Radioactive milk can be made safe by boiling it.	True, *False*
14. Which travels faster: light or sound?	*Light*, Sound, Both the same
15. Does the Earth go around the Sun, or does the Sun go around the Earth?	*Earth goes around the Sun*, Sun goes around the Earth
16. How long does it take for the Earth to go around the Sun?	One day, one month, *one year*
17. In your own words, what is DNA?	--
18. In your own words, what is a molecule?	--

Note: Correct answers are shown in italics.

For the quantitative analyses, we began by exploring the dimensionality of the items, using both exploratory and confirmatory analyses. Principal components analyses were conducted on the FKS items; the number of eigenvalues greater than 1 in this analysis indicated the maximum number of suitable factors. For solutions containing

more than one factor, we conducted principal factor analyses with promax rotation and squared multiple correlations as the prior communality estimates. The residuals, eigenvalues, scree plot, and factor structure were examined to determine the most appropriate number of factors.

Results of the exploratory factor analyses were also verified using confirmatory factor analysis; all confirmatory factor analyses were computed using the LISREL software program. Because the FKS items were scored dichotomously (i.e., correct vs. incorrect), tetrachoric correlations and an asymptotic covariance matrix were computed and weighted least squares estimation was used (Jöreskog & Sörbom, 1996). A good model fit was defined as having values of .90 for the goodness of fit index, adjusted goodness of fit index, comparative fit index, and incremental fit index (Hoyle & Panter, 1995; Schumacker & Lomax, 1996) and a value of .08 or lower for the standardized root mean square residual (Hu & Bentler, 1999).

After establishing the dimensionality of the FKS scale, the psychometric properties of the individual items were assessed using Item Response Theory (IRT). IRT uses a statistical model to describe the relationship between an individual's response to an item and the underlying construct being measured by the scale (e.g., scientific knowledge). The two-parameter logistic (2PL) IRT model was used to evaluate the FKS items. This model estimates two types of parameters for each item, a slope, or *a,* parameter and a threshold, or *b,* parameter. The threshold measures the item's difficulty; items with higher thresholds are more difficult. The slope is an indicator of item discrimination, which is the ability of the item to distinguish between individuals above or below the threshold; items with higher slopes have greater discrimination. The

Multilog for Windows software program was used to compute the IRT models (Scientific Software International, 2003).

The quantitative results, as well as content considerations, were then used to select items for the short forms. Ideally, items should have high IRT slopes, indicating good discrimination. A short form should contain items with a range of difficulty parameters to effectively measure knowledge among respondents with varying knowledge levels. In addition, short forms should include at least one item from each content area.

Finally, we evaluated the functional equivalence of the short and long forms. We conducted analyses of variance (ANOVAs) and t-tests to compare mean scores on each of the forms across groups of respondents defined according to the following variables: gender, age, education level, level of math and science education, support of government funding for scientific research, belief that astrology is scientific, belief in lucky numbers, and attentiveness to science and technology. To be equivalent, the short forms should exhibit the same group differences as the long form.

The correlation between the short and long forms and the percentage of variance in the long form accounted for by each short form were also computed. (The percentage of variance was computed by regressing the long form on the short form and computing the corresponding R^2.) Both the internal consistency reliability (i.e., Cronbach's alpha) and IRT marginal reliability were computed for the short and long forms; ideally, a short form should demonstrate reliability similar to the long form, although removing items from a scale can often lower its reliability, particularly when measured using Cronbach's alpha. All analyses except for the confirmatory factor analyses and IRT analyses were

weighted using the survey weights provided by NSF.[1] (Please refer to Miller, Kimmel, Hess, Dennis, & Jen (2000) for a description of the creation of the survey weights.)

2.2 Public Understanding of Scientific Inquiry

As shown in Table 2.3, the Public Understanding of Scientific Inquiry scale contains four true/false questions that correspond to this scenario: "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" and assess respondents' understanding of the concept of probability. The scientific inquiry scale also contains two open-ended questions, one that asks about the meaning of scientific study and another that asks the respondent to explain the best method for testing the effectiveness of a medication.

The scientific inquiry scale was evaluated using an approach similar to that used for the FKS. Specifically, the items were divided into content areas and the factor structure of the items was determined using exploratory and confirmatory factor analysis. One difference is that IRT was not used because the four probability items refer to the same scenario and therefore violate the IRT assumption of local independence. Instead, the percentage of correct responses was used to assess the difficulty of the items. In addition, stepwise regression was used to evaluate the contribution of each item to explaining the variation in the scientific inquiry long form scores.[2] The stepwise

[1] The CFA and IRT analyses were not weighted due to software limitations. In particular, there are no commercially available software programs that utilize survey weights in the calculation of IRT parameters.

[2] For these analyses, the scientific inquiry long form was computed as the sum of the items. This approach differs from the scoring algorithm used in the SEI report in which respondents were classified as understanding or not understanding scientific inquiry based on their responses to these items.

regression procedure added items to the model sequentially based on the percentage of unique variation in the outcome that they accounted for.

Table 2.3. Public Understanding of Scientific Inquiry Items

Item	Response Options
1. Does this mean that if their first three children are healthy, the fourth will have the illness?	Yes, *No*
2. Does this mean that if their first child has the illness, the next three will not?	Yes, *No*
3. Does this mean that each of the couple's children will have the same risk of suffering from the illness?	*Yes*, No
4. Does this mean that if they have only three children, none will have the illness?	Yes, *No*
5. In your own words, could you tell me what it means to study something scientifically?	--
6. Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to a 1,000 people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure and not give the drug to another 500 people with high blood pressure and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? Why is it better to test the drug this way?	--

Note: Correct answers are shown in italics.

Based on the results, two possible short forms of the scientific inquiry scale were developed. For each short form, the Cronbach's alpha coefficient, correlation with the long form, and percentage of variance in the long form accounted for by the short form were computed. T-tests and ANOVAs were also used to explore group differences in long and short form scores. Furthermore, because the scientific inquiry items have previously been used to classify respondents as either understanding or not understanding scientific inquiry, we examined the number of respondents classified into these two

groups based on the long and short forms. For the forms to be equivalent, respondents should be classified into the same group regardless of which form is used.

2.3 Indices of Scientific Promise and Reservation

Tables 2.4 and 2.5 present the items comprising the final two measures, the Index of Scientific Promise (ISP) and the Index of Scientific Reservation (ISR). The ISP contains four statements that proclaim various benefits of science and technology, and the ISR consists of three statements describing possible perceived reservations about the advancement of science. For each of the statements, respondents indicate their level of agreement from "strongly agree" to "strongly disagree."[3]

Table 2.4. Index of Scientific Promise Items

Question	Response Options
1. Science and technology are making our lives healthier, easier, and more comfortable.	Strongly agree, Agree, Disagree, Strongly disagree
2. Most scientists want to work on things that will make life better for the average person.	Strongly agree, Agree, Disagree, Strongly disagree
3. With the application of science and new technology, work will become more interesting.	Strongly agree, Agree, Disagree, Strongly disagree
4. Because of science and technology, there will be more opportunities for the next generation.	Strongly agree, Agree, Disagree, Strongly disagree

[3] For these analyses, responses to the ISP and ISR items were recoded as follows: strongly disagree (1), disagree (2), don't know, refused, or missing (3), agree (4), and strongly agree (5).

Table 2.5. Index of Scientific Reservation Items

Question	Response Options
1. We depend too much on science and not enough on faith.	Strongly agree, Agree, Disagree, Strongly disagree
2. It is not important for me to know about science in my daily life.	Strongly agree, Agree, Disagree, Strongly disagree
3. Science makes our way of life change too fast.	Strongly agree, Agree, Disagree, Strongly disagree

First, we conducted exploratory factor analyses to determine if the items form two factors, with one factor containing the scientific promise items and the other factor containing the scientific reservation items. Next, we computed item-total correlations and the percentage of respondents who endorsed each item by indicating that they "agree" or "strongly agree" with the statement. As with the scientific inquiry scale, we also computed stepwise regressions to determine which combination of items explains the most unique variance in the long form scores.

Because of the small number of items constituting these indices, we used a slightly different approach to selecting items for the short forms. If we were to select only items with high factor loadings and/or item-total correlations, we would run the risk of developing a short form with very narrow content coverage and limited variability in responses. The resulting short form would have limited ability to discriminate between respondents and effectively measure the construct.

Therefore, we took two approaches to developing the short forms. For the first short form, we utilized the same approach as with the previous scales. Specifically, we selected items that seemed to be related to each other, as demonstrated by high factor loadings and item-total correlations, and therefore appeared to be measuring the same construct. For the second short form, the goal was to select items that were the most

diverse and would provide greater content coverage. For example, the stepwise regression results were used to identify items that accounted for the most unique variation in the long forms.

The functional equivalence of the long and short forms was then evaluated. The long and short form mean scores were compared according to various demographic characteristics and responses to other items on the survey. The SEI report includes a ratio of scientific promise to scientific reservation as a measure of the public's attitudes toward science. We computed the promise/reservation ratios using both the long and short ISP and ISR forms. Ideally, the short forms should maintain the ratio found using the long forms.

Finally, due to the small number of items on these indices, we also explored the possibility of replacing the long forms with only one item from each index. Although a one-item index would have less variability in scores than a longer index, it could provide a useful reduction in the time needed for survey administration. To examine the properties of the one-item indices, we calculated the percentage of variance in the long form scores explained by each individual item. We also computed the promise/reservation ratios for all individual item combinations to determine which combination provides a ratio similar to that found with the long forms. Finally, we computed the mean long form scores by the one-item scores; ideally, there should be a monotonic relationship between a one-item index and the long form, with the long form scores increasing as the values on the one-item index increase.

3. Factual Knowledge of Science

3.1 Psychometric Properties of Long Form

The 18 items on the Factual Knowledge of Science (FKS) long form may be classified into the following seven content areas, as shown in Table A-1: (1) Life science/biology, (2) Evolution/history of Earth, (3) Geology/geography, (4) Astronomy, (5) Radioactivity, (6) Physics, and (7) Chemistry. The largest content areas are evolution, with three items, and life science, with five items. The remaining content areas contain only two items each.

As a first step in evaluating the factor structure of the scale, principal components analyses were conducted on the FKS items. For each year, two eigenvalues were greater than 1, suggesting a maximum of two factors. Exploratory factor analyses were conducted to examine one- and two-factor solutions. Examination of the factor structures for both the one- and two-factor solutions suggested that the one-factor solution is most appropriate. The factor loadings for the one-factor solution are presented in Table A-2; values of 0.30 or greater are shown in bold. The items demonstrated similar factor structure across all 3 years. For example, in each year, items 3 (oxygen comes from plants), 4 (father's gene decides sex of baby), and 11 (smoking causes lung cancer) had very low factor loadings. One slight difference between the years was that item 13 (radioactive milk made safe by boiling) had a slightly higher factor loading in 1999 than in 1997 and 2001, when it did not have a value of .30 or greater.

Confirmatory factor analyses were also conducted to test the one-factor solution. As shown in Table A-3, all of the goodness of fit indices are greater than 0.90 and the

standardized root mean square residuals are less than 0.08, indicating a good fit. These results further support the appropriateness of the one-factor solution.

Both the exploratory and confirmatory factor analysis results indicate that the FKS items satisfy the IRT assumption of unidimensionality. Therefore, we computed two-parameter logistic (2PL) IRT models for the FKS items in each year; the resulting parameter estimates are presented in Table A-4.[4] Ideally, the slope or *a* parameter for an item should have a value of 1 or higher, indicating that it can discriminate between respondents above and below the threshold. However, as shown in the table, three items, item 3 (oxygen comes from plants), item 4 (father's gene decides sex of baby), and item 11 (smoking causes lung cancer), have low slopes.

Examining the *b* parameters provides information about the difficulty of the items. Items with smaller *b* parameters are easier, and items with larger *b* parameters are more difficult. Ideally, a knowledge scale should contain items with a wide range of difficulty levels to effectively measure knowledge among a diverse group of individuals. Overall, it appears that the FKS has a good spread of difficulty levels. Item 3 (oxygen comes from plants) and item 11 (smoking causes lung cancer) are clearly the easiest items, with difficulty parameters of -2.90 and -4.93 during 1997. In contrast, the two open-ended items, item 17 (meaning of DNA) and item 18 (meaning of molecule) were among the most difficult, with difficulty parameters of 1.17and 0.81 during 1997.

[4] Because Items 15 (Earth travels around Sun) and 16 (Length of Earth orbit) are not locally independent, they were combined into a testlet and the Nominal model, rather than the 2PL model, was used.

3.2 Development of Short Form—Version 1

Results of the quantitative analyses for the long form were used to inform the selection of items for the first version of the short form. Using the values for the IRT parameters, items were selected to maintain a good distribution of difficulty levels on the short form. Items with low factor loadings and/or IRT slopes were generally excluded from the short form. Specifically, items 3 (oxygen comes from plants), 11 (smoking causes lung cancer), and 13 (radioactive milk made safe by boiling) were excluded due to their low loadings and slopes. In addition to its low loadings, item 11 was also excluded because very few individuals answered it incorrectly,[5] suggesting it provides limited information and can only discriminate among those with very little knowledge. One exception to this criterion is item 4 (father's gene determines sex of baby), which was retained despite its low slopes and factor loadings. Item 4 was included on the short form because it is the only item that females consistently answer correctly more often than males. Removing this item could affect the equivalence of the short and long forms by changing the trends found over time if the short form rather than the long form is used.

Content was also an important consideration when developing the short form. An attempt was made to preserve the content coverage of the long form by retaining at least one item from each of the seven content areas. Substantive importance and impact of each item were also considered.

Balancing these considerations, an 11-item short form was developed. The short form contains items representing all content areas; the items by content area are presented in Table 3.1. As with the long form, the items on the short form constituted one factor;

the corresponding factor loadings are shown in Appendix Table A-5, and the confirmatory factor analysis fit indices are presented in Table A-6. All items except for item 4 (father's gene decides sex of baby) had loadings of greater than .30. Table A-7 contains the IRT parameters for the short form items. The items represent a good spread of difficulty levels, with *b* parameters in 1997 ranging from -2.14 for item 4 (father's gene decides sex of baby) to 0.96 for item 17 (meaning of DNA).

Table 3.1. FKS Short Form (Version 1): Items by Content Area

Content Area/Item
Life science/biology
4. Father's gene decides sex of baby
7. Antibiotics kill viruses and bacteria
17. Meaning of DNA
Evolution/history of Earth
8. Universe began with explosion
10. Humans developed from earlier species
Geology/geography
1. Center of Earth is hot
9. Continents moving and will continue to
Astronomy
15. Earth travels around Sun
Radioactivity
2. Radioactivity man-made
Physics
5. Lasers focus sound waves
Chemistry
6. Electrons smaller than atoms

[5] The percentage of respondents answering item 11 correctly in each year are as follows: 92.8% in 1997, 93.8% in 1999, and 94.0% in 2001.

3.3 Development of Short Form—Version 2

Another possible short form for the FKS scale was also developed. Given the concern about response rates and the length of time required to administer open-ended items, the second version of the FKS short form excluded both open-ended FKS items (items 17 and 18). The items constituting Version 2 of the FKS short form are presented in Table 3.2. This scale contains all of the same items as Version 1 with the exception of item 17 (meaning of DNA); item 16 (length of Earth orbit) was included in its place.

Table 3.2. FKS Short Form (Version 2): Items by Content Area

Content Area/Item
Life science/biology
4. Father's gene decides sex of baby
7. Antibiotics kill viruses and bacteria
Evolution/history of Earth
8. Universe began with explosion
10. Humans developed from earlier species
Geology/geography
1. Center of Earth is hot
9. Continents moving and will continue to
Astronomy
15. Earth travels around Sun
16. Length of Earth orbit
Radioactivity
2. Radioactivity man-made
Physics
5. Lasers focus sound waves
Chemistry
6. Electrons smaller than atoms

As expected, the Version 2 items formed a single factor. Factor loadings and fit indices are presented in Tables A-8 and A-9, respectively. As shown in Table A-10, all of the items except for item 4 (father's gene decides sex of baby) have good IRT slope parameters. The IRT difficulty parameters in 1997 ranged from -2.56 for item 4 (father's

gene decides sex of baby) to 0.77 for item 8 (universe began with explosion). This range is somewhat reduced due to the removal of the open-ended item, item 17. With the exclusion of this item, the short form no longer contains any items at the higher level of difficulty.

3.4 Equivalence of Short and Long Forms

Next, scores were computed for both the long and short FKS scales. Each score is the percentage of items on the scale that were answered correctly. Don't know responses were considered to be incorrect.

A primary goal of this study was to develop short forms that are functionally equivalent to the long form. To be a suitable replacement to the long form, we would expect a short form to be highly correlated with the long form, account for a large percentage of variance in the long form scores, have similar reliability coefficients, and demonstrate the same group differences in mean scores.

Table A-11 presents the reliability indices for all three FKS scales. The Cronbach's alphas were very similar for the long form and both short forms. However, the IRT marginal reliability is somewhat lower for the short forms than the long form. As shown in Table A-12, both short forms had a correlation of 0.95 with the long form and accounted for approximately 90 percent of the variance in long form scores.

Tables A-13 to A-20 present the FKS long and short form means, standard deviations, and significance tests by various background characteristics and beliefs. For all variables, significant group differences were found with every FKS form. Examining the means in Table A-13 indicates that males consistently received higher knowledge

scores regardless of which form was used. Table A-14 presents the FKS scores by respondent age. On both the long and short forms, respondents who are 65 years old or older consistently had lower knowledge scores than the other age groups. Tables A-15 and A-16 present knowledge scores by educational achievement and level of math and science education, respectively. Consistent with expectations, respondents with higher education and more math/science background had higher knowledge scores.

As a part of the survey, respondents are asked whether they feel the government is spending "too much" or "too little" on scientific research. Respondent FKS scores by their responses to this question are presented in Table A-17. All forms demonstrate a similar pattern, with respondents who felt the government is spending "too little" having higher knowledge scores than those who felt that government funding is "about right" or "too much."

Table A-18 shows FKS mean scores by belief that astrology is scientific. On each form, respondents who believe astrology is "not at all scientific" have higher knowledge scores than those who believe it is "sort of scientific" or "very scientific." Similarly, in Table A-19, individuals who disagree with the statement that some numbers are lucky for some people demonstrated more scientific knowledge than those who agree.

Finally, Table A-20 presents FKS long and short form scores by attentiveness to science and technology. Respondents were classified as "attentive," "interested," or "residual" based on whether they felt they are interested and/or well informed about scientific discoveries and new technologies and how often they read a daily newspaper or science-related magazine. As shown in the table, respondents who are "attentive" to

science and technology receive higher scores than those who are "interested" or in the "residual" group on all three FKS forms.

3.5 Summary

In this chapter, we outlined the development and evaluation of two possible short forms for the Factual Knowledge of Science scale. Table 3.1 summarizes the properties of the FKS long and short forms. Both short forms reduced the number of items to 11, were highly correlated with the long form, accounted for a large percentage of variation in long form scores, had similar Cronbach's alphas, and detected the same relationships with the background variables as the long form. The short forms also contain items from each content area and include items with a variety of difficulty parameters. One difference is that, in contrast to the long form and the Version 1 short form, the Version 2 short form does not contain any open-ended items, which would reduce the amount of time need for its administration.

Table 3.3. Comparison of Long and Short Factual Knowledge of Science Forms

Characteristic	Long Form	Short Form Version 1	Short Form Version 2
Number of items	18	11	11
Does form contain open-ended items?	Yes	Yes	No
Cronbach's alpha*	.70	.70	.71
IRT-based reliability coefficient*	.79	.72	.70
Correlation with long form*	--	.95	.95
Percentage of variance in long form accounted for*	--	90%	90%
Does short form detect same group differences as long form?	--	Yes	Yes
Number of items by content area			
Life science/biology	5	3	2
Evolution/history of Earth	3	2	2
Geology/geography	2	2	2
Astronomy	2	1	2
Radioactivity	2	1	1
Physics	2	1	1
Chemistry	2	1	1
Number of items according to difficulty parameter estimates*			
< -1.00	5	5	4
-1.00 to -0.01	3	2	2
0.00 to 1.00	8	4	3
> 1.00	0	0	0

* Averaged across all 3 years

Note: Two of the items on the long form and Version 2 short form do not have difficulty parameter estimates because they were analyzed using the Nominal IRT model due to their local dependence.

4. Public Understanding of Scientific Inquiry

4.1 Psychometric Properties of Long Form

The six items on the Public Understanding of Scientific Inquiry scale were divided into two content areas, Probability and Scientific Study, as shown in Table B-1 in Appendix B. An exploratory factor analysis indicated that the four items formed one factor in all three survey years; the factor loadings are shown in Table B-2. In each year, the two open-ended items measuring understanding of scientific study, items 5 (meaning of scientific study) and 6 (best way to test drug), had lower factor loadings than the remaining items. This may be due to the larger number of items addressing probability than scientific study. Also, the probability items would be expected to be highly related because they all refer to the same scenario. The scientific inquiry items could possibly split into two factors, one factor for probability and another factor for scientific study, if the scale included more items on scientific study. The one-factor confirmatory factor analyses also support a one-factor solution based on the fit indices presented in Table B-3.

To assess item difficulty, we computed the percentage of correct responses for each of the scientific inquiry items; these results are presented in Table B-4. Overall, the probability items had much higher correct percentages and therefore were less difficult than the scientific study questions. This result could be due to the fact that the scientific study items were open-ended and therefore the probability of guessing the correct answer is greatly reduced. Among the probability items, item 3 (each of the couple's children will have same risk of getting illness) was more difficult than the other three items.

Next, stepwise regression was used to determine which items account for the most unique variation in scientific inquiry long form scores. As shown in Table B-5, items 2, 3, 5, and 6 accounted for approximately 90 percent of variance in the scientific inquiry long form scores on the 1997 and 1999 surveys. The 2001 results differed slightly with item 1 rather than item 2 being entered first into the model.

4.2 Development of Short Form—Version 1

The first possible short form was developed by selecting items that have a variety of difficulty levels, explain a large percentage of variance in the long form scores, and cover both content areas. As shown in Table 4.1, the resulting form included items 2 (if first child has illness, next three will not), 3 (each of the couple's children will have same risk of getting illness), 5 (meaning of scientific study), and 6 (best way to test drug). Among the probability items, item 3 was selected because conceptually it differs from the other three items and is also the only item for which "yes" is the correct response. Item 2 was chosen from the remaining three probability items because it was selected first in the stepwise regression models with the 1997 and 1999 data and therefore accounted for the most unique variance in the scientific inquiry long form scores. Items 5 and 6 were included because they are the only two items addressing understanding of scientific study.

As expected, the items on the Version 1 short form combined into one factor. The factor loadings for each year are presented in Appendix Table B-6. Table B-7 displays the percentages of correct responses for the items constituting the short form. As shown

in the table, the scale includes items covering the same range of difficulty levels as the long form.

Table 4.1. Scientific Inquiry Short Form (Version 1): Items by Content Area

Content Area/Item
Probability
2. If first child has illness, the next three will not
3. Each of the couple's children will have same risk of getting illness
Scientific Study
5. Meaning of scientific study
6. Best way to test drug

4.3 Development of Short Form—Version 2

The primary motivation for this study was to shorten the scales in order to reduce the length of time needed for survey administration. While the first version of the scientific inquiry short form may preserve much of the information provided by the long form, the removal of the two probability items may not result in a significant time savings. The probability scenario would still need to be read in order for respondents to answer the two probability items included on the short form. Version 1 also includes both open-ended items, items 5 and 6, which themselves require significant administration time.

Therefore, the second version of the short form also removed one of the open-ended items, item 5 (meaning of scientific study), from the first version. This item was selected for removal because it is more difficult for respondents, as indicated by the lower percentage of correct responses. This may be because respondents must formulate an answer on their own rather than having a scenario to respond to, as in the case of item

6 (best way to test drug). Including the slightly easier item (item 6) could help foster participant responsiveness by avoiding possible frustration caused by trying to answer a more difficult question.

Table 4.2 lists the items on the Version 2 short form by content area. As with the Version 1 short form, the Version 2 items form a single factor; the factor loadings are listed in Appendix Table B-8. As shown in Table B-9, the short form cannot effectively measure understanding of scientific inquiry for respondents with the highest level of knowledge due to the exclusion of the most difficult item, item 5. However, the scale still retains items at the middle to easier difficulty levels.

Table 4.2. Scientific Inquiry Short Form (Version 2): Items by Content Area

Content Area/Item
Probability
2. If first child has illness, the next three will not
3. Each of the couple's children will have same risk of getting illness
Scientific Study
6. Best way to test drug

4.4 Equivalence of Short and Long Forms

As shown in Table B-10, the reliability coefficients for the scientific inquiry long form are higher than those for either short form. Among the short forms, Version 1 has slightly higher values than Version 2. Because Cronbach's alpha is influenced by scale length, these results are probably attributable to the smaller number of items included on the short forms.

Scores for both the long and short forms were computed as the percentage of scientific inquiry items answered correctly. We then calculated the correlation between scores on each short form and the long form and regressed the long form scores on the short form scores to determine the percentage of variance in long form scores accounted for by the short form scores. These results are presented in Table B-11. As would be expected due to the greater number of items included on the scale, the Version 1 short form had higher correlations with the long form ($r = .93$ to $.94$) and accounted for a larger percentage of variance (87 percent) than the Version 2 short form.

In previous SEI reports, the scientific inquiry items have been used to classify respondents as either understanding or not understanding scientific inquiry (e.g., National Science Board, 2000, 2002). We also classified respondents into these two groups using the long and short forms to determine how many respondents are misclassified when a short form is used instead. As shown in Table B-12, when the Version 1 short form is used, only about 2 to 3 percent of respondents who are classified as not understanding scientific inquiry using the long form are incorrectly classified as understanding with the use of the short form. There are no errors for respondents who understand scientific inquiry (as measured by the long form).

Version 2 has only slightly more errors in classification. As shown in Table B-13, similar percentages of respondents who do not understand scientific inquiry were classified as understanding with the short form. However, there are also about 1 to 2 percent of respondents who understand scientific inquiry based on long form scores who were classified as not understanding with the short form, resulting in an overall error rate of about 3 to 4 percent for the Version 2 short form.

Tables B-14 to B-21 present the scientific inquiry long and short form means, standard deviations, and significance tests by the following variables: gender, age, formal education, level of math and science education, support of government funding for scientific research, belief that astrology is scientific, belief in lucky numbers, and attentiveness to science and technology. Generally, both short forms demonstrated similar group differences as with the long form, with the exception of the gender comparisons. While the long form and the Version 1 short form indicated significant differences in 1997 and nonsignificant differences in 1999, the opposite is true of the Version 2 short form. Overall, the following groups tended to have greater understanding of scientific inquiry as measured by any of the three forms: (1) males, (2) ages between 25 and 34, (3) higher educational achievement, (4) more math and science background, (5) belief that government funding of scientific research is "too little" or "about right," (6) belief that astrology is "not at all scientific," (7) disagreement with the statement that some numbers are lucky, and (8) attentiveness to or interest in science and technology.

4.5 Summary

Table 4.3 outlines the characteristics of the Public Understanding of Scientific Inquiry short and long forms. The Version 1 short form has a high correlation with the long form, accounts for about 87 percent of its variation, and detected the same group-level differences. However, Version 1 still retains both open-ended scientific study items, which require substantial administration time. In contrast, Version 2 removes one of the open-ended items, which has the benefit of lowering respondent burden; however, it has a lower correlation with long form and does not detect the same gender differences.

Table 4.3. Comparison of Long and Short Public Understanding of Scientific Inquiry Forms

Characteristic	Long Form	Short Form Version 1	Short Form Version 2
Total number of items	6	4	3
Number of open-ended items	2	2	1
Cronbach's alpha*	.60	.45	.38
Correlation with long form*	--	.93	.87
Percentage of variance in long form accounted for*	--	87%	74%
Percentage of respondents who change classification when using short form*	--	2%	4%
Does short form detect same group differences as long form?	--	Yes	Yes, with the exception of gender
Number of items by content area			
Probability	4	2	2
Scientific study	2	2	1
Number of items according to % correct*			
0-20% correct	0	0	0
21-40% correct	2	2	1
41-60% correct	0	0	0
61-80% correct	3	1	1
81-100% correct	1	1	1

* Averaged across all 3 years.

5. Indices of Scientific Promise and Reservation

5.1 Psychometric Properties of ISP and ISR Long Forms

The final two measures are the Index of Scientific Promise (ISP) and Index of Scientific Reservation (ISR), which are designed to assess overall attitudes toward scientific research. The items for these indices by topic are listed in Appendix Table C-1. We began by conducting exploratory factor analyses to evaluate the factor structure of the items; these results are presented in Appendix tables C-2 to C-4. As expected, the items split into two factors corresponding to the two indices, with one factor representing scientific promise and the other representing scientific reservation.

The number of respondents who agree or strongly agree with each statement is presented in Table C-5. Overall, respondents were most likely to agree that "science and technology are making our lives healthier, easier, and more comfortable" (ISP item 1) and least likely to endorse the view that "it is not important for me to know about science in my daily life" (ISR item 2). Table C-6 shows the item-total correlations for each index. Generally, items 3 (work will become more interesting) and 4 (more opportunities for next generation) on the Promise index have higher item-total correlations. Among the Reservation items, item 2 (not important to know about science) has the lowest item-total correlations, suggesting it is less related to the other two items.

Scores for the Promise and Reservation long forms were computed as the mean of the items. To help identify items for inclusion in the short forms, stepwise regression was used to identify items that are good predictors of the long form scores. As shown in Table C-7, items 1 (makes our lives easier), 2 (scientists want to make life better), and 3 (work will become more interesting) were selected first by the model with the 1997 and

1999 data and account for 92 percent of the variation in long form scores. The 2001 results were slightly different, with item 4 (more opportunities for next generation) being selected first instead of item 3 (work will become more interesting).

For the Reservation index, items 1 (depend too much on science, not enough on faith) and 2 (not important to know about science) were selected first in all 3 years (see Table C-8). Together these items account for about 82 to 84 percent of variation in the Index of Scientific Reservation long form.

A useful indicator of public sentiment toward science and technology is the ratio of the Index of Scientific Promise to the Index of Scientific Reservation. Ideally, the value of this ratio would be maintained when changing from the long ISP and ISR forms to the short forms. To evaluate the impact of removing items from the indices, we computed the promise/reservation ratio when one item at a time is removed from the calculations (see Appendix Table C-9). The removal of items 2 (scientists want to make life better), 3 (work will become more interesting), and 4 (more opportunities for next generation) from the Promise index had very little impact on the overall ratio. Of the Reservation items, removing item 2 (not important to know about science) produced the greatest change in ratio values, while removing item 3 (science makes life change too fast) had the smallest effect on the ratio.

5.2 Development of ISP Short Form—Version 1

To develop Version 1 of the ISP, we identified items that were highly related to each other and appeared to be measuring the same construct. Also, to ensure at least some variability in index scores, we selected items that had differing levels of agreement.

The resulting short form is presented in Table 5.1; the levels of agreement for the items on the short form are shown in Table C-10 in Appendix C. This index includes all of the ISP items except for item 2 (scientists want to make life better). This item was excluded because it had lower item-total correlations and its content differed from the other items. Specifically, it asks about scientists rather than science in general. Furthermore, the ratio of scientific promise to scientific reservation changes very little when this item is removed (see Table C-9).

Table 5.1. Index of Scientific Promise (ISP) Short Form (Version 1)

Item
1. Science and technology are making our lives healthier, easier, and more comfortable
3. With the application of science and new technology, work will become more interesting
4. Because of science and technology, there will be more opportunities for the next generation

5.3 Development of ISP Short Form—Version 2

A slightly different approach was used for the development of the second short form. Selecting only similar items on an index with such few items can produce an index with very narrow content and limited ability to distinguish between respondents with differing levels of understanding of scientific inquiry. Version 2 of the short form is presented in Table 5.2. This scale includes all of the ISP items except item 4 (more opportunities for next generation). Item 4 is removed because it has somewhat similar content to item 3 (work will become more interesting) (i.e., a focus on the impact of science on the future). It is also the final item entered into the stepwise regressions (see Table C-7), suggesting it is explaining the least amount of unique variance in the long

form. The ratio of promise to reservation also stays nearly identical when this item is removed.

Table 5.2. Index of Scientific Promise (ISP) Short Form (Version 2)

Item
1. Science and technology are making our lives healthier, easier, and more comfortable
2. Most scientists want to work on things that will make life better for the average person.
3. With the application of science and new technology, work will become more interesting

5.4 Equivalence of ISP Short and Long Forms

The ISP Version 1 short form demonstrated reliability coefficients similar to those of the long form (see Appendix Table C-11). The Version 2 short form had slightly lower values. This result is expected because Cronbach's alphas are higher when a scale includes very similar items and, as mentioned earlier, the most similar items were selected for the Version 1 index while the goal of the Version 2 index was to introduce more variability in responses by including an item that differed somewhat from the others. Although the two ISP short forms differ somewhat in content and reliability levels, they both have very high correlations with the long form and account for a large percentage of variance in long form scores (see Table C-12).

The group comparisons for the Promise indices are presented in Tables C-13 to C-20. In general, the short forms detect the same group differences as the long form. Specifically, greater belief in the promise of science is associated with being male, having more education and math/science background, believing that there is too little government funding for scientific research, believing in lucky numbers, and being

attentive to science and technology. There were slight differences for the Version 1 short form. Specifically, it indicated significant education differences in 2001, although the long form and Version 2 short form did not. It also had differing results from the long form and Version 2 for the 1997 and 2001 comparisons by belief that astrology is scientific.

5.5 Development of ISR Short Form—Version 1

Similar to the Version 1 ISP short form, the Version 1 ISR short form was developed by selecting items with the greatest similarity. The resulting short form included items 1 (depend too much on science, not enough on faith) and 3 (science makes life change too fast) (see Table 5.3). Item 2 (science not important in daily life) was excluded because it has the lowest item-total correlations, suggesting it is least related to the other items. It also has a low endorsement rate (about 14 to 16 percent of respondents agreed with this statement; see Table C-21), suggesting it is relevant to only a small proportion of the sample. Finally, it conceptually seems to be addressing a lack of interest in science rather an opposition to it.

Table 5.3. Index of Scientific Reservation (ISR) Short Form (Version 1)

Item
1. We depend too much on science and not enough on faith
3. Science makes our way of life change too fast

5.6 Development of ISR Short Form—Version 2

As with Version 2 of the ISP, the second version of the ISR was developed by selecting items that cover a broader range of content rather than selecting the most similar items (see Table 5.4). Items 1 (depend too much on science, not enough on faith) and 2 (not important to know about science) were included in the Version 2 short form (see Table C-22). Item 3 (science makes life change too fast) was not included because it is entered last in the stepwise regression, suggesting that it has a smaller contribution to the explanatory power of the model after the other two items are entered; items 1 and 2 account for 82 to 84 percent of the variation in the long form scores. Item 3 also had the smallest effect on the promise/reservation ratio when it was removed.

Table 5.4. Index of Scientific Reservation (ISR) Short Form (Version 2)

Item
1. We depend too much on science and not enough on faith
2. It is not important for me to know about science in my daily life

5.7 Equivalence of ISR Long and Short Forms

The reliability coefficients for each of the ISR forms are presented in Table C-11. Consistent with the ISP findings, the Version 1 ISR short form had reliability coefficients similar to those for the long form, probably due to the similarity of the questions included on the form. In fact, the alphas are slightly higher for the Version 1 form, possibly as a result of removing item 2 (not important to know about science), which is conceptually different than the other two items. Both short forms were highly correlated with the long

form and accounted for approximately 80 percent of the variance in the long forms (see Table C-21).

Tables C-23 to C-30 contain the group-level comparisons. All three forms detected the same significant group differences. In general, greater reservations to science were associated with (1) female gender, (2) older age, specifically 65 years and older, (3) less education, (4) less math/science background, (5) belief that there is too much government funding for scientific research, (6) belief that astrology is very scientific, (7) belief in lucky numbers, and (8) lack of interest in or attentiveness to science and technology. In general, the mean values for the Version 2 short form more closely approximated the long form means than did the Version 1 short form.

5.8 One-Item ISP and ISR Indices

We also explored the possibility of simply using one-item indices for the ISP and ISR. To help with the selection of the items, we computed the percentage of variance in the long form scores, which are accounted for by each individual item (see Table C-31). This analysis differs slightly from the stepwise regression results reported earlier; in this case, only one item at a time is entered into the model. On the Promise index, items 3 (work will become more interesting) and 4 (more opportunities for next generation) accounted for the highest percentages of variance. Among the Reservation items, item 2 (not important to know about science) accounted for the smallest percentage of variance, indicating that it would not be a good candidate for use as a one-item index.

Next, we explored whether the value for the ratio of promise to reservation would remain the same if we replaced the promise and reservation indices with just one item

each. Table C-32 presents the promise/reservation ratios for all possible combinations of individual items. As shown in the table, the ratios when using the entire promise and reservation indices were 1.64 in 1997, 1.58 in 1999, and 1.58 in 2001. Reviewing the item combinations suggests that ISP item 2 (scientists want to make life better) and ISR item 3 (science makes life change too fast) came closest to retaining the ratio found with the long forms in 1997 (ratio=1.63) and 1999 (ratio=1.58) although it was somewhat different in 2001 (ratio=1.66). The combination of ISP item 4 (more opportunities for next generation) and ISR item 1 (depend too much on science, not enough on faith) also came close to preserving the overall ratio: 1997 (ratio=1.58), 1999 (ratio=1.55), and 2001 (ratio=1.54).

Finally, we plotted the mean long form scores for each index by responses to each of the individual items (see Figures D-1 to D-7 in Appendix D). If the item is a good substitute for the long form, it should demonstrate a monotonic relationship in which the long form means increase as values on the item increase, suggesting that respondents would receive similar scores regardless of which measure is used. For all of the items, ANOVAs indicated significant differences in mean long form scores according to responses on the individual items (see Table C-33). Examining the patterns of means suggests that all of the items show monotonic relationships with the long form scores. Among the items, ISP item 4 (more opportunities for next generation) and ISR items 1 (depend too much on science, not enough on faith) and 3 (science makes life change too fast) demonstrated particularly strong increasing relationships, which would make them good candidates for use as single item measures.

5.9 Summary

This chapter outlined the creation of two potential short forms for both the Index of Scientific Promise and the Index of Scientific Reservation. Table 5.5 lists characteristics of the long and short ISP forms. Both short forms had high correlations with the long form and therefore accounted for a large percentage of variation in long form scores. They also maintained the general distribution of agreement levels of the long form and detected the same group-level differences. However, the Version 2 short form had somewhat lower reliability coefficients.

The analyses of the one-item indices suggest that ISP item 4 (more opportunities for the next generation) and ISR item 1 (depend too much on science, not enough on faith) are the most promising one-item indices. They accounted for large percentages of variance in the long forms, demonstrated strong increasing relationships with the long form scores, and produced similar promise/reservation ratios to those found with the complete promise and reservation indices. However, it should be noted that each of these items has limitations and may not fully capture respondents' beliefs about science. For example, ISR item 1 may cover only religious or spiritual reservations about science and not measure more secular concerns.

Table 5.5. Comparison of Long and Short Index of Scientific Promise Forms

Characteristic	Long Form	Short Form Version 1	Short Form Version 2
Total number of items	4	3	3
Cronbach's alpha*	.62	.59	.48
Correlation with long form*	--	.95	.94
Percentage of variance in long form accounted for*	--	90%	89%
Does short form detect same group differences as long form?	--	Yes	Yes
Number of items by percentage of agreement*			
70-75%	1	1	1
76-80%	0	0	0
81-85%	2	1	1
85-90%	1	1	1

* Averaged across all 3 years.

Note: No items had agreement levels of less than 70 percent or greater than 90 percent.

Properties of the ISR short and long forms are outlined in Table 5.6. The Cronbach's alpha for the Version 1 short form actually increased slightly over the long form, while the Version 2 alpha is greatly reduced. Both short forms accounted for similar percentages of variance and were able to detect the same group-level differences as the long form. Version 2 contains items with the highest and lowest levels of agreement, while Version 1 includes items at only the higher agreement levels.

Table 5.6. Comparison of Long and Short Index of Scientific Reservation Forms

Characteristic	Long Form	Short Form Version 1	Short Form Version 2
Total number of items	3	2	2
Cronbach's alpha*	.47	.51	.26
Correlation with long form*	--	.91	.90
Percentage of variance in long form accounted for*	--	83%	80%
Does short form detect same group differences as long form?	--	Yes	Yes
Number of items by percentage of agreement*			
10-19%	1	0	1
20-29%	0	0	0
30-39%	1	1	0
40-49%	1	1	1

* Averaged across all 3 years.

Note: No items had agreement levels of less than 10 percent or greater than 49 percent.

6. Conclusion and Discussion

This report described the development and psychometric evaluation of two short forms for each of the following four scales/indices included on the NSF Survey of Public Attitudes: Factual Knowledge of Science scale, Public Understanding of Scientific Inquiry scale, Index of Scientific Promise, and Index of Scientific Reservation. The short forms were developed based on both content and the results of psychometric analyses. The functional equivalence of the short forms and the original scale were also evaluated.

The results suggest that the Factual Knowledge of Science short forms performed very well. They reduced the number of items by approximately 40 percent (7 out of 18 items were removed) while still retaining enough items to cover each of the content areas. Both short forms had Cronbach's alpha reliability coefficients nearly identical to those for the long form and were highly correlated with the long form. They also detected all of the group-level differences indicated by the original scale. While both short forms are suitable replacements for the long form, the Version 2 scale does not include any open-ended items and therefore has the advantage of requiring less time to administer. However, the Version 1 scale includes an open-ended item and may be useful when guessing is a concern and adequate time is available.

The first short form for the Public Understanding of Scientific Inquiry scale also performed very well. It appeared to be functionally equivalent to the long form. It correlated highly with the long form scores, accounted for a large percentage of variance, and demonstrated the same relationship with other items on the survey. In addition, it misclassified only 2 percent of the respondents as when compared to the long form. However, one disadvantage of this form is that it retains both open-ended items and

therefore is not likely to significantly reduce time needed to complete the survey. The Version 2 short form removed one of the open-ended items, which reduces administration time but lowers the reliability of the short form and its correlation with the long form. However, if the goal is simply to classify respondents as understanding or not understanding scientific inquiry, the Version 2 short form is also a good alternative for the long form with a misclassification rate of only 4 percent.

The Index of Scientific Promise and Index of Scientific Reservation both contain a very small number of items (four and three items, respectively). Therefore, each of the short forms was only able to make a small reduction in the number of items. Both short forms for the Index of Scientific Promise demonstrated good functional equivalence with the long form. They were highly correlated with the long form scores, accounted for a large percentage of variance, demonstrated similar group-level differences, and maintained the distribution of agreement levels.

Among the Index of Scientific Reservation short forms, the Version 1 form performed well on all of the measures and actually increased the Cronbach's alpha over the long form. Although the Version 2 form was highly correlated with the long form, it had a much lower reliability coefficient due to the inclusion of an item that seemed to address lack of interest in science rather than an overt opposition to it. However, because this item is included in the long form, the Version 2 form seems to be a closer representation of the long form and had similar mean values.

Overall, this study produced several short forms that are suitable replacements for the long forms. However, with the removal of items from a scale, there is always some loss of information and the appropriate short form should be selected based on the goals

of a particular study. The primary objectives of this study were to develop short forms that reduced administration time while still preserving the relationships, such as the group-level differences, that have been found previously with the long forms. Based on these criteria, we recommend the Version 1 short form for the Index of Scientific Promise and the Version 2 short forms for the Factual Knowledge of Science scale, Public Understanding of Scientific Inquiry scale, and the Index of Scientific Reservation. Both FKS short forms performed very well; however, the Version 2 scale is recommended because it does not contain open-ended items and therefore should significantly reduce the time needed for administration. Although the Version 2 scientific inquiry scale did not have as high a reliability as the Version 1 scale, it removed an open-ended item while still maintaining a small error rate (4 percent) for classifying respondents as understanding or not understanding scientific inquiry. While both ISP short forms were good substitutes for the long form, the Version 1 short form is recommended because it removes the scientist item (item 3) and therefore only contains items concerning science in general. Finally, we suggest Version 2 of the Reservation index because it has mean scores similar to those for the long form and therefore meets the criterion of preserving relationships found with the long form.

It is important to note that the current study utilized only the existing set of items when developing the short forms. This approach has the advantage of allowing users of the public use dataset to retroactively analyze prior years' data using the short forms instead. However, the short forms could be improved by refining some of the existing items and perhaps developing new items. In particular, further development is needed for the Index of Scientific Reservation. For example, item 1 on the ISR states, "We depend

too much on science, not enough on faith." This item appears to be double-barreled. In other words, it really seems to include two statements, "we depend too much on science" and "we do not depend enough on faith." Respondents could have difficulty responding if they agree with one statement but not the other. This item should be reworded or perhaps separated into two questions.

Finally, the primary motivation behind this study was to improve survey response rates by removing items from the scales and therefore reducing respondent burden. Future studies should field test these scales to determine if the shorter scale length does in fact increase response rates when compared to the long forms. Future research could also explore other possible sources of respondent burden. For example, some respondents may have difficulty responding to complex questions over the telephone, particularly related to topics which they may not contemplate on a daily basis, and may require greater time to formulate their answers. Perhaps alternate modes of administration (e.g., web-based surveys) could be tested.

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Appendix A:

Tables for Factual Knowledge of Science Scale

List of Tables in Appendix A

List of Tables (continued)

Table A-1. Factual Knowledge of Science (FKS) Long Form: Items by Content Area

Content Area/Item
Life science/biology
3. Oxygen comes from plants
4. Father's gene decides sex of baby
7. Antibiotics kill viruses and bacteria
11. Smoking causes lung cancer
17. Meaning of DNA
Evolution/history of Earth
8. Universe began with explosion
10. Humans developed from earlier species
12. Humans and dinosaurs co-existed
Geology/geography
1. Center of Earth is hot
9. Continents moving and will continue to
Astronomy
15. Earth travels around Sun
16. Length of Earth orbit
Radioactivity
2. Radioactivity man-made
13. Radioactive milk made safe by boiling
Physics
5. Lasers focus sound waves
14. Light or sound travels faster
Chemistry
6. Electrons smaller than atoms
18. Meaning of molecule

Table A-2. Factor Loadings for One-Factor Exploratory Factor Analysis of FKS Long Form

Item	Year		
	1997	1999	2001
1. Center of Earth is hot	**.37**	**.31**	**.39**
2. Radioactivity man-made	**.38**	**.43**	**.35**
3. Oxygen comes from plants	.07	.07	-.04
4. Father's gene decides sex of baby	.21	.03	.18
5. Lasers focus sound waves	**.62**	**.62**	**.56**
6. Electrons smaller than atoms	**.52**	**.49**	**.45**
7. Antibiotics kill viruses and bacteria	**.40**	**.34**	**.39**
8. Universe began with explosion	**.35**	**.49**	**.52**
9. Continents moving and will continue to	**.35**	**.32**	**.40**
10. Humans developed from earlier species	**.49**	**.40**	**.42**
11. Smoking causes lung cancer	.09	.08	.13
12. Humans and dinosaurs co-existed	**.49**	**.49**	**.40**
13. Radioactive milk made safe by boiling	.24	**.34**	.28
14. Light or sound travels faster	**.40**	**.35**	**.37**
15. Earth travels around Sun	**.52**	**.59**	**.56**
16. Length of Earth orbit	**.65**	**.65**	**.64**
17. Meaning of DNA	**.44**	**.55**	**.44**
18. Meaning of molecule	**.46**	**.32**	**.44**

Note: Loadings greater than .30 are shown in bold.

Table A-3. Fit Indices for One-Factor Confirmatory Factor Analysis of FKS Long Form

Fit Index	Year		
	1997	1999	2001
Goodness of Fit Index	.98	.98	.98
Adjusted Goodness of Fit Index	.98	.97	.97
Comparative Fit Index	.92	.90	.90
Incremental Fit Index	.92	.90	.90
Standardized Root Mean Square Residual	.053	.058	.061

Note: Correlated errors were permitted between items 15 and 16 to account for their dependence.

Table A-4. Two-Parameter Logistic IRT Parameters for FKS Long Form

Item	1997		1999		2001	
	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)
1. Center of Earth is hot	1.35	-1.17	1.34	-1.00	1.54	-0.91
2. Radioactivity man-made	1.69	-0.64	1.87	-0.55	1.79	-0.71
3. Oxygen comes from plants	0.56	-2.90	0.66	-2.42	0.46	-3.84
4. Father's gene decides sex of baby	0.31	-1.87	0.43	-1.35	0.49	-1.21
5. Lasers focus sound waves	1.98	0.52	2.13	0.46	1.78	0.38
6. Electrons smaller than atoms	1.39	0.42	1.48	0.37	1.35	0.31
7. Antibiotics kill viruses and bacteria	0.93	0.38	1.15	0.33	1.19	0.08
8. Universe began with explosion	1.04	1.09	1.13	0.98	1.21	0.89
9. Continents moving and will continue to	1.40	-0.96	1.40	-1.01	1.26	-1.10
10. Humans developed from earlier species	1.02	0.51	0.97	0.52	0.89	-0.06
11. Smoking causes lung cancer	0.51	-4.93	0.59	-4.51	0.62	-4.32
12. Humans and dinosaurs co-existed	0.90	0.14	0.92	0.14	0.90	0.27
13. Radioactive milk made safe by boiling	0.95	-0.38	1.12	-0.16	0.96	-0.59
14. Light or sound travels faster	1.36	-0.86	1.39	-0.79	1.32	-0.86
17. Meaning of DNA	1.37	1.17	1.97	0.73	1.37	0.48
18. Meaning of molecule	1.08	0.81	0.99	0.49	1.08	0.90

Note: Because items 15 and 16 are not locally independent, they were combined into a single testlet and the Nominal model, rather than the 2PL model, was used.

Table A-5. Factor Loadings for One-Factor Exploratory Factor Analysis of FKS Short Form (Version 1)

Item	Year		
	1997	1999	2001
1. Center of Earth is hot	.46	.47	.48
2. Radioactivity man-made	.54	.57	.53
4. Father's gene decides sex of baby	.30	.23	.32
5. Lasers focus sound waves	.62	.64	.55
6. Electrons smaller than atoms	.55	.55	.56
7. Antibiotics kill viruses and bacteria	.46	.53	.48
8. Universe began with explosion	.43	.48	.51
9. Continents moving and will continue to	.50	.44	.49
10. Humans developed from earlier species	.47	.41	.40
15. Earth travels around Sun	.56	.55	.56
17. Meaning of DNA	.55	.64	.59

Table A-6. Fit Indices for One-Factor Confirmatory Factor Analysis of FKS Short Form (Version 1)

Fit Index	Year		
	1997	1999	2001
Goodness of Fit Index	.98	.98	.98
Adjusted Goodness of Fit Index	.98	.98	.97
Comparative Fit Index	.91	.93	.91
Incremental Fit Index	.91	.93	.91
Standardized Root Mean Square Residual	.062	.059	.068

Table A-7. Two-Parameter Logistic IRT Parameters for FKS Short Form (Version 1)

Item	1997		1999		2001	
	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)
1. Center of Earth is hot	1.22	-1.69	1.22	-1.48	1.31	-1.49
2. Radioactivity man-made	1.38	-1.15	1.59	-1.03	1.48	-1.29
4. Father's gene decides sex of baby	0.32	-2.14	0.40	-1.84	0.46	-1.72
5. Lasers focus sound waves	1.60	0.21	1.76	0.14	1.37	-0.01
6. Electrons smaller than atoms	1.24	0.08	1.32	0.03	1.27	-0.08
7. Antibiotics kill viruses and bacteria	0.81	0.04	1.01	-0.02	0.99	-0.36
8. Universe began with explosion	0.97	0.82	1.06	0.68	1.14	0.53
9. Continents moving and will continue to	1.29	-1.43	1.21	-1.55	1.19	-1.62
10. Humans developed from earlier species	0.98	0.17	0.89	0.19	0.85	-0.49
15. Earth travels around Sun	1.29	-1.21	1.44	-1.07	1.38	-1.31
17. Meaning of DNA	1.62	0.96	2.16	0.56	1.49	0.25

Table A-8. Factor Loadings for One-Factor Exploratory Factor Analysis of FKS Short Form (Version 2)

Item	Year		
	1997	1999	2001
1. Center of Earth is hot	.46	.49	.48
2. Radioactivity man-made	.55	.56	.52
4. Father's gene decides sex of baby	.27	.22	.29
5. Lasers focus sound waves	.61	.62	.53
6. Electrons smaller than atoms	.51	.55	.52
7. Antibiotics kill viruses and bacteria	.42	.50	.45
8. Universe began with explosion	.42	.46	.49
9. Continents moving and will continue to	.48	.45	.49
10. Humans developed from earlier species	.45	.39	.37
15. Earth travels around Sun	.65	.63	.66
16. Length of Earth orbit	.71	.68	.70

Table A-9. Fit Indices for One-Factor Confirmatory Factor Analysis of FKS Short Form (Version 2)

Fit Index	Year		
	1997	1999	2001
Goodness of Fit Index	.99	.99	.98
Adjusted Goodness of Fit Index	.98	.98	.97
Comparative Fit Index	.95	.95	.90
Incremental Fit Index	.95	.95	.90
Standardized Root Mean Square Residual	.060	.060	.067

Note: Correlated errors were permitted between items 15 and 16 to account for their dependence.

Table A-10. Two-Parameter Logistic IRT Parameters for FKS Short Form (Version 2)

Item	1997		1999		2001	
	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)	Slope (a)	Difficulty (b)
1. Center of Earth is hot	1.25	-1.65	1.28	-1.44	1.42	-1.43
2. Radioactivity man-made	1.39	-1.14	1.57	-1.04	1.45	-1.30
4. Father's gene decides sex of baby	0.27	-2.56	0.38	-1.93	0.42	-1.88
5. Lasers focus sound waves	1.67	0.20	1.77	0.14	1.38	-0.01
6. Electrons smaller than atoms	1.15	0.09	1.30	0.02	1.19	-0.09
7. Antibiotics kill viruses and bacteria	0.77	0.04	0.95	-0.02	0.94	-0.38
8. Universe began with explosion	1.05	0.77	1.14	0.65	1.26	0.50
9. Continents moving and will continue to	1.28	-1.43	1.28	-1.49	1.22	-1.59
10. Humans developed from earlier species	1.04	0.16	0.94	0.18	0.91	-0.46

Note: Because items 15 and 16 are not locally independent, they were combined into a single testlet and the Nominal model, rather than the 2PL model, was used.

Table A-11. Reliability Indices for FKS Long and Short Forms

Reliability Index/Form	Year		
	1997	1999	2001
Cronbach's alpha			
FKS Long Form	.70	.70	.69
FKS Short Form (Version 1)	.69	.71	.70
FKS Short Form (Version 2)	.71	.71	.71
IRT-based reliability coefficient			
FKS Long Form	.79	.81	.78
FKS Short Form (Version 1)	.71	.74	.70
FKS Short Form (Version 2)	.69	.71	.69

Table A-12. Percentage of Variance in FKS Long Form Accounted for by Short Forms and Correlations between Short and Long Forms

Year/Form	Correlation	% Variance
FKS Short Form (Version 1)		
1997	.95	90%
1999	.95	90%
2001	.95	91%
FKS Short Form (Version 2)		
1997	.95	90%
1999	.95	90%
2001	.95	90%

Table A-13. Means (and Standard Deviations) of FKS Long and Short Forms by Gender

Year/Form	Gender		Statistical Test
	Male	Female	
1997			
Long Form	62.6 (19.1)	51.7 (19.8)	t(1040) = 6.82***
Short Form (Version 1)	59.2 (21.8)	48.6 (22.6)	t(1522) = 8.10***
Short Form (Version 2)	62.0 (22.5)	50.6 (23.7)	t(1915) = 10.78***
1999			
Long Form	63.0 (21.7)	54.2 (19.5)	t(963) = 6.94***
Short Form (Version 1)	60.1 (24.3)	51.5 (22.0)	t(1447) = 8.68***
Short Form (Version 2)	62.2 (24.5)	52.9 (22.4)	t(1866) = 8.59***
2001			
Long Form	65.9 (19.9)	55.7 (19.4)	t(1040) = 6.82***
Short Form (Version 1)	63.0 (23.1)	54.1 (22.5)	t(1522) = 8.10***
Short Form (Version 2)	65.5 (23.1)	54.9 (22.7)	t(1915) = 10.78***

*** $p < .001$

Table A-14. Means (and Standard Deviations) of FKS Long and Short Forms by Age

Year/Form	Age						Statistical Test
	18-24	25-34	35-44	45-54	55-64	65+	
1997							
Long Form	67.7 (20.1)	69.0 (18.5)	69.6 (14.8)	70.6 (16.0)	68.0 (12.5)	58.4 (15.1)	F(5,1029) = 7.98***
Short Form (Version 1)	50.5 (23.9)	60.9 (23.1)	62.0 (18.7)	60.3 (21.5)	55.7 (17.7)	48.9 (19.5)	F(5,1508) = 10.47***
Short Form (Version 2)	58.9 (26.6)	59.7 (24.9)	61.1 (19.4)	57.0 (23.9)	52.7 (20.6)	42.6 (23.4)	F(5,1898) = 29.91***
1999							
Long Form	72.5 (21.2)	73.0 (18.3)	72.7 (15.6)	72.9 (13.5)	70.3 (12.1)	66.2 (14.3)	F(5,954) = 2.59*
Short Form (Version 1)	62.5 (25.9)	62.4 (26.1)	63.1 (20.7)	62.0 (19.1)	57.4 (19.8)	52.4 (19.8)	F(5,1436) = 6.74***
Short Form (Version 2)	61.6 (25.5)	60.5 (26.4)	61.2 (22.6)	59.3 (21.2)	53.5 (21.3)	44.4 (21.6)	F(5,1853) = 25.63***
2001							
Long Form	71.2 (17.7)	73.4 (15.3)	71.0 (16.8)	73.9 (15.6)	71.6 (12.5)	65.5 (15.1)	F(5,876) = 3.48**
Short Form (Version 1)	63.4 (24.9)	67.0 (19.8)	64.3 (21.9)	66.5 (19.7)	60.4 (18.0)	51.9 (21.1)	F(5,1226) = 12.38***
Short Form (Version 2)	61.2 (26.4)	64.7 (22.1)	63.3 (24.1)	64.0 (21.3)	56.9 (20.6)	47.6 (22.9)	F(5,1495) = 19.05***

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table A-15. Means (and Standard Deviations) of FKS Long and Short Forms by Education Level

Year/Form	Education Level				Statistical Test
	Less than H.S.	H.S. Grad	4-year College Degree	Graduate Degree	
1997					
Long Form	42.6 (29.6)	56.3 (18.5)	60.6 (16.8)	71.5 (13.4)	F(3,1889) = 168.15***
Short Form (Version 1)	39.0 (35.5)	52.4 (20.6)	56.6 (19.4)	70.6 (15.1)	F(3,1938) = 159.69***
Short Form (Version 2)	40.7 (39.0)	55.4 (21.7)	59.5 (20.5)	72.1 (15.1)	F(3,1894) = 136.65***
1999					
Long Form	43.7 (26.8)	57.1 (19.2)	65.2 (19.1)	74.2 (13.5)	F(3,1803) = 174.35***
Short Form (Version 1)	40.8 (30.5)	53.7 (21.8)	63.5 (21.7)	72.8 (15.0)	F(3,1807) = 153.64***
Short Form (Version 2)	42.0 (31.5)	55.8 (22.3)	64.7 (22.4)	74.3 (14.8)	F(3,1828) = 149.69***
2001					
Long Form	45.5 (26.8)	58.3 (19.5)	63.2 (20.1)	75.7 (12.1)	F(3,1413) = 137.57***
Short Form (Version 1)	41.1 (31.2)	55.8 (22.5)	60.5 (23.2)	75.8 (13.1)	F(3,1430) = 141.41***
Short Form (Version 2)	43.3 (32.5)	57.3 (23.2)	62.6 (23.3)	76.8 (13.4)	F(3,1500) = 131.97***

*** $p < .001$.

Table A-16. Means (and Standard Deviations) of FKS Long and Short Forms by Level of Math and Science Education

Year/Form	Math/Science Education			Statistical Test
	Low	Medium	High	
1997				
Long Form	48.5 (19.4)	60.2 (16.5)	76.4 (13.2)	F(2,1909) = 369.13***
Short Form (Version 1)	44.6 (22.1)	56.4 (18.9)	75.7 (14.6)	F(2,1959) = 358.01***
Short Form (Version 2)	47.1 (24.0)	59.1 (19.7)	77.5 (14.7)	F(2,1914) = 298.70***
1999				
Long Form	49.5 (20.0)	64.4 (17.3)	77.0 (14.6)	F(2,1839) = 333.21***
Short Form (Version 1)	46.2 (22.6)	61.8 (19.6)	75.8 (16.3)	F(2,1843) = 301.57***
Short Form (Version 2)	47.8 (23.5)	63.7 (19.7)	77.2 (16.0)	F(2,1865) = 290.37***
2001				
Long Form	52.1 (19.7)	64.9 (18.3)	78.6 (12.3)	F(2,1439) = 246.76***
Short Form (Version 1)	48.6 (22.8)	63.5 (21.0)	78.1 (13.9)	F(2,1456) = 235.36***
Short Form (Version 2)	50.4 (23.7)	64.9 (21.0)	79.5 (14.0)	F(2,1529) = 229.25***

*** $p < .001$.

Table A-17. Means (and Standard Deviations) of FKS Long and Short Forms by Support of Government Funding for Scientific Research

Year/Form	Government Funding			Statistical Test
	Too Little	About Right	Too Much	
1997				
Long Form	61.3 (19.9)	57.5 (18.9)	47.5 (19.4)	F(2,1777) = 49.41***
Short Form (Version 1)	58.8 (22.2)	54.9 (21.3)	42.0 (21.8)	F(2,1825) = 58.55***
Short Form (Version 2)	61.1 (22.8)	57.0 (22.4)	45.0 (23.7)	F(2,1781) = 48.42***
1999				
Long Form	61.9 (20.5)	59.1 (20.6)	53.1 (19.8)	F(2,1715) = 17.84***
Short Form (Version 1)	59.7 (22.5)	56.4 (23.1)	49.8 (22.2)	F(2,1719) = 18.54***
Short Form (Version 2)	61.3 (22.8)	58.1 (23.3)	52.1 (23.3)	F(2,1740) = 15.40***
2001				
Long Form	64.4 (20.2)	62.2 (19.3)	47.9 (18.8)	F(2,1322) = 54.29***
Short Form (Version 1)	61.8 (23.4)	60.4 (22.1)	44.9 (22.1)	F(2,1337) = 44.78***
Short Form (Version 2)	63.5 (23.5)	62.0 (22.3)	46.2 (22.5)	F(2,1406) = 47.38***

*** $p < .001$.

Table A-18. Means (and Standard Deviations) of FKS Long and Short Forms by Belief that Astrology Is Scientific

Year/Form	Astrology			Statistical Test
	Not At All Scientific	Sort of Scientific	Very Scientific	
1997				
Long Form	60.4 (19.7)	54.0 (18.5)	50.2 (18.1)	F(2,1837) = 31.23***
Short Form (Version 1)	57.6 (22.1)	50.8 (21.1)	46.0 (19.9)	F(2,1887) = 30.34***
Short Form (Version 2)	60.0 (22.7)	53.2 (22.5)	48.9 (21.3)	F(2,1842) = 26.55***
1999				
Long Form	63.2 (19.6)	55.4 (20.1)	47.5 (17.5)	F(2,1770) = 54.85***
Short Form (Version 1)	60.3 (22.0)	52.7 (23.1)	46.3 (19.4)	F(2,1774) = 37.77***
Short Form (Version 2)	62.0 (22.1)	54.7 (24.0)	47.6 (19.9)	F(2,1794) = 37.38***
2001				
Long Form	65.1 (19.4)	56.5 (19.6)	55.2 (18.7)	F(2,1384) = 35.92***
Short Form (Version 1)	63.1 (21.9)	54.1 (22.7)	52.8 (23.3)	F(2,1401) = 30.27***
Short Form (Version 2)	64.4 (22.2)	55.6 (23.1)	56.1 (24.4)	F(2,1472) = 26.55***

*** $p < .001$.

Table A-19. Means (and Standard Deviations) of FKS Long and Short Forms by Belief in Lucky Numbers

Form/Year	Lucky Numbers				Statistical Test
	Strongly Disagree	Disagree	Agree	Strongly Agree	
1997					
Long Form	63.9 (19.6)	59.1 (19.0)	52.7 (20.3)	44.7 (15.4)	F(3,1813) = 30.45***
Short Form (Version 1)	61.0 (21.8)	55.5 (21.6)	50.0 (23.7)	44.8 (17.1)	F(3,1861) = 20.70***
Short Form (Version 2)	62.7 (22.5)	58.2 (22.3)	52.0 (24.9)	44.3 (17.4)	F(3,1818) = 20.18***
1999					
Long Form	67.5 (21.0)	61.6 (20.4)	51.0 (19.7)	53.3 (19.5)	F(3,1769) = 49.62***
Short Form (Version 1)	64.7 (23.6)	58.7 (22.8)	48.4 (22.2)	52.0 (23.0)	F(3,1773) = 37.73***
Short Form (Version 2)	55.1 (23.3)	50.3 (23.1)	50.1 (23.3)	55.6 (20.6)	F(3,1795) = 35.25***
2001					
Long Form	69.5 (19.8)	62.2 (19.4)	55.5 (20.7)	51.6 (17.7)	F(3,1374) = 24.64***
Short Form (Version 1)	66.7 (23.0)	60.1 (22.2)	53.1 (23.7)	48.8 (22.8)	F(3,1391) = 18.66***
Short Form (Version 2)	68.5 (22.8)	61.3 (22.5)	55.4 (24.5)	51.4 (23.1)	F(3,1461) = 16.35***

*** $p < .001$.

Table A-20. Means (and Standard Deviations) of FKS Long and Short Forms by Attentiveness to Science and Technology

Year/Form	Attentiveness			Statistical Test
	Attentive Public	Interested Public	Residual Public	
1997				
Long Form	73.3 (17.2)	68.8 (16.2)	63.1 (15.8)	F(2,1039) = 22.14***
Short Form (Version 1)	67.0 (22.2)	61.6 (19.5)	51.4 (20.9)	F(2,1521) = 58.22***
Short Form (Version 2)	67.1 (23.0)	59.4 (21.9)	47.7 (23.7)	F(2,1914) = 93.80***
1999				
Long Form	79.0 (13.0)	71.8 (16.0)	69.1 (16.5)	F(2,962) = 17.71***
Short Form (Version 1)	70.8 (20.2)	63.0 (21.1)	55.2 (22.2)	F(2,1446) = 41.75***
Short Form (Version 2)	69.4 (21.0)	60.9 (22.6)	50.6 (23.8)	F(2,1865) = 75.88***
2001				
Long Form	76.4 (15.2)	72.0 (15.5)	68.4 (15.6)	F(2,895) = 10.68***
Short Form (Version 1)	72.1 (17.6)	65.4 (20.5)	57.1 (21.7)	F(2,1250) = 36.12***
Short Form (Version 2)	69.7 (20.9)	63.2 (22.6)	54.0 (23.7)	F(2,1529) = 43.60***

*** $p < .001$.

Appendix B:

Tables for Public Understanding of Scientific Inquiry Scale

List of Tables in Appendix B

List of Tables (continued)

Table B-1. Public Understanding of Scientific Inquiry Long Form: Items by Content Area

Content Area/Item
Probability
1. If first three children are healthy, fourth child will have illness
2. If first child has illness, the next three will not
3. Each of the couple's children will have same risk of getting illness
4. If couple only has three children, none will have the illness
Scientific Study
5. Meaning of scientific study
6. Best way to test drug

Table B-2. Factor Loadings for One-Factor Exploratory Factor Analysis of Scientific Inquiry Long Form

Item	Year		
	1997	1999	2001
1. If first three children are healthy, fourth child will have illness	.74	.72	.69
2. If first child has illness, the next three will not	.79	.78	.69
3. Each of the couple's children will have same risk of getting illness	.58	.48	.56
4. If couple only has three children, none will have the illness	.66	.68	.65
5. Meaning of scientific study	.38	.40	.48
6. Best way to test drug	.36	.42	.46

Table B-3. Fit Indices for One-Factor Confirmatory Factor Analysis of Scientific Inquiry Long Form

Fit Index	Year		
	1997	1999	2001
Goodness of Fit Index	.99	.99	.99
Adjusted Goodness of Fit Index	.97	.97	.98
Comparative Fit Index	.97	.96	.97
Incremental Fit Index	.97	.96	.97
Standardized Root Mean Square Residual	.056	.064	.046

Table B-4. Percentages of Correct Responses for Scientific Inquiry Long Form Items

Item	1997	1999	2001
	% Correct	% Correct	% Correct
1. If first child has illness, the next three will not	79%	78%	78%
2. If first child has illness, the next three will not	81%	82%	84%
3. Each of the couple's children will have same risk of getting illness	71%	74%	75%
4. If couple only has three children, none will have the illness	80%	81%	84%
5. Meaning of scientific study	29%	27%	33%
6. Best way to test drug	39%	36%	43%

Table B-5. Stepwise Regression Results for Scientific Inquiry Long Form

Item Entered/Year	Partial R^2	Model R^2
1997		
2. If first child has illness, the next three will not	.43	.43
6. Best way to test drug	.22	.66
3. Each of the couple's children will have same risk of getting illness	.15	.81
5. Meaning of scientific study	.10	.91
4. If couple only has three children, none will have the illness	.05	.96
1. If first three children are healthy, fourth child will have illness	.04	1.00
1999		
2. If first child has illness, the next three will not	.41	.41
6. Best way to test drug	.26	.67
3. Each of the couple's children will have same risk of getting illness	.13	.80
5. Meaning of scientific study	.10	.90
1. If first three children are healthy, fourth child will have illness	.05	.96
4. If couple only has three children, none will have the illness	.04	1.00
2001		
1. If first three children are healthy, fourth child will have illness	.39	.39
5. Meaning of scientific study	.25	.63
6. Best way to test drug	.15	.78
3. Each of the couple's children will have same risk of getting illness	.12	.89
4. If couple only has three children, none will have the illness	.07	.96
2. If first child has illness, the next three will not	.04	1.00

Table B-6. Factor Loadings for One-Factor Exploratory Factor Analysis of Scientific Inquiry Short Form (Version 1)

Item	1997	1999	2001
2. If first child has illness, the next three will not	.62	.58	.59
3. Each of the couple's children will have same risk of getting illness	.62	.52	.67
5. Meaning of scientific study	.63	.66	.65
6. Best way to test drug	.61	.67	.56

Table B-7. Percentages of Correct Responses for Scientific Inquiry Short Form (Version 1) Items

Item	1997	1999	2001
	% Correct	% Correct	% Correct
2. If first child has illness, the next three will not	81%	82%	84%
3. Each of the couple's children will have same risk of getting illness	71%	74%	75%
5. Meaning of scientific study	29%	27%	33%
6. Best way to test drug	39%	36%	43%

Table B-8. Factor Loadings for One-Factor Exploratory Factor Analysis of Scientific Inquiry Short Form (Version 2)

Item	1997	1999	2001
2. If first child has illness, the next three will not	.74	.69	.69
3. Each of the couple's children will have same risk of getting illness	.72	.68	.74
6. Best way to test drug	.57	.63	.60

Table B-9. Percentages of Correct Responses for Scientific Inquiry Short Form (Version 2) Items

Item	1997	1999	2001
	% Correct	% Correct	% Correct
2. If first child has illness, the next three will not	81%	82%	84%
3. Each of the couple's children will have same risk of getting illness	71%	74%	75%
6. Best way to test drug	39%	36%	43%

Table B-10. Reliability Indices for Scientific Inquiry Long and Short Forms

Cronbach's Alpha	1997	1999	2001
Scientific Inquiry Long Form	.61	.60	.60
Scientific Inquiry Short Form (Version 1)	.46	.43	.46
Scientific Inquiry Short Form (Version 2)	.39	.33	.42

Table B-11. Percentage of Variance in Scientific Inquiry Long Form Accounted for by Short Forms and Correlation between Short and Long Forms

Year	Correlation	% Variance
Short Form (Version 1)		
1997	.93	87%
1999	.93	87%
2001	.94	87%
Short Form (Version 2)		
1997	.88	77%
1999	.87	75%
2001	.85	71%

Table B-12. Classification of Respondents' Understanding of Scientific Inquiry Using Long Form and Short Form (Version 1)

Short Form (V1) 1997	Long Form	
	Understand	**Do Not Understand**
Understand	515 (25.8%)	55.1 (2.8%)
Do Not Understand	0 (0%)	1430 (71.5%)
1999	**Understand**	**Do Not Understand**
Understand	481 (25.5%)	39 (2.1%)
Do Not Understand	0 (0%)	1363 (72.4%)
2001	**Understand**	**Do Not Understand**
Understand	468 (29.7%)	36 (2.3%)
Do Not Understand	0 (0%)	1070 (68.0%)

Note: Results are weighted. Using short form (V1) instead of long form, results in a change in classification for 2.8% of respondents in 1997, 2.1% in 1999, and 2.3% in 2001.

Table B-13. Classification of Respondents' Understanding of Scientific Inquiry Using Long Form and Short Form (Version 2)

Short Form (V2)	Long Form	
1997	**Understand**	**Do Not Understand**
Understand	492 (24.7%)	53 (2.7%)
Do Not Understand	22 (1.1%)	1431 (71.6%)
1999	**Understand**	**Do Not Understand**
Understand	458 (24.3%)	30 (1.6%)
Do Not Understand	23 (1.2%)	1371 (72.9%)
2001	**Understand**	**Do Not Understand**
Understand	443 (28.2%)	34 (2.2%)
Do Not Understand	25 (1.6%)	1072 (68.1%)

Note: Results are weighted. Using short form (V2) instead of long form, results in a change in classification for 3.8% of respondents in 1997, 2.8% in 1999, and 3.8% in 2001.

Table B-14. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Gender

Year/Form	Gender		Statistical Test
	Male	Female	
1997			
Long Form	68.7 (23.6)	65.5 (23.0)	t(1635) = 2.65**
Short Form (Version 1)	60.1 (26.1)	56.8 (25.9)	t(1636) = 2.53*
Short Form (Version 2)	65.8 (30.0)	64.2 (28.9)	t(1874) = 1.18
1999			
Long Form	68.0 (22.8)	66.6 (22.7)	t(1513) = 1.13
Short Form (Version 1)	59.3 (25.0)	57.4 (25.7)	t(1514) = 1.40
Short Form (Version 2)	67.1 (28.6)	62.8 (28.4)	t(1761) = 3.14**
2001			
Long Form	69.5 (23.4)	70.5 (22.3)	t(1259) = -0.75
Short Form (Version 1)	61.8 (25.9)	62.4 (26.0)	t(1259) = -0.41
Short Form (Version 2)	68.9 (27.8)	67.5 (29.6)	t(1406) = 0.92

* $p < .05$, ** $p < .01$.

Table B-15. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Age

Year/Form	Age						Statistical Test
	18-24	25-34	35-44	45-54	55-64	65+	
1997							
Long Form	66.8 (28.2)	71.3 (22.8)	70.5 (20.6)	68.4 (20.7)	65.4 (21.6)	50.7 (24.6)	F(5,1622) = 22.20***
Short Form (Version 1)	60.5 (31.0)	62.8 (26.5)	62.2 (22.7)	59.3 (24.4)	55.8 (22.3)	39.1 (25.4)	F(5,1623) = 24.92***
Short Form (Version 2)	67.2 (35.0)	69.7 (30.4)	68.8 (24.8)	64.5 (27.7)	64.1 (25.9)	50.9 (31.4)	F(5,1860) = 16.94***
1999							
Long Form	68.0 (29.3)	72.3 (24.8)	69.3 (20.3)	68.0 (18.4)	61.4 (21.2)	54.3 (21.8)	F(5,1503) = 17.45***
Short Form (Version 1)	61.3 (30.5)	64.4 (27.5)	60.0 (23.4)	58.2 (22.4)	50.4 (22.4)	43.8 (22.6)	F(5,1504) = 19.60***
Short Form (Version 2)	64.7 (36.0)	72.0 (29.8)	69.0 (25.9)	64.2 (24.5)	59.2 (25.9)	51.7 (27.4)	F(5,1749) = 20.10***
2001							
Long Form	70.7 (32.0)	74.1 (19.4)	71.5 (24.4)	71.2 (22.3)	72.5 (15.6)	57.3 (20.6)	F(5,1236) = 11.14***
Short Form (Version 1)	65.8 (33.6)	66.3 (23.3)	64.4 (27.3)	63.1 (25.8)	62.2 (19.3)	46.3 (21.7)	F(5,1236) = 13.61***
Short Form (Version 2)	71.7 (36.1)	73.5 (24.4)	71.1 (28.1)	67.8 (28.8)	68.8 (23.8)	54.1 (29.6)	F(5,1373) = 12.30***

*** $p < .001$.

Table B-16. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Education Level

Year/Form	Education Level				Statistical Test
	Less than H.S.	H.S. Grad	4-year College Degree	Graduate Degree	
1997					
Long Form	49.1 (41.5)	65.8 (23.3)	70.7 (20.8)	78.4 (15.5)	F(3,1614) = 81.24***
Short Form (Version 1)	38.1 (40.1)	57.0 (25.7)	60.9 (24.6)	71.7 (18.9)	F(3,1615) = 86.30***
Short Form (Version 2)	45.2 (51.3)	66.2 (28.0)	68.1 (26.9)	78.1 (19.5)	F(3,1853) = 88.32***
1999					
Long Form	51.6 (36.8)	65.2 (22.6)	71.0 (22.1)	78.7 (15.7)	F(3,1480) = 69.12***
Short Form (Version 1)	41.9 (36.7)	55.6 (24.4)	61.8 (26.3)	71.8 (19.6)	F(3,1481) = 69.48***
Short Form (Version 2)	47.2 (40.5)	64.6 (27.9)	69.9 (27.5)	79.8 (19.0)	F(3,1725) = 86.56***
2001					
Long Form	60.6 (37.2)	67.3 (25.5)	69.4 (22.1)	79.4 (15.2)	F(3,1234) = 29.65***
Short Form (Version 1)	54.5 (39.0)	58.5 (28.1)	60.4 (26.0)	73.1 (19.0)	F(3,1234) = 27.80***
Short Form (Version 2)	52.6 (46.8)	67.4 (29.8)	69.3 (29.8)	79.1 (19.4)	F(3,1378) = 39.07***

*** $p < .001$.

Table B-17. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Level of Math and Science Education

Year/Form	Math/Science Education			Statistical Test
	Low	Medium	High	
1997				
Long Form	59.4 (24.8)	68.1 (22.3)	81.3 (15.9)	F(2,1634) = 122.20***
Short Form (Version 1)	49.3 (26.5)	59.6 (24.2)	75.4 (20.0)	F(2,1635) = 142.89***
Short Form (Version 2)	57.1 (32.5)	67.7 (26.1)	82.0 (19.7)	F(2,1873) = 110.96***
1999				
Long Form	59.5 (24.5)	69.8 (20.5)	79.9 (16.8)	F(2,1512) = 108.39***
Short Form (Version 1)	49.2 (25.4)	61.4 (23.1)	73.0 (21.3)	F(2,1513) = 120.26***
Short Form (Version 2)	56.6 (30.0)	69.7 (26.7)	80.6 (20.4)	F(2,1760) = 111.64***
2001				
Long Form	62.0 (25.1)	73.9 (22.0)	81.2 (15.6)	F(2,1258) = 80.40***
Short Form (Version 1)	52.9 (26.3)	67.0 (26.4)	74.5 (27.5)	F(2,1258) = 82.15***
Short Form (Version 2)	59.6 (31.5)	74.3 (27.5)	80.7 (19.9)	F(2,1405) = 74.25***

*** $p < .001$.

Table B-18. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Support of Government Funding for Scientific Research

Year/Form	Government Funding			Statistical Test
	Too Little	About Right	Too Much	
1997				
Long Form	67.2 (23.7)	69.2 (22.0)	56.7 (25.7)	F(2,1543) = 19.14***
Short Form (Version 1)	58.9 (26.4)	60.5 (25.0)	47.8 (26.5)	F(2,1544) = 16.55***
Short Form (Version 2)	66.0 (29.2)	67.7 (27.5)	55.4 (33.5)	F(2,1755) = 17.03***
1999				
Long Form	68.9 (22.4)	68.2 (22.3)	60.4 (21.6)	F(2,1425) = 9.92***
Short Form (Version 1)	60.8 (24.7)	58.9 (25.5)	50.0 (23.8)	F(2,1426) = 12.18***
Short Form (Version 2)	67.5 (27.4)	66.1 (28.5)	56.2 (28.5)	F(2,1652) = 14.87***
2001				
Long Form	71.2 (22.8)	71.6 (22.1)	60.2 (25.1)	F(2,1166) = 14.88***
Short Form (Version 1)	64.0 (25.5)	63.4 (26.0)	51.2 (25.9)	F(2,1166) = 14.37***
Short Form (Version 2)	70.2 (26.6)	69.1 (28.7)	60.0 (32.6)	F(2,1298) = 9.12***

*** $p < .001$.

Table B-19. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Belief that Astrology Is Scientific

Year/Form	Astrology			Statistical Test
	Not At All Scientific	Sort of Scientific	Very Scientific	
1997				
Long Form	70.6 (21.3)	63.7 (24.5)	54.5 (28.3)	F(2,1590) = 29.32***
Short Form (Version 1)	62.2 (24.6)	54.6 (26.6)	46.9 (28.5)	F(2,1591) = 24.28***
Short Form (Version 2)	68.8 (27.3)	63.5 (30.5)	48.3 (34.1)	F(2,1814) = 31.94***
1999				
Long Form	71.5 (20.7)	62.7 (22.5)	55.0 (25.8)	F(2,1479) = 39.60***
Short Form (Version 1)	62.7 (24.4)	53.3 (24.3)	47.5 (24.4)	F(2,1480) = 31.28***
Short Form (Version 2)	70.0 (26.1)	59.8 (28.9)	54.8 (31.1)	F(2,1705) = 35.18***
2001				
Long Form	73.1 (21.2)	68.8 (23.7)	55.7 (26.5)	F(2,1219) = 25.66***
Short Form (Version 1)	65.7 (24.2)	60.1 (27.6)	48.2 (28.0)	F(2,1219) = 21.37***
Short Form (Version 2)	72.4 (26.4)	65.1 (31.1)	57.4 (29.0)	F(2,1358) = 19.90***

*** $p < .001$.

Table B-20. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Belief in Lucky Numbers

Form/Year	Lucky Numbers				Statistical Test
	Strongly Disagree	Disagree	Agree	Strongly Agree	
1997					
Long Form	73.2 (20.9)	69.1 (22.6)	62.2 (24.3)	55.4 (23.3)	F(3,1557) = 16.63***
Short Form (Version 1)	65.6 (24.7)	60.6 (25.7)	52.7 (26.3)	47.1 (23.8)	F(3,1558) = 17.19***
Short Form (Version 2)	71.2 (25.4)	68.3 (28.0)	59.5 (31.1)	46.0 (35.0)	F(3,1787) = 20.93***
1999					
Long Form	75.4 (22.3)	69.2 (21.2)	62.2 (23.7)	50.1 (25.0)	F(3,1458) = 25.04***
Short Form (Version 1)	68.7 (25.4)	60.3 (24.5)	52.6 (24.9)	38.0 (24.3)	F(3,1459) = 28.26***
Short Form (Version 2)	74.4 (26.2)	67.6 (27.0)	58.9 (30.1)	45.5 (28.2)	F(3,1698) = 28.30***
2001					
Long Form	78.0 (17.4)	71.6 (22.2)	64.3 (23.8)	53.8 (21.7)	F(3,1202) = 19.48***
Short Form (Version 1)	70.7 (21.8)	63.5 (25.5)	56.4 (26.2)	41.4 (24.5)	F(3,1202) = 18.01***
Short Form (Version 2)	78.4 (22.1)	70.4 (28.1)	61.0 (30.6)	49.0 (24.3)	F(3,1343) = 22.53***

*** $p < .001$.

Table B-21. Means (and Standard Deviations) of Scientific Inquiry Long and Short Forms by Attentiveness to Science and Technology

Year/Form	Attentiveness			Statistical Test
	Attentive Public	Interested Public	Residual Public	
1997				
Long Form	69.1 (24.9)	69.2 (21.3)	62.9 (24.8)	F(2,1634) = 13.06***
Short Form (Version 1)	61.1 (27.5)	61.1 (24.0)	53.0 (27.5)	F(2,1635) = 17.29***
Short Form (Version 2)	68.0 (29.3)	68.9 (27.0)	58.9 (31.5)	F(2,1873) = 25.05***
1999				
Long Form	70.9 (20.2)	68.7 (21.8)	64.3 (24.5)	F(2,1512) = 8.53***
Short Form (Version 1)	62.9 (24.2)	60.6 (24.0)	54.1 (27.0)	F(2,1513) = 13.72***
Short Form (Version 2)	67.3 (27.1)	68.5 (27.2)	60.3 (29.7)	F(2,1760) = 17.41***
2001				
Long Form	71.9 (20.7)	69.8 (23.0)	69.7 (23.4)	F(2,1258) = 0.52
Short Form (Version 1)	63.5 (24.7)	62.5 (25.4)	61.3 (27.1)	F(2,1258) = 0.48
Short Form (Version 2)	71.0 (25.9)	69.2 (28.2)	66.1 (30.1)	F(2,1405) = 2.62

*** $p < .001$.

Appendix C:

Tables for Indices of Scientific Promise and Reservation

List of Tables in Appendix C

List of Tables (continued)

Table C-1. Index of Scientific Promise (ISP) and Index of Scientific Reservation (ISR) Items

Index of Scientific Promise
1. Science and technology are making our lives healthier, easier, and more comfortable
2. Most scientists want to work on things that will make life better for the average person.
3. With the application of science and new technology, work will become more interesting
4. Because of science and technology, there will be more opportunities for the next generation
Index of Scientific Reservation
1. We depend too much on science and not enough on faith
2. It is not important for me to know about science in my daily life
3. Science makes our way of life change too fast

Note: Response options for all items are strongly agree, agree, disagree, and strongly disagree.

Table C-2. ISP and ISR Factor Loadings (1997)

	Factor 1: Scientific Promise	Factor 2: Scientific Reservation
Index of Scientific Promise		
1. Science and technology are making our lives healthier, easier, and more comfortable	**0.37**	-0.20
2. Most scientists want to work on things that will make life better for the average person.	**0.50**	0.12
3. With the application of science and new technology, work will become more interesting	**0.60**	-0.02
4. Because of science and technology, there will be more opportunities for the next generation	**0.60**	-0.05
Index of Scientific Reservation		
1. We depend too much on science and not enough on faith	0.04	**0.52**
2. It is not important for me to know about science in my daily life	-0.01	**0.33**
3. Science makes our way of life change too fast	-0.01	**0.51**

Table C-3. ISP and ISR Factor Loadings (1999)

	Factor 1: Scientific Promise	Factor 2: Scientific Reservation
Index of Scientific Promise		
1. Science and technology are making our lives healthier, easier, and more comfortable	**0.42**	-0.10
2. Most scientists want to work on things that will make life better for the average person.	**0.46**	0.04
3. With the application of science and new technology, work will become more interesting	**0.62**	0.04
4. Because of science and technology, there will be more opportunities for the next generation	**0.60**	-0.05
Index of Scientific Reservation		
1. We depend too much on science and not enough on faith	0.03	**0.52**
2. It is not important for me to know about science in my daily life	0.01	0.28
3. Science makes our way of life change too fast	-0.07	**0.49**

Table C-4. ISP and ISR Factor Loadings (2001)

	Factor 1: Scientific Promise	Factor 2: Scientific Reservation
Index of Scientific Promise		
1. Science and technology are making our lives healthier, easier, and more comfortable	**0.30**	-0.20
2. Most scientists want to work on things that will make life better for the average person.	**0.42**	0.08
3. With the application of science and new technology, work will become more interesting	**0.51**	0.02
4. Because of science and technology, there will be more opportunities for the next generation	**0.51**	-0.10
Index of Scientific Reservation		
1. We depend too much on science and not enough on faith	-0.01	**0.47**
2. It is not important for me to know about science in my daily life	0.00	**0.36**
3. Science makes our way of life change too fast	0.04	**0.52**

Table C-5. Percentage of Respondents Indicating "Agree" or "Strongly Agree" with ISP and ISR Items

	Year		
	1997	**1999**	**2001**
Index of Scientific Promise			
1. Science and technology are making our lives healthier, easier, and more comfortable	89.2%	89.8%	85.6%
2. Most scientists want to work on things that will make life better for the average person.	79.3%	82.6%	88.7%
3. With the application of science and new technology, work will become more interesting	71.7%	72.6%	71.7%
4. Because of science and technology, there will be more opportunities for the next generation	81.1%	83.8%	84.4%
Index of Scientific Reservation			
1. We depend too much on science and not enough on faith	47.0%	49.5%	49.9%
2. It is not important for me to know about science in my daily life	14.3%	16.0%	15.6%
3. Science makes our way of life change too fast	36.2%	40.7%	38.5%

Table C-6. Item-Total Correlations for ISP and ISR Items

	Year		
	1997	**1999**	**2001**
Index of Scientific Promise			
1. Science and technology are making our lives healthier, easier, and more comfortable	0.37	0.37	0.29
2. Most scientists want to work on things that will make life better for the average person.	0.35	0.36	0.29
3. With the application of science and new technology, work will become more interesting	0.49	0.48	0.37
4. Because of science and technology, there will be more opportunities for the next generation	0.50	0.50	0.43
Index of Scientific Reservation			
1. We depend too much on science and not enough on faith	0.33	0.35	0.31
2. It is not important for me to know about science in my daily life	0.20	0.18	0.23
3. Science makes our way of life change too fast	0.37	0.34	0.36

Table C-7. Stepwise Regression Results for ISP Long Form

Item Entered/Year	Partial R^2	Model R^2
1997		
3. With the application of science and new technology, work will become more interesting	0.56	0.56
1. Science and technology are making our lives healthier, easier, and more comfortable	0.20	0.76
2. Most scientists want to work on things that will make life better for the average person.	0.14	0.91
4. Because of science and technology, there will be more opportunities for the next generation	0.09	1.00
1999		
3. With the application of science and new technology, work will become more interesting	0.57	0.57
1. Science and technology are making our lives healthier, easier, and more comfortable	0.21	0.78
2. Most scientists want to work on things that will make life better for the average person.	0.14	0.91
4. Because of science and technology, there will be more opportunities for the next generation	0.09	1.00
2001		
4. Because of science and technology, there will be more opportunities for the next generation	0.53	0.53
3. With the application of science and new technology, work will become more interesting	0.22	0.76
1. Science and technology are making our lives healthier, easier, and more comfortable	0.15	0.91
2. Most scientists want to work on things that will make life better for the average person.	0.09	1.00

Table C-8. Stepwise Regression Results for ISR Long Form

Item Entered/Year	Partial R^2	Model R^2
1997		
1. We depend too much on science and not enough on faith	0.58	0.58
2. It is not important for me to know about science in my daily life	0.25	0.83
3. Science makes our way of life change too fast	0.17	1.00
1999		
1. We depend too much on science and not enough on faith	0.60	0.60
2. It is not important for me to know about science in my daily life	0.23	0.82
3. Science makes our way of life change too fast	0.18	1.00
2001		
1. We depend too much on science and not enough on faith	0.55	0.55
2. It is not important for me to know about science in my daily life	0.28	0.83
3. Science makes our way of life change too fast	0.17	1.00

Table C-9. Ratio of Scientific Promise to Reservation When Removing Individual Items

Item Removed	Year		
	1997	1999	2001
Index of Scientific Promise			
1. Science and technology are making our lives healthier, easier, and more comfortable	1.59	1.54	1.57
2. Most scientists want to work on things that will make life better for the average person.	1.65	1.59	1.58
3. With the application of science and new technology, work will become more interesting	1.66	1.61	1.62
4. Because of science and technology, there will be more opportunities for the next generation	1.63	1.58	1.57
Index of Scientific Reservation			
1. We depend too much on science and not enough on faith	1.81	1.73	1.76
2. It is not important for me to know about science in my daily life	1.52	1.48	1.47
3. Science makes our way of life change too fast	1.72	1.67	1.66
All Items Included	**1.64**	**1.58**	**1.58**

Note: Ratio is computed with only one item removed at a time. Index scores are computed as the average of the remaining items.

Table C-10. Percentage of Agreement for ISP Short Form Items

Index	Year		
	1997	1999	2001
ISP Short Form (Version 1)			
1. Science and technology are making our lives healthier, easier, and more comfortable	89.2%	89.8%	85.6%
3. With the application of science and new technology, work will become more interesting	71.7%	72.6%	71.7%
4. Because of science and technology, there will be more opportunities for the next generation	81.1%	83.8%	84.4%
ISP Short Form (Version 2)			
1. Science and technology are making our lives healthier, easier, and more comfortable	89.2%	89.8%	85.6%
2. Most scientists want to work on things that will make life better for the average person.	79.3%	82.6%	88.7%
3. With the application of science and new technology, work will become more interesting	71.7%	72.6%	71.7%

Table C-11. Reliability Indices for ISP and ISR Long and Short Forms

Cronbach's Alpha	1997	1999	2001
Index of Scientific Promise			
Long Form	.65	.65	.56
Short Form (Version 1)	.63	.62	.53
Short Form (Version 2)	.52	.53	.40
Index of Scientific Reservation			
Long Form	.48	.46	.48
Short Form (Version 1)	.52	.53	.49
Short Form (Version 2)	.25	.27	.27

Table C-12. Percentage of Variance in ISP Long Form Accounted for by Short Forms and Correlation between Short and Long Forms

Year	Correlation	% Variance
Short Form (Version 1)		
1997	.94	88.8%
1999	.95	89.7%
2001	.95	90.8%
Short Form (Version 2)		
1997	.95	90.7%
1999	.95	90.9%
2001	.93	86.7%

Table C-13. Means (and Standard Deviations) of ISP Long and Short Forms by Gender

Year/Form	Gender		Statistical Test
	Male	Female	
1997			
Long Form	3.82 (0.63)	3.75 (0.63)	t(1998) = 2.35*
Short Form (Version 1)	3.86 (0.68)	3.76 (0.70)	t(1998) = 3.35***
Short Form (Version 2)	3.82 (0.66)	3.76 (0.65)	t(1998)=2.22*
1999			
Long Form	3.86 (0.60)	3.75 (0.61)	t(1880) = 3.95***
Short Form (Version 1)	3.90 (0.65)	3.75 (0.67)	t(1880) = 4.76***
Short Form (Version 2)	3.87 (0.63)	3.74 (0.63)	t(1880) = 4.49***
2001			
Long Form	3.82 (0.57)	3.79 (0.56)	t(1572) = 1.04
Short Form (Version 1)	3.81 (0.65)	3.75 (0.65)	t(1572) = 1.84
Short Form (Version 2)	3.79 (0.58)	3.77 (0.56)	t(1572) = 0.68

* $p < .05$, *** $p < .001$.

Table C-14. Means (and Standard Deviations) of ISP Long and Short Forms by Age

Year/Form	Age						Statistical Test
	18-24	25-34	35-44	45-54	55-64	65+	
1997							
Long Form	3.78 (0.86)	3.78 (0.62)	3.81 (0.59)	3.82 (0.57)	3.90 (0.6)	3.67 (0.64)	F(5,1980) = 3.75**
Short Form (Version 1)	3.82 (0.98)	3.79 (0.69)	3.83 (0.64)	3.84 (0.61)	3.96 (0.62)	3.67 (0.67)	F(5,1980) = 4.86***
Short Form (Version 2)	3.75 (0.88)	3.79 (0.62)	3.80 (0.61)	3.82 (0.59)	3.90 (0.62)	3.70 (0.7)	F(5,1980) = 2.64*
1999							
Long Form	3.79 (0.7)	3.79 (0.7)	3.82 (0.57)	3.82 (0.56)	3.78 (0.63)	3.80 (0.52)	F(5,1867) = 0.20
Short Form (Version 1)	3.78 (0.8)	3.82 (0.76)	3.85 (0.62)	3.84 (0.6)	3.79 (0.69)	3.82 (0.58)	F(5,1867) = 0.49
Short Form (Version 2)	3.80 (0.73)	3.79 (0.71)	3.81 (0.6)	3.79 (0.58)	3.80 (0.64)	3.80 (0.57)	F(5,1867) = 0.07
2001							
Long Form	3.84 (0.7)	3.82 (0.53)	3.80 (0.61)	3.81 (0.49)	3.80 (0.55)	3.79 (0.52)	F(5,1533) = 0.20
Short Form (Version 1)	3.81 (0.84)	3.81 (0.6)	3.75 (0.71)	3.77 (0.58)	3.78 (0.62)	3.78 (0.59)	F(5,1533) = 0.32
Short Form (Version 2)	3.82 (0.72)	3.76 (0.55)	3.78 (0.62)	3.77 (0.5)	3.78 (0.53)	3.78 (0.52)	F(5,1533) = 0.34

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table C-15. Means (and Standard Deviations) of ISP Long and Short Forms by Education Level

Year/Form	Education Level				Statistical Test
	Less than H.S.	H.S. Grad	4-year College Degree	Graduate Degree	
1997					
Long Form	3.74 (1.15)	3.74 (0.63)	3.78 (0.59)	3.92 (0.45)	F(3,1976) = 8.19***
Short Form (Version 1)	3.73 (1.26)	3.76 (0.69)	3.81 (0.65)	4.00 (0.49)	F(3,1976) = 12.97***
Short Form (Version 2)	3.74 (1.24)	3.75 (0.65)	3.81 (0.61)	3.91 (0.46)	F(3,1976) = 6.52***
1999					
Long Form	3.68 (1.07)	3.78 (0.57)	3.89 (0.54)	3.93 (0.45)	F(3,1842) = 11.90***
Short Form (Version 1)	3.66 (1.19)	3.81 (0.61)	3.93 (0.62)	3.96 (0.5)	F(3,1842) = 14.91***
Short Form (Version 2)	3.69 (1.12)	3.77 (0.6)	3.91 (0.54)	3.93 (0.46)	F(3,1842) = 11.75***
2001					
Long Form	3.74 (0.83)	3.82 (0.59)	3.77 (0.68)	3.85 (0.42)	F(3,1541) = 2.25
Short Form (Version 1)	3.69 (0.96)	3.78 (0.69)	3.75 (0.73)	3.84 (0.48)	F(3,1541) = 2.70*
Short Form (Version 2)	3.73 (0.82)	3.80 (0.6)	3.70 (0.68)	3.80 (0.42)	F(3,1541) = 2.15

* $p < .05$, *** $p < .001$.

Table C-16. Means (and Standard Deviations) of ISP Long and Short Forms by Level of Math and Science Education

Year/Form	Math/Science Education			Statistical Test
	Low	Medium	High	
1997				
Long Form	3.73 (0.71)	3.79 (0.57)	3.94 (0.52)	F(3,1997) = 15.99***
Short Form (Version 1)	3.72 (0.78)	3.85 (0.62)	4.00 (0.55)	F(3,1997) = 25.48***
Short Form (Version 2)	3.74 (0.74)	3.78 (0.59)	3.93 (0.54)	F(3,1997) = 12.01***
1999				
Long Form	3.73 (0.68)	3.84 (0.52)	3.95 (0.49)	F(2,1879) = 18.61***
Short Form (Version 1)	3.74 (0.74)	3.87 (0.58)	4.00 (0.55)	F(2,1879) = 22.49***
Short Form (Version 2)	3.73 (0.71)	3.84 (0.55)	3.94 (0.51)	F(2,1879) = 16.27***
2001				
Long Form	3.79 (0.61)	3.82 (0.58)	3.85 (0.47)	F(2,1571) = 1.65
Short Form (Version 1)	3.75 (0.7)	3.79 (0.66)	3.84 (0.54)	F(2,1571) = 2.68
Short Form (Version 2)	3.77 (0.61)	3.78 (0.59)	3.79 (0.48)	F(2,1571) = 0.10

*** $p < .001$.

Table C-17. Means (and Standard Deviations) of ISP Long and Short Forms by Support of Government Funding for Scientific Research

Year/Form	Government Funding			Statistical Test
	Too Little	About Right	Too Much	
1997				
Long Form	3.95 (0.58)	3.82 (0.56)	3.38 (0.77)	F(2,1856) = 88.17***
Short Form (Version 1)	3.99 (0.65)	3.84 (0.6)	3.38 (0.84)	F(2,1856) = 85.18***
Short Form (Version 2)	3.94 (0.6)	3.81 (0.6)	3.43 (0.8)	F(2,1856) = 63.78***
1999				
Long Form	3.97 (0.54)	3.83 (0.52)	3.37 (0.8)	F(2,1753) = 104.25***
Short Form (Version 1)	4.00 (0.6)	3.85 (0.57)	3.38 (0.86)	F(2,1753) = 94.15***
Short Form (Version 2)	3.96 (0.56)	3.83 (0.54)	3.36 (0.84)	F(2,1753) = 99.31***
2001				
Long Form	3.93 (0.51)	3.83 (0.52)	3.48 (0.78)	F(2,1444) = 49.77***
Short Form (Version 1)	3.90 (0.6)	3.80 (0.61)	3.41 (0.84)	F(2,1444) = 47.65***
Short Form (Version 2)	3.88 (0.54)	3.79 (0.53)	3.51 (0.76)	F(2,1444) = 32.91***

*** $p < .001$.

Table C-18. Means (and Standard Deviations) of ISP Long and Short Forms by Belief that Astrology Is Scientific

Year/Form	Astrology			Statistical Test
	Not At All Scientific	Sort of Scientific	Very Scientific	
1997				
Long Form	3.82 (0.6)	3.76 (0.65)	3.75 (0.78)	F(2,1921) = 2.20
Short Form (Version 1)	3.85 (0.65)	3.78 (0.72)	3.75 (0.84)	F(2,1921) = 3.07*
Short Form (Version 2)	3.82 (0.61)	3.76 (0.69)	3.75 (0.82)	F(2,1921) = 1.74
1999				
Long Form	3.81 (0.59)	3.83 (0.63)	3.74 (0.64)	F(2,1808) = 1.41
Short Form (Version 1)	3.83 (0.64)	3.84 (0.71)	3.75 (0.71)	F(2,1808) = 1.06
Short Form (Version 2)	3.80 (0.62)	3.83 (0.65)	3.73 (0.69)	F(2,1808) = 1.58
2001				
Long Form	3.79 (0.55)	3.84 (0.58)	3.90 (0.66)	F(2,1511) = 3.45*
Short Form (Version 1)	3.76 (0.64)	3.81 (0.66)	3.86 (0.72)	F(2,1511) = 2.15
Short Form (Version 2)	3.75 (0.55)	3.81 (0.6)	3.90 (0.63)	F(2,1511) = 4.50*

* $p < .05$.

Table C-19. Means (and Standard Deviations) of ISP Long and Short Forms by Belief in Lucky Numbers

Form/Year	Lucky Numbers				Statistical Test
	Strongly Disagree	Disagree	Agree	Strongly Agree	
1997					
Long Form	3.85 (0.71)	3.80 (0.58)	3.71 (0.66)	4.44 (0.63)	F(3,1897) = 21.26***
Short Form (Version 1)	3.91 (0.81)	3.82 (0.64)	3.72 (0.69)	4.40 (0.76)	F(3,1897) = 17.10***
Short Form (Version 2)	3.84 (0.73)	3.80 (0.59)	3.72 (0.70)	4.42 (0.72)	F(3,1897) = 17.64***
1999					
Long Form	3.85 (0.74)	3.76 (0.57)	3.80 (0.55)	4.35 (0.87)	F(3,1808) = 17.93***
Short Form (Version 1)	3.88 (0.80)	3.79 (0.63)	3.79 (0.62)	4.39 (0.91)	F(3,1808) = 16.16***
Short Form (Version 2)	3.82 (0.77)	3.76 (0.60)	3.80 (0.57)	4.36 (0.91)	F(3,1808) = 17.12***
2001					
Long Form	3.83 (0.66)	3.80 (0.55)	3.82 (0.54)	3.97 (0.68)	F(3,1498) = 1.43
Short Form (Version 1)	3.82 (0.73)	3.78 (0.62)	3.77 (0.64)	3.93 (0.86)	F(3,1498) = 0.98
Short Form (Version 2)	3.75 (0.67)	3.76 (0.56)	3.82 (0.53)	3.91 (0.66)	F(3,1498) = 2.09

*** $p < .001$.

Table C-20. Means (and Standard Deviations) of ISP Long and Short Forms by Attentiveness to Science and Technology

Year/Form	Attentiveness			Statistical Test
	Attentive Public	Interested Public	Residual Public	
1997				
Long Form	3.97 (0.68)	3.87 (0.57)	3.61 (0.65)	F(2,1997) = 54.03***
Short Form (Version 1)	4.06 (0.72)	3.90 (0.63)	3.60 (0.70)	F(2,1997) = 67.06***
Short Form (Version 2)	3.96 (0.70)	3.88 (0.60)	3.61 (0.67)	F(2,1997) = 50.19***
1999				
Long Form	3.98 (0.57)	3.88 (0.55)	3.67 (0.64)	F(2,1879) = 37.92***
Short Form (Version 1)	4.04 (0.59)	3.92 (0.61)	3.66 (0.71)	F(2,1879) = 46.11***
Short Form (Version 2)	3.98 (0.61)	3.88 (0.58)	3.67 (0.66)	F(2,1879) = 35.65***
2001				
Long Form	3.92 (0.59)	3.87 (0.52)	3.71 (0.59)	F(2,1571) = 17.48***
Short Form (Version 1)	3.95 (0.63)	3.84 (0.62)	3.66 (0.67)	F(2,1571) = 20.13***
Short Form (Version 2)	3.89 (0.59)	3.84 (0.53)	3.69 (0.60)	F(2,1571) = 15.13***

*** $p < .001$.

Table C-21. Percentage of Agreement for ISR Short Form Items

Index	Year		
	1997	1999	2001
ISR Short Form (Version 1)			
1. We depend too much on science and not enough on faith	47.0%	49.5%	49.9%
3. Science makes our way of life change too fast	36.2%	40.7%	38.5%
ISR Short Form (Version 2)			
1. We depend too much on science and not enough on faith	47.0%	49.5%	49.9%
2. It is not important for me to know about science in my daily life	14.3%	16.0%	15.6%

Table C-22. Percentage of Variance in ISR Long Form Accounted for by Short Forms and Correlation between Short and Long Forms

Year	Correlation	% Variance
Short Form (Version 1)		
1997	.91	83.3%
1999	.91	82.1%
2001	.91	83.0%
Short Form (Version 2)		
1997	.90	80.9%
1999	.90	80.4%
2001	.89	79.6%

Table C-23. Means (and Standard Deviations) of ISR Long and Short Forms by Gender

Year/Form	Gender		Statistical Test
	Male	Female	
1997			
Long Form	2.54 (0.78)	2.66 (0.77)	t(1998) = -3.36***
Short Form (Version 1)	2.79 (0.95)	2.96 (0.98)	t(1998) = -3.82***
Short Form (Version 2)	2.48 (0.86)	2.59 (0.83)	t(1998) = -2.78**
1999			
Long Form	2.59 (0.76)	2.76 (0.76)	t(1880) = -5.00***
Short Form (Version 1)	2.84 (0.96)	3.05 (0.94)	t(1880) = -4.89***
Short Form (Version 2)	2.52 (0.85)	2.69 (0.84)	t(1880) = -4.48***
2001			
Long Form	2.61 (0.76)	2.73 (0.76)	t(1572) = -3.07**
Short Form (Version 1)	2.87 (0.91)	3.02 (0.94)	t(1572) = -3.21**
Short Form (Version 2)	2.55 (0.85)	2.67 (0.79)	t(1572) = -2.82**

** $p < .01$, *** $p < .001$.

Table C-24. Means (and Standard Deviations) of ISR Long and Short Forms by Age

Year/Form	Age						Statistical Test
	18-24	25-34	35-44	45-54	55-64	65+	
1997							
Long Form	2.46 (1.07)	2.50 (0.76)	2.54 (0.71)	2.57 (0.69)	2.60 (0.66)	2.97 (0.73)	F(5,1980) = 19.90***
Short Form (Version 1)	2.74 (1.27)	2.79 (0.98)	2.86 (0.92)	2.87 (0.91)	2.87 (0.82)	3.17 (0.89)	F(5,1980) = 8.32***
Short Form (Version 2)	2.39 (1.16)	2.40 (0.83)	2.47 (0.77)	2.50 (0.74)	2.58 (0.73)	2.95 (0.83)	F(5,1980) = 22.16***
1999							
Long Form	2.60 (0.92)	2.55 (0.84)	2.57 (0.72)	2.62 (0.66)	2.82 (0.70)	3.06 (0.69)	F(5,1867) = 22.06***
Short Form (Version 1)	2.87 (1.14)	2.85 (1.08)	2.92 (0.96)	2.84 (0.85)	3.11 (0.86)	3.24 (0.79)	F(5,1867) = 8.82***
Short Form (Version 2)	2.48 (1.02)	2.47 (0.91)	2.46 (0.76)	2.58 (0.73)	2.80 (0.81)	3.05 (0.79)	F(5,1867) = 24.86***
2001							
Long Form	2.66 (0.92)	2.53 (0.72)	2.60 (0.79)	2.61 (0.69)	2.73 (0.77)	2.92 (0.71)	F(5,1533) = 7.90***
Short Form (Version 1)	2.92 (1.12)	2.82 (0.88)	2.90 (0.99)	2.89 (0.84)	2.95 (0.95)	3.22 (0.86)	F(5,1533) = 5.25***
Short Form (Version 2)	2.60 (0.99)	2.44 (0.82)	2.52 (0.84)	2.55 (0.73)	2.71 (0.80)	2.89 (0.75)	F(5,1533) = 9.21***

*** $p < .001$.

Table C-25. Means (and Standard Deviations) of ISR Long and Short Forms by Education Level

Year/Form	Education Level				Statistical Test
	Less than H.S.	H.S. Grad	4-year College Degree	Graduate Degree	
1997					
Long Form	2.83 (1.41)	2.65 (0.74)	2.58 (0.73)	2.25 (0.54)	F(3,1976) = 42.88***
Short Form (Version 1)	3.07 (1.83)	2.95 (0.91)	2.90 (0.92)	2.51 (0.70)	F(3,1976) = 26.29***
Short Form (Version 2)	2.78 (1.47)	2.60 (0.83)	2.49 (0.79)	2.15 (0.59)	F(3,1976) = 42.85***
1999					
Long Form	3.02 (1.04)	2.71 (0.75)	2.54 (0.79)	2.30 (0.55)	F(3,1842) = 61.58***
Short Form (Version 1)	3.25 (1.3)	2.98 (0.95)	2.9 (1.01)	2.58 (0.71)	F(3,1842) = 32.64***
Short Form (Version 2)	2.95 (1.24)	2.65 (0.81)	2.46 (0.85)	2.21 (0.63)	F(3,1842) = 53.32***
2001					
Long Form	3.07 (1.15)	2.71 (0.77)	2.62 (0.83)	2.32 (0.50)	F(3,1541) = 55.08***
Short Form (Version 1)	3.34 (1.42)	3.00 (0.95)	2.86 (1.03)	2.58 (0.64)	F(3,1541) = 37.91***
Short Form (Version 2)	2.97 (1.20)	2.67 (0.84)	2.57 (0.92)	2.25 (0.55)	F(3,1541) = 45.23***

*** $p < .001$.

Table C-26. Means (and Standard Deviations) of ISR Long and Short Forms by Level of Math and Science Education

Year/Form	Math/Science Education			Statistical Test
	Low	Medium	High	
1997				
Long Form	2.79 (0.82)	2.48 (0.73)	2.21 (0.61)	F(2,1997) = 94.14***
Short Form (Version 1)	3.06 (1.03)	2.79 (0.95)	2.50 (0.76)	F(2,1997) = 52.84***
Short Form (Version 2)	2.74 (0.9)	2.43 (0.77)	2.10 (0.67)	F(2,1997) = 95.38***
1999				
Long Form	2.88 (0.79)	2.55 (0.69)	2.26 (0.62)	F(2,1879) = 107.98***
Short Form (Version 1)	3.13 (0.99)	2.86 (0.91)	2.54 (0.81)	F(2,1879) = 58.08***
Short Form (Version 2)	2.82 (0.89)	2.47 (0.74)	2.17 (0.68)	F(2,1879) = 96.99***
2001				
Long Form	2.85 (0.85)	2.59 (0.71)	2.30 (0.53)	F(2,1571) =66.13***
Short Form (Version 1)	3.14 (1.04)	2.84 (0.87)	2.57 (0.69)	F(2,1571) = 46.35***
Short Form (Version 2)	2.79 (0.91)	2.53 (0.76)	2.22 (0.61)	F(2,1571) = 60.20***

*** $p < .001$.

Table C-27. Means (and Standard Deviations) of ISR Long and Short Forms by Support of Government Funding for Scientific Research

Year/Form	Government Funding			Statistical Test
	Too Little	About Right	Too Much	
1997				
Long Form	2.43 (0.79)	2.62 (0.75)	2.89 (0.78)	F(2,1856) = 37.89***
Short Form (Version 1)	2.71 (0.95)	2.89 (0.93)	3.23 (1.07)	F(2,1856) = 29.33***
Short Form (Version 2)	2.35 (0.85)	2.57 (0.83)	2.80 (0.83)	F(2,1856) = 30.36***
1999				
Long Form	2.51 (0.76)	2.64 (0.70)	3.13 (0.77)	F(2,1753) = 69.60***
Short Form (Version 1)	2.77 (0.92)	2.91 (0.92)	3.47 (0.98)	F(2,1753) = 54.99***
Short Form (Version 2)	2.44 (0.86)	2.58 (0.78)	3.05 (0.86)	F(2,1753) = 53.32***
2001				
Long Form	2.50 (0.74)	2.61 (0.70)	3.25 (0.76)	F(2,1444) = 86.42***
Short Form (Version 1)	2.75 (0.91)	2.89 (0.87)	3.63 (0.94)	F(2,1444) = 78.54***
Short Form (Version 2)	2.45 (0.81)	2.55 (0.77)	3.15 (0.81)	F(2,1444) = 61.97***

*** $p < .001$.

Table C-28. Means (and Standard Deviations) of ISR Long and Short Forms by Belief that Astrology Is Scientific

Year/Form	Astrology			Statistical Test
	Not At All Scientific	Sort of Scientific	Very Scientific	
1997				
Long Form	2.52 (0.73)	2.70 (0.84)	2.67 (0.90)	F(2,1921) = 11.42***
Short Form (Version 1)	2.80 (0.93)	3.00 (1.01)	2.89 (1.08)	F(2,1921) = 7.94***
Short Form (Version 2)	2.46 (0.81)	2.62 (0.90)	2.68 (0.99)	F(2,1921) = 9.67***
1999				
Long Form	2.60 (0.75)	2.75 (0.75)	2.75 (0.84)	F(2,1808) = 7.61***
Short Form (Version 1)	2.88 (0.94)	3.01 (0.95)	3.03 (1.05)	F(2,1808) = 4.15*
Short Form (Version 2)	2.52 (0.81)	2.69 (0.86)	2.66 (0.89)	F(2,1808) = 8.50***
2001				
Long Form	2.63 (0.75)	2.65 (0.71)	2.88 (1.00)	F(2,1511) = 6.62**
Short Form (Version 1)	2.89 (0.92)	2.96 (0.90)	3.16 (1.19)	F(2,1511) = 5.28**
Short Form (Version 2)	2.58 (0.80)	2.57 (0.81)	2.78 (1.01)	F(2,1511) = 3.88*

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table C-29. Means (and Standard Deviations) of ISR Long and Short Forms by Belief in Lucky Numbers

Form/Year	Lucky Numbers				Statistical Test
	Strongly Disagree	Disagree	Agree	Strongly Agree	
1997					
Long Form	2.31 (0.88)	2.54 (0.67)	2.78 (0.82)	2.80 (1.08)	F(3,1897) = 27.86***
Short Form (Version 1)	2.65 (1.12)	2.80 (0.86)	3.08 (0.99)	3.06 (1.43)	F(3,1897) = 17.75***
Short Form (Version 2)	2.23 (0.98)	2.49 (0.74)	2.69 (0.88)	2.77 (1.16)	F(3,1897) = 21.25***
1999					
Long Form	2.32 (0.85)	2.64 (0.7)	2.83 (0.73)	3.03 (1.25)	F(3,1808) = 30.13***
Short Form (Version 1)	2.61 (1.08)	2.90 (0.88)	3.13 (0.92)	3.16 (1.49)	F(3,1808) = 18.75***
Short Form (Version 2)	2.25 (0.92)	2.57 (0.79)	2.75 (0.80)	3.13 (1.43)	F(3,1808) = 27.89***
2001					
Long Form	2.39 (0.76)	2.63 (0.70)	2.81 (0.79)	2.88 (0.93)	F(3,1498) = 15.87***
Short Form (Version 1)	2.71 (0.99)	2.89 (0.88)	3.07 (0.94)	3.41 (1.12)	F(3,1498) = 11.07***
Short Form (Version 2)	2.37 (0.84)	2.59 (0.76)	2.71 (0.87)	2.62 (1.03)	F(3,1498) = 7.32***

*** $p < .001$.

Table C-30. Means (and Standard Deviations) of ISR Long and Short Forms by Attentiveness to Science and Technology

Year/Form	Attentiveness			Statistical Test
	Attentive Public	Interested Public	Residual Public	
1997				
Long Form	2.35 (0.87)	2.53 (0.74)	2.78 (0.74)	F(2,1997) = 42.40***
Short Form (Version 1)	2.67 (1.07)	2.80 (0.93)	3.05 (0.94)	F(2,1997) = 22.75***
Short Form (Version 2)	2.25 (0.92)	2.46 (0.81)	2.74 (0.82)	F(2,1997) = 44.80***
1999				
Long Form	2.37 (0.81)	2.59 (0.73)	2.85 (0.74)	F(2,1879) = 47.06***
Short Form (Version 1)	2.65 (1.01)	2.87 (0.92)	3.12 (0.93)	F(2,1879) = 27.81***
Short Form (Version 2)	2.25 (0.86)	2.53 (0.83)	2.78 (0.82)	F(2,1879) = 41.19***
2001				
Long Form	2.39 (0.66)	2.60 (0.77)	2.81 (0.75)	F(2,1571) = 26.09***
Short Form (Version 1)	2.67 (0.85)	2.88 (0.94)	3.08 (0.93)	F(2,1571) = 16.06***
Short Form (Version 2)	2.29 (0.70)	2.54 (0.84)	2.77 (0.8)	F(2,1571) = 27.82***

*** $p < .001$.

Table C-31. Percentage of Variance in ISP and ISR Long Forms Accounted for by Individual Items

Index/Item	Year		
	1997	1999	2001
Index of Scientific Promise			
1. Science and technology are making our lives healthier, easier, and more comfortable	42%	43%	37%
2. Most scientists want to work on things that will make life better for the average person.	42%	42%	32%
3. With the application of science and new technology, work will become more interesting	57%	58%	51%
4. Because of science and technology, there will be more opportunities for the next generation	56%	55%	53%
Index of Scientific Reservation			
1. We depend too much on science and not enough on faith	59%	60%	55%
2. It is not important for me to know about science in my daily life	34%	34%	38%
3. Science makes our way of life change too fast	56%	52%	55%

Table C-32. Promise/Reservation Ratios for Individual Item Combinations

Items	Year		
	1997	1999	2001
1. Science and technology are making our lives healthier, easier, and more comfortable			
1. We depend too much on science and not enough on faith	1.71	1.65	1.52
2. It is not important for me to know about science in my daily life	2.48	2.35	2.23
3. Science makes our way of life change too fast	1.80	1.73	1.67
2. Most scientists want to work on things that will make life better for the average person.			
1. We depend too much on science and not enough on faith	1.52	1.50	1.51
2. It is not important for me to know about science in my daily life	2.23	2.13	2.24
3. Science makes our way of life change too fast	1.63	1.58	1.66
3. With the application of science and new technology, work will become more interesting			
1. We depend too much on science and not enough on faith	1.49	1.44	1.40
2. It is not important for me to know about science in my daily life	2.17	2.03	2.05
3. Science makes our way of life change too fast	1.58	1.50	1.53
4. Because of science and technology, there will be more opportunities for the next generation			
1. We depend too much on science and not enough on faith	1.58	1.55	1.54
2. It is not important for me to know about science in my daily life	2.30	2.18	2.27
3. Science makes our way of life change too fast	1.67	1.61	1.68
All Items Included	**1.64**	**1.58**	**1.58**

Table C-33. Analyses of Variance for ISP and ISR Long Form Scores by Individual Items

Item Removed	Year		
	1997	1999	2001
Index of Scientific Promise			
1. Science and technology are making our lives healthier, easier, and more comfortable	F(4,1995) = 360.46***	F(4,1877) = 357.77***	F(4,1569) = 229.63***
2. Most scientists want to work on things that will make life better for the average person.	F(4,1995) = 365.16***	F(4,1877) = 345.48***	F(4,1569) = 185.92***
3. With the application of science and new technology, work will become more interesting	F(4,1995) = 656.97***	F(4,1877) = 657.87***	F(4,1569) = 407.59***
4. Because of science and technology, there will be more opportunities for the next generation	F(4,1995) = 628.14***	F(4,1877) = 575.22***	F(4,1569) = 449.64***
Index of Scientific Reservation			
1. We depend too much on science and not enough on faith	F(4,1995) = 709.20***	F(4,1877) = 695.16***	F(4,1569) = 480.91***
2. It is not important for me to know about science in my daily life	F(4,1995) = 261.32***	F(4,1877) = 241.08***	F(4,1569) = 239.57***
3. Science makes our way of life change too fast	F(4,1995) = 623.02***	F(4,1877) = 515.80***	F(4,1569) = 485.61***

*** $p < .001$

Appendix D:

Graphs for Indices of Scientific Promise and Reservation

List of Figures in Appendix D

Figure D.1. ISP 1: Science and Technology Are Making Our Lives Easier

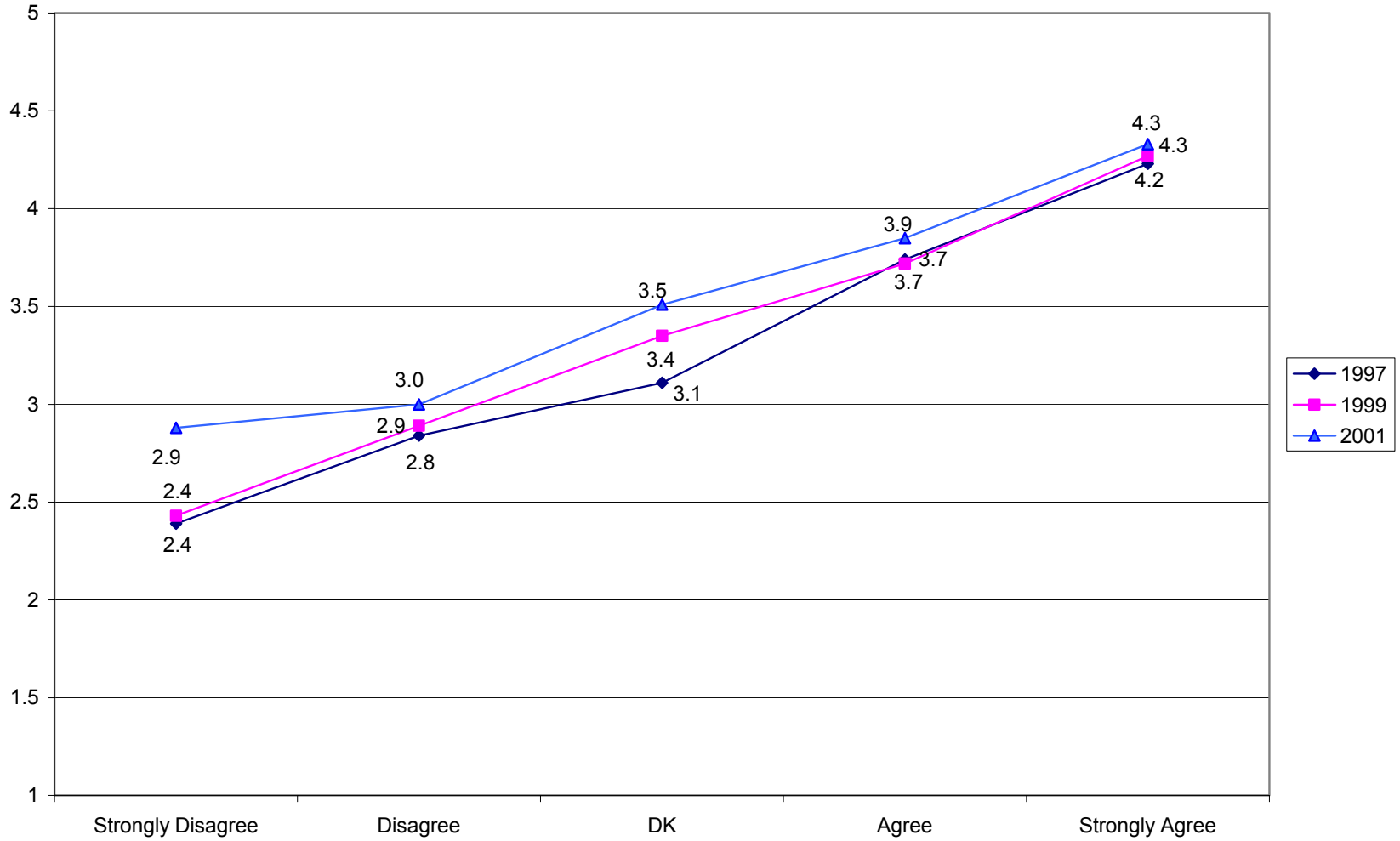

Figure D.2. ISP 2: Scientists Want to Work On Things That Make Life Better

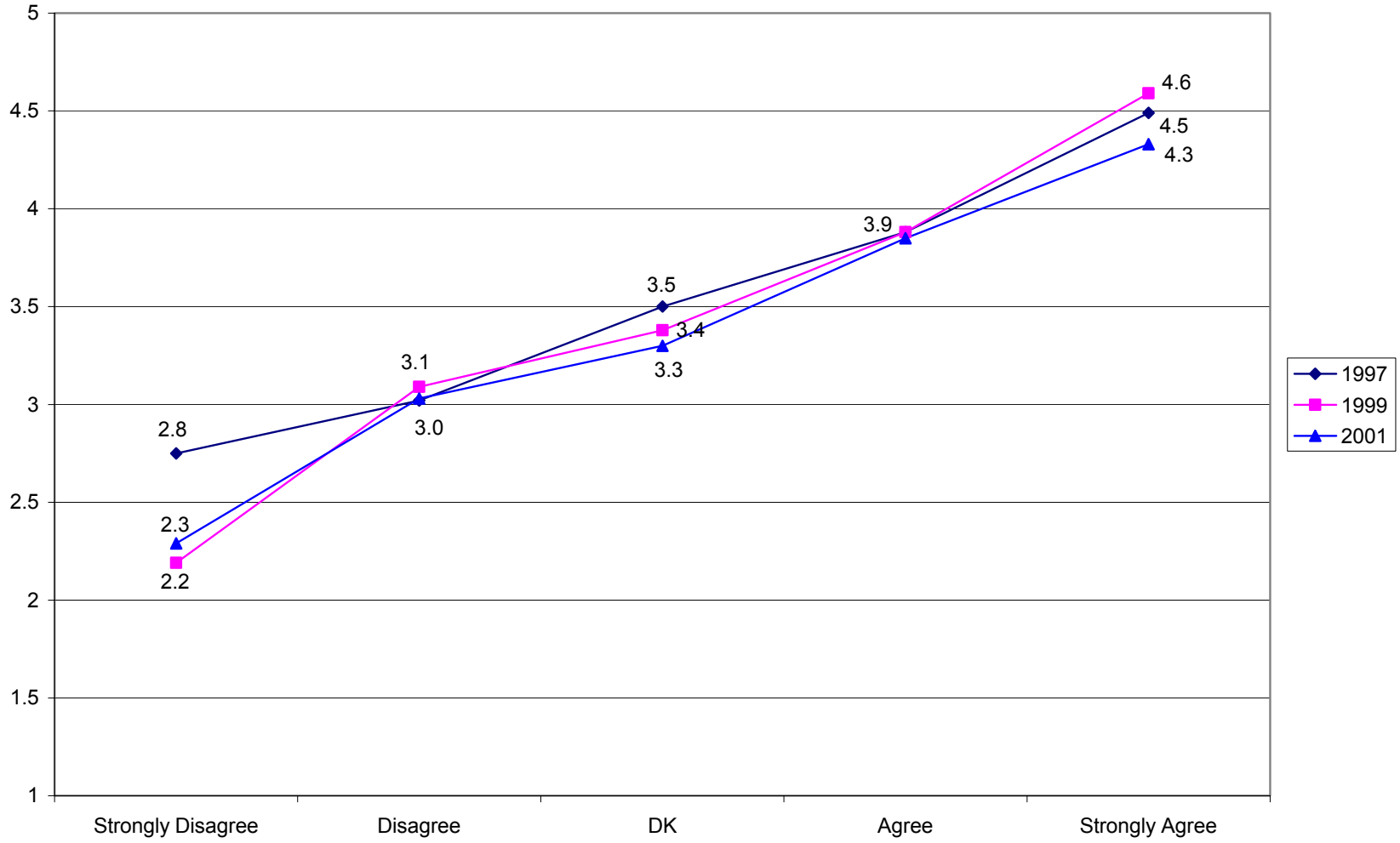

Figure D.3. ISP 3: Application of Science Will Make Work More Interesting

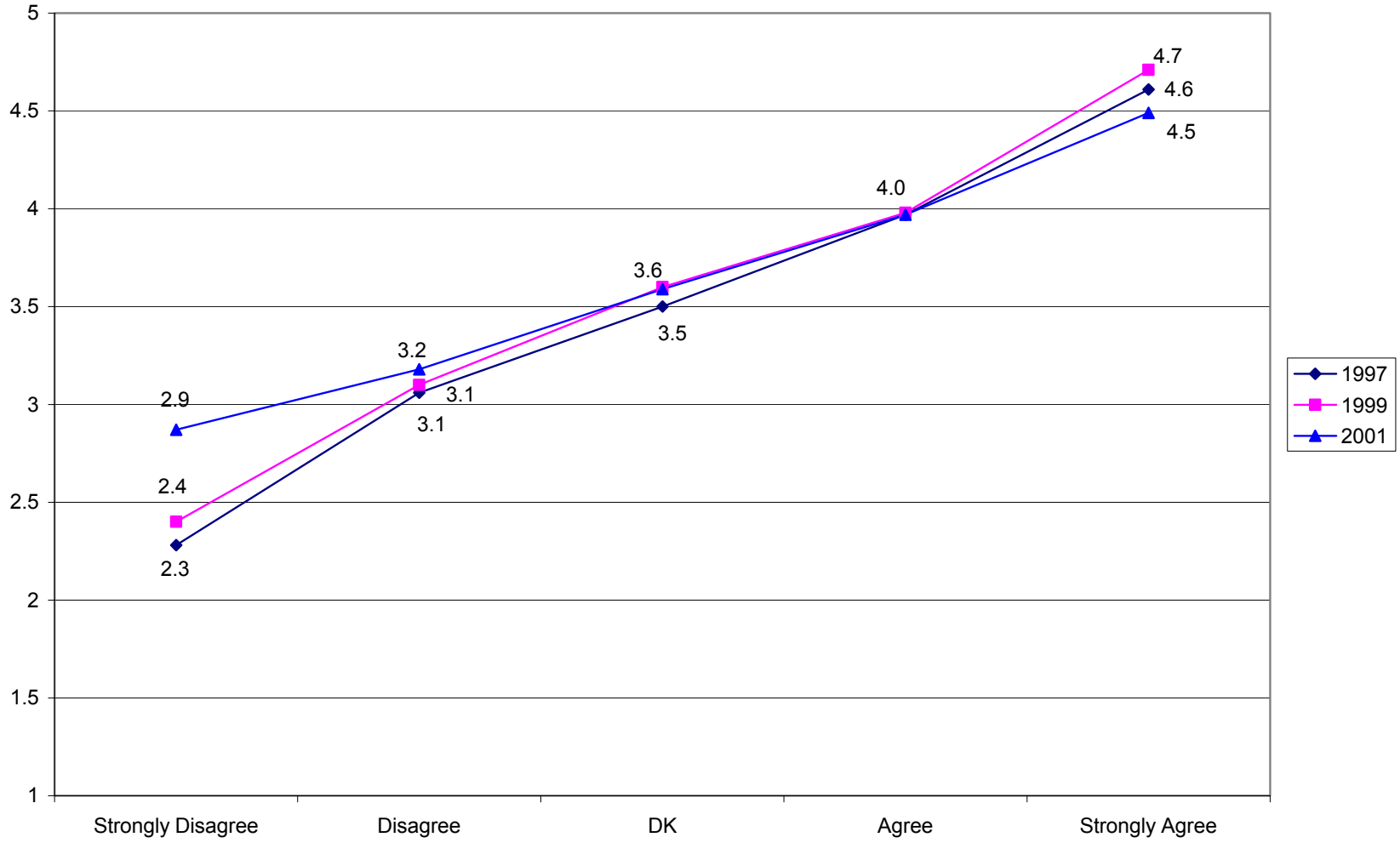

Figure D.4. ISP 4: More Opportunities for the Next Generation

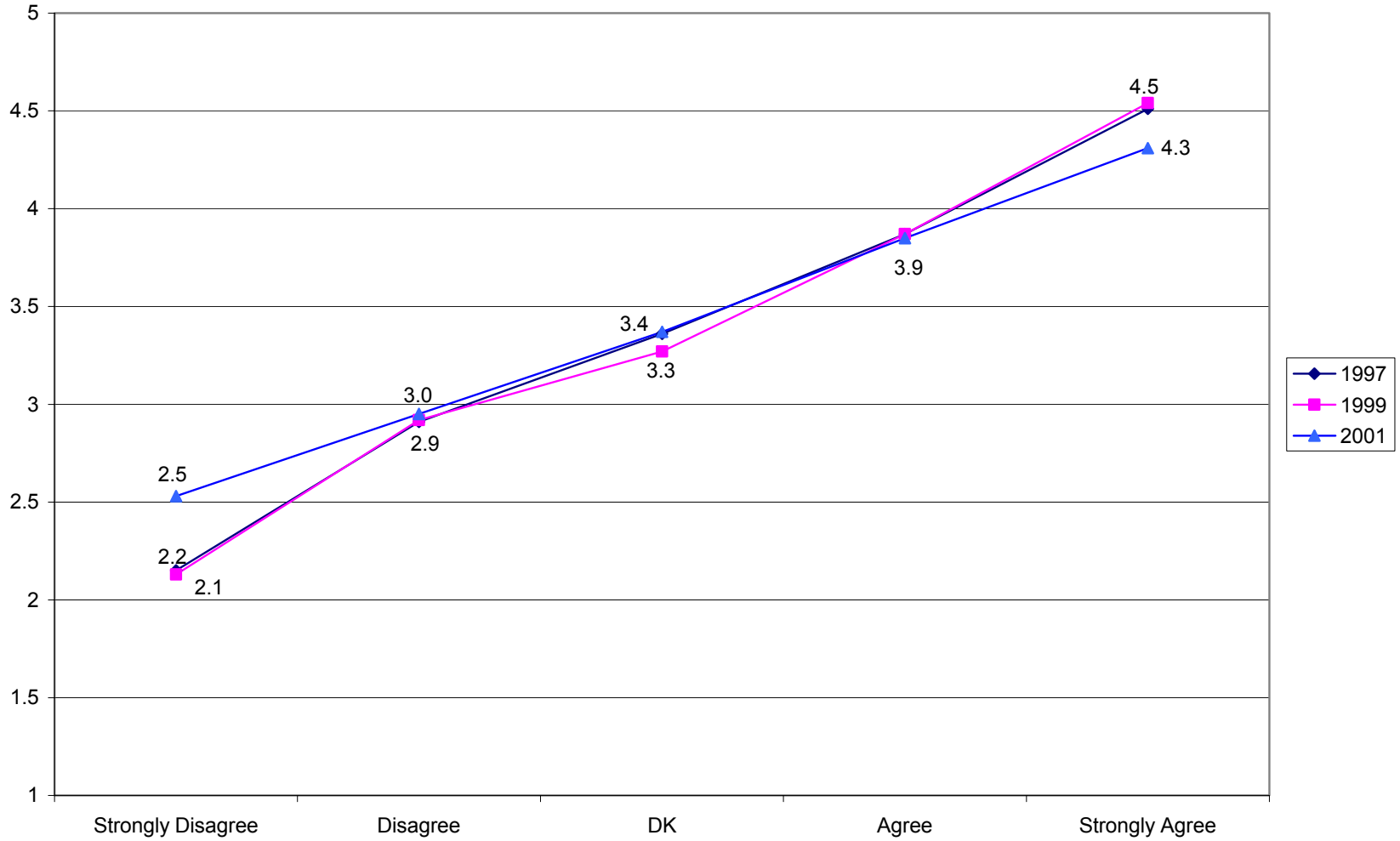

Figure D.5. ISR 1: Depend Too Much on Science, Not Enough on Faith

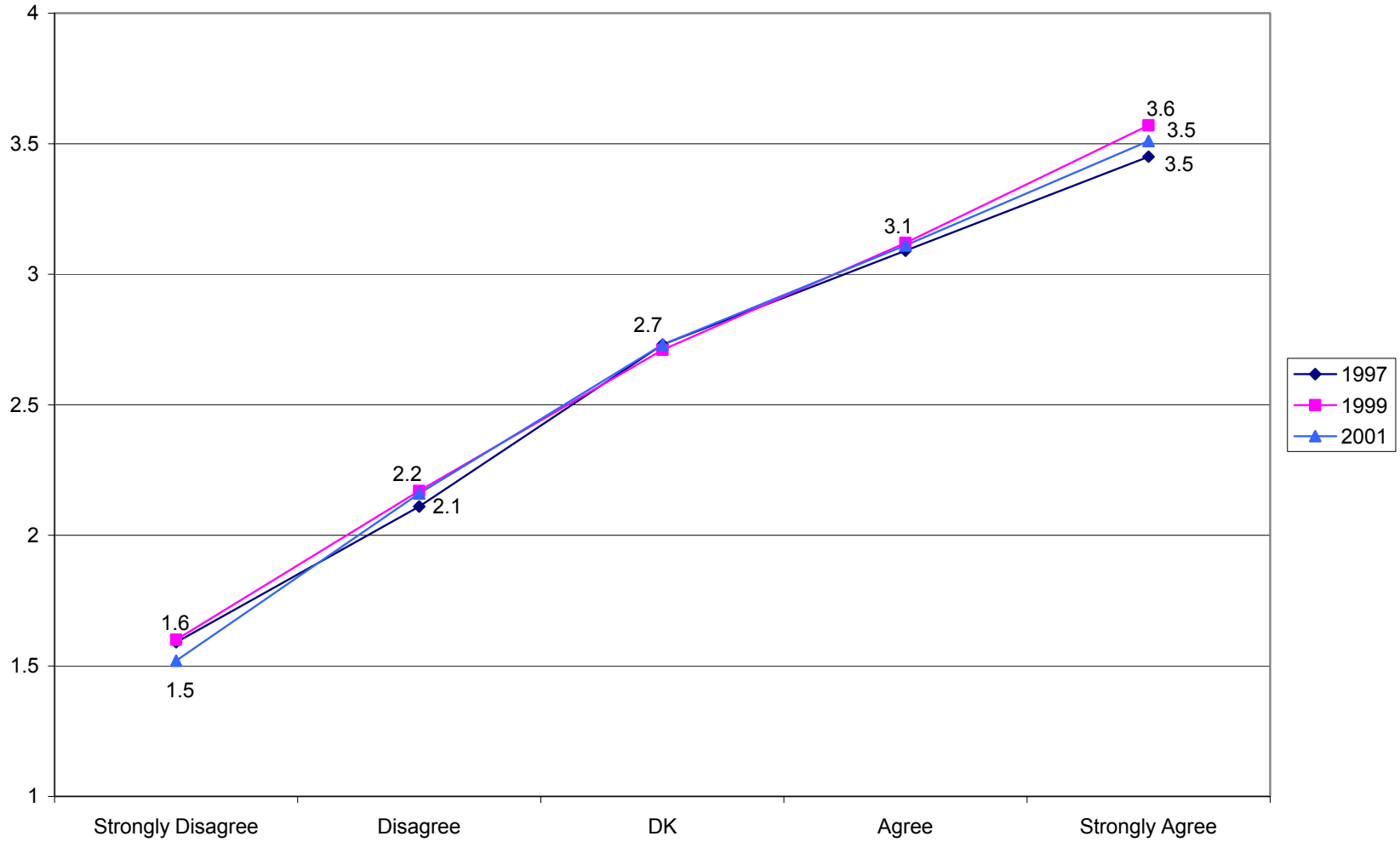

Figure D.6. ISR 2: Not Important to Know About Science in Daily Life

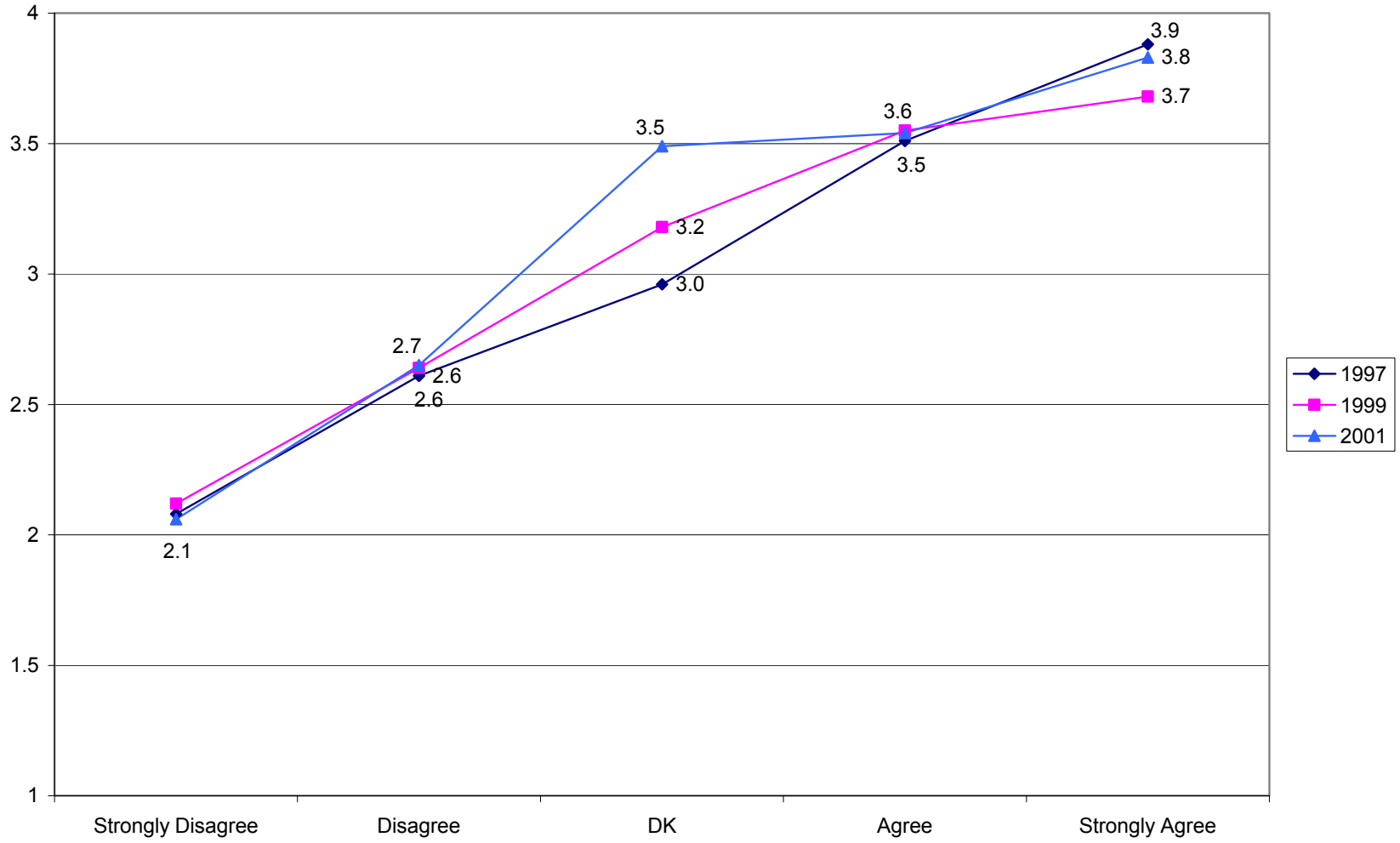

Figure D.7. ISR 3: Science Makes Life Change Too Fast