Exploring item non-response in public opinion surveys about nanotechnology: Evidence from 21 countries

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Abstract

Using data collected from 21 different countries, this study employed a multilevel model in understanding why people choose “don’t know” in public opinion surveys. Specifically, this study argues that item non-response could be attributable to factors beyond individual cognitive ability, although it does play a crucial role in the opinion-formation process. The results supported such a hypothesis as they indicated that uncertainty avoidance, individualism, and masculinity, as cultural characteristics, are all statistically significant predicators of item non-response. It is noteworthy that the *uncertainty hypothesis* and *ambivalence hypothesis* at the personal level were also supported, even after the cultural factors were taken into account. The findings bear great implications for both public opinion research and the development of nanotechnology across countries.

Exploring item non-response in public opinion surveys about nanotechnology: Evidence from 21 countries

As public opinion surveys assume an increasingly important role in modern society, more and more social scientists start to pay attention to the quality of survey and the issue of measurement error, especially after the mid-20th century (Johnson, Kulesa, Cho, & Shavitt, 2005). Particularly, a significant number of researchers have devoted their efforts to examining why survey respondents answer “don’t know,” rather than provide other answers of more substantive value (e.g., Bradburn & Sudman, 1988; Converse, 1976; Groothuis & Whitehead, 2002; Shoemaker, Eichholz, & Skewes, 2002; Sicinski, 1970). This inquiry is important because item non-response has been found to be non-random; that is, it is affected by respondents’ demographic characteristics, and therefore could exert great impacts on the validity of data and research results (Francis & Busch, 1975; Krosnick et al., 2002).

Before unraveling the myth of why survey respondents fail to provide substantive answers, it is necessary to know how people form an opinion. For starters, people will have to understand and interpret the question directed to them before they can search their memories for relevant information. At the next step, they will need to integrate the information into summary judgments, which then should be conveyed to the interviewer (Krosnick, 2002). Based on this opinion-forming process, it is likely that people would fail to report their opinion when (1) the questions are too difficult to understand; (2) they do not have enough information about the subject matter; (3) they have problem integrating information, especially when information is contradictory; and (4) they are unwilling to reveal their true thoughts.

Although the research on the impact of question properties on item non-response has a long history (e.g., Converse, 1976), the influence of information availability and integration appears to fit better within the context of nanotechnology, which is the subject matter of this study. This is because nanotechnology is in its infancy and the general public still does not know much about it (Cobb & Macoubrie, 2004). Therefore, as an emerging issue, nanotechnology may elicit more non-responses than other topics with which people are more familiar, such as the economy. In other words, people may answer “don’t know” because they are *uncertain* about what opinion they should give. In addition, nanotechnology is considered a morally-loaded issue, where contrasting values such as religiosity and trust play an important role in shaping public opinions (Brossard, Scheufele, Kim, & Lewenstein, 2008; Scheufele, 2006b). It is therefore likely that people answer “don’t know” because they are unable to resolve the *ambivalent* feelings resulted from contradictory beliefs or information they have.

One problem facing extant research on item non-response is that they are primarily theory-based (e.g., Beatty & Herrmann, 2002; Krosnick, 2002) or restricted to explanations at the individual level (e.g., Converse, 1976; Shoemaker et al., 2002). Little effort has been dedicated to understanding whether people in different cultures may have different proclivity in answering “don’t know,” on top of and beyond their individual differences and the way in which survey questions are asked (for an exception, see Johnson et al., 2005). Taking into account the influence of cultural givens is especially important when a researcher aims to investigate item non-response across countries. In fact, as early as the 1970s, researchers have recognized variation in different cultures about “the readiness to admit lack of knowledge or opinion about the subject of the question” (Sicinski, 1970, p. 1). Such a difference is likely to make research findings dubious (Sicinski, 1970).

Nanotechnology proves to be a decent case to study item non-response across countries because nanotechnology is an international issue, with its development often involving cooperation across national borders. In the interest of accurately measuring what people in different countries perceive the technology, it is important to understand whether they have any "preferred way" of answering survey questions, which may render survey results problematic.

As a result, this study aims to provide an integrative view about item non-response by bringing together factors at both personal level and cultural level. Specifically, I will test the *uncertainty hypothesis* and the *ambivalence hypothesis* mentioned earlier that are considered to account for item non-response at the individual level. I will also draw on Hofstede's (1998) four cultural dimensions—power distance, individualism, masculinity, and uncertainty avoidance—to examine the impact of culture on response styles.

Uncertainty as an explanatory factor

One reason why people answer "don't know" in public opinion surveys is because they are uncertain about their attitude. Wilson (2000), for instance, took the "don't know" response category as an indication of an uncertain mind in his study about why journalists felt uncertain about global climate change. Thus, the question of why people choose "don't know," in a sense, has become a question of why people felt uncertain about an issue. In the following section, I will outline two elements that account for the level of uncertainty: scientific knowledge and interpersonal discussion.

Scientific knowledge and uncertainty. Conceptually, uncertainty is often defined as a status where people do not have sufficient information needed to form an opinion. Walker and colleagues (2003) have offered a continuum that characterizes different levels of uncertainty. On the far left end of the continuum stands statistical uncertainty, which is the form of uncertainty usually referred to in the natural sciences. Among all the different manifestations of uncertainty, statistical uncertainty is closest to determinism because people have enough knowledge to specify the relationships between different driving forces in a statistical model. Assessment of probability also serves as a type of statistical uncertainty. To the extent that scientists cannot be sure about the outbreak of a disease, the safety of a nuclear power plant, or the toxicity of nanomaterials, probability will always be the most convenient form of expressing such uncertainty. Studies have shown that different expressions of probability, such as point estimation versus range estimation, or the bounds of a range estimation, produced different reactions from people about the information provider's honesty and credibility, and the perceived magnitude of risks (Johnson & Slovic, 1995, 1998).

To the right of statistical uncertainty is scenario uncertainty, where there exist many possible outcomes and the mechanisms leading to these outcomes are uncertain. Towards the more indeterminate end of the continuum, recognized ignorance refers to the total lack of idea about the relationships between driving forces. It is therefore difficult, if not impossible, to formulate statistical models or to develop scenarios. On the far right side stands the total ignorance, which represents the ultimate representation of indeterminacy where information is completely absent (Shackley & Wynne, 1996; Smithson, 1993) and "we do not even know that we do not know" (Walker et al., 2003, p. 13). As we can tell from the definition of the different levels of uncertainty explicated above, knowledge is the key concept used to demarcate the between-level boundaries, although there is no clear cut point. However, it is recognizable that increasing knowledge is associated with decreasing levels of uncertainty.

Scientific discussion and uncertainty. Given that knowledge plays a role in the strength of people's attitude towards nanotechnology, it is important to take into account variables that affect the accumulation of knowledge or awareness. In the field of political communication, researchers usually consider discussion or deliberation to exert desirable outcomes, such as better understanding of social issues or increased level of political participation, because it crystallizes ideas that are otherwise vague to media audiences and amplifies mobilizing information that is otherwise unnoticed (McLeod, Scheufele, & Moy, 1999; Scheufele, 2000). Interpersonal discussion has also been found to moderate the influence of media on the audience's knowledge, an effect dubbed "differential gains." Specifically, people gain most knowledge when they talk to others about the information they acquired from the media (Scheufele, 2000, 2002).

In the realm of science communication, researchers have identified "talk with others" as an important communication channel in disseminating information and in decision-making about scientific issues (O'Keefe, Ward, & Shepard, 2002; Trumbo, 1998). In addition, science discussions were found to increase the understanding of science (e.g., Southwell & Torres, 2006) and contribute to positive attitudes towards stem cell research (e.g., Shih, 2006). The literature suggests that interpersonal discussion can decrease the level of uncertainty either directly by clarifying information gleaned from the media or indirectly by increasing people's level of knowledge.

In sum, uncertainty is a common characteristic of public perception of science and risk assessment (Frewer et al., 2003; Zehr, 1999). The unknown feature of an innovation, and its associated risks, gives people a hard time when it comes to deciding whether they should support the invention or not. This is especially the case for nanotechnology because of its fledgling nature and a lack of understanding, even among nanoscientists, of its potential risks (Scheufele et al., 2007). The miniature scale at which nanotechnology operates also creates an obstacle for understanding (Batt, 2008). This uncertain state of mind is believed to be associated with the inability to assess probability or make decisions (e.g., Einsiedel & Thorne, 1999; Smithson, 1993), an increased level of perceived uncertainty about health and environmental issues (Powell, Dunwoody, Griffin, & Neuwirth, 2007), and the perceived credibility of information providers and magnitude of risks (Johnson & Slovic, 1995, 1998). Based on the literature, I formulated the following hypotheses which stipulate the “uncertainty” component of the “don’t know” decision made by survey respondents.

H1: The more knowledgeable people are about science and technology, the less likely they will choose “don’t know” when asked about how they would support nanotechnology.

H2: Those who are aware of nanotechnology would be less likely to choose “don’t know” than those who are unaware of it when asked about how they would support nanotechnology.

H3: The more people talk to others about science and technology, the less likely they will be to choose “don’t know” when asked about how they would support nanotechnology.

Ambivalence as an explanatory factor

Ambivalence refers to the coexistence of conflicting values (McGraw, Hasecke, & Conger, 2003; Zaller & Feldman, 1992). Its difference with uncertainty lies in the fact that increased level of knowledge or information may not decrease the level of ambivalence (Alvarez & Brehm, 1996). The coexistence of multiple contradictory beliefs or values can be troublesome and this feeling is not uncommon when people are asked to express opinions on controversial technologies which are often framed as competition between different values. Some examples of the "tug of war" between values include the issues of genetic engineering and stem cell research, which often involve several hard-to-reconcile values, such as social progress, ethical concerns, and family heritage (Nisbet, Brossard, & Kroepsch, 2003; Priest, 1999).

In the case of nanotechnology, studies have identified several sets of values or beliefs that people employ to facilitate their decision making process. The first group of variables entails value predispositions, such as religiosity and trust in scientists, and the second group of variables pertains to core beliefs about nanotechnology, such as its moral acceptance, usefulness, and level of risk.

Although research has found that both trust and religiosity are correlated with public support for nanotechnology (Brossard et al., 2008; Lee & Scheufele, 2006; Scheufele, Corley, Shih, Dalrymple, & Ho, 2009), how they will affect the respondents' likelihood of choosing "don't know" is less clear. However, based on the idea of ambivalence, this study suggests that it is the interplay of religiosity and trust that determines whether people will choose the "non-attitude" response. For example, a highly religious person will experience the status of ambivalence if he/she also has a high level of trust in scientists because the two feelings are equally strong and are difficult to reconcile.

Similarly, the interaction between public evaluation of risks, benefits, and moral acceptance is also expected to influence the level of ambivalence people may have. These concerns related to nanotechnology are correlated with public support in different directions (Cobb & Macoubrie, 2004; Scheufele & Lewenstein, 2005; Scheufele et al., 2008) and, if they appear simultaneously, are able to create mixed feelings in people's minds, which, in turn, will drive them to choose the "don't know" response. This study, therefore, postulates the following hypotheses which stipulate the "ambivalence" component of the "don't know" decision made by survey respondents.

H4: Those who possess contradictory opinions about the usefulness, risk, and moral acceptability of nanotechnology will be more likely to choose "don't know" when asked about how they would support the technology.

Influences at the country level

As mentioned earlier, people are not living in a vacuum where an individual's life is isolated from others'. People's definition of risk, their moral perception, and their views about nature are subject to the impact of the larger culture. In the previous sections, I have shown that people's perception of benefits and risks was associated with the predominant worldviews and preferred social relations in a society. These findings therefore prompted the following question. In addition to the psychological and cognitive determinants, are there any cultural factors that will shape people's proclivity to answer "don't know?"

Hofstede's "Uncertainty Avoidance Index (UAI)" proves useful here as it provides a decent measure of how people deal with uncertainty across cultures. As a dimension of national culture, *uncertainty avoidance* was defined as "the extent to which the members of a culture feel threatened by uncertain or unknown situations" (Hofstede, 2001, p. 161). The definition assumes that, although uncertainty is a basic element of human life, people in different societies have different ways to manage it. These ways of coping with uncertainty are transferred and reinforced by basic institutions such as family, the school, and the media, and therefore become part of the collectively shared values held by members of a particular society.

The concept of uncertainty avoidance has been linked to politics, consumer behaviors, and child-raising. For example, Almond and Verba (1963) found UAI to be negatively associated with “citizen competence.” In other words, they found that people with lower UAI scores had a stronger tendency to protest decisions, either made by the political authorities or by company supervisors. In addition, examining representative samples of the populations of Austria, Germany, Great Britain, the Netherlands, and the United States, Kaase and Marsh (1976) found that people in the higher-UAI countries, such as Austria and Germany, were less likely to prefer unorthodox protest behaviors, such as demonstrations and boycotts.

In general, people in cultures with different UAI scores exhibited different characteristics. Those in low-UAI societies consider uncertainty in life easily accepted; have lower stress and less anxiety; are open to change and innovation; are more willing to take unknown risks; have more tolerance of diversity; and feel comfortable with ambiguity and chaos. In contrast, those who grew up in high-UAI societies consider uncertainty in life a continuous threat; have higher stress and anxiety; are conservative and compliant; are only willing to take known risks; have lower tolerance of diversity; and have higher need for clarity and structure (Hofstede, 2001). Based on these characteristics, it is therefore reasonable to assume that people in low-UAI countries will be more prone to choose the non-opinion option because admitting “don’t know” does not result in mental discomfort. In contrast, people in high-UAI countries will be relatively reluctant to choose “don’t know” due to their need for clarity and answers. As a result, the following hypothesis was formulated.

H5: The more a culture emphasizes “uncertainty avoidance,” the less likely people in that culture would be to choose “don’t know” when asked about how they support nanotechnology.

In addition to UAI, Hofstede's other cultural dimensions might also contribute to a greater understanding of why people chose "don't know" because these cultures cultivate characteristics that provides important guidance for people in their decision-making process. For example, *power distance* measures the hierarchical relationship between people. A higher level of power distance would indicate a more authoritarian culture where decisiveness and definitiveness in communication is considered necessary. In contrast, cultures with lower power distance will emphasize equality and modesty as important values (Nelson & Shavitt, 2002; Triandis & Gelfand, 1998). Therefore, power distance may have a negative relationship with the likelihood of answering "don't know."

A similar demand for assertiveness and decisive behavior was also seen in cultures emphasizing *masculinity* (Hofstede, 1998). As mentioned earlier, these qualities may prompt people to give affirmative answers. In contrast, people in feminine cultures may be more prone to choose the middle point due to the emphasis on modesty. Based on this reasoning, this study hypothesizes a negative relationship between masculinity and the likelihood of answering "don't know."

Some characteristics inherent in *individualistic* cultures also affect item non-response. People living in societies emphasizing individualism have a stronger inclination to pursue clarity in communication and express strong opinions (Johnson et al., 2005). In contrast, people in collectivist care more about interpersonal harmony and less about individual opinions (Triandis et al., 2001). As a consequence, the level of individualism will be negatively associated with the likelihood of answer "don't know." Based on the literature, the following hypotheses were formulated.

H6: The greater the power distance is in a country, the less likely people in that culture would choose “don’t know” when asked about how they support nanotechnology.

H7: The more a culture emphasizes “masculinity,” the less likely people in that culture would choose “don’t know” when asked about how they support nanotechnology.

H8: The more a culture emphasizes “individualism,” the less likely people in that culture would choose “don’t know” when asked about how they support nanotechnology.

Methods

Explication of datasets

The U.S. survey was conducted by the University of Wisconsin Survey Center under the auspices of the Center for Nanotechnology in Society at Arizona State University. Data collection for the study began on 15 February and ended on 27 June 2007, using a dual frame method of national random digit dial and listed household phone survey. The total sample size was 1,015, with a response rate of 30.60% (calculated using AAPORs formula for RR3; ref. 21).

The Eurobarometer 64.3 survey was collected by the European Committee in 2005. The Eurobarometer public opinion surveys were conducted on behalf of the European Commission. Using a multistage national probability sampling technique, the Eurobarometer 64.3 provides opinion data collected from 29 countries through face-to-face interviews of 29,193 Europeans aged 15 and above. The fieldwork was conducted between 5 November and 7 December 2005. I excluded interviewees under 18 in order to make the U.S. and European samples comparable. Also, there were slight variations in wording for scale anchors across countries, that is, “strongly disagree" and "strongly agree" were used in the U.S. survey, and "totally disagree" and "totally agree" in the English version of the Eurobarometer. Undecided respondents were coded into a middle category in all countries to make metrics comparable.

Variables at the individual level

Awareness of nanotechnology. The level of awareness was measured by asking survey respondents how much have they heard, read or seen about nanotechnology. In the US survey, this question was measured on a one to 10 scale, where one indicates knowing nothing about nanotechnology and 10 indicates knowing everything. However, in the Eurobarometer survey, the response categories include only yes and no. In order to make the two datasets comparable, the variable in the US survey was dichotomized in a way that reflected only awareness and no awareness. The average proportion of the respondents who had heard of nanotechnology in the 21 countries was 44.2 percent.

Confidence. The variable was measured by asking the respondents: "How confident would you say you are in the safety and regulatory approval systems governing nanotechnology?" The variable was on a 5-point scale with -2 indicating "not at all confident and 2 indicating "very confident" (*M*=-0.01, *SD*=1.11).

Scientific knowledge. The knowledge variable was an additive index of 10 items measuring respondents' general scientific knowledge, which was only available in the Eurobarometer. It was, therefore, used when the analysis involved only Europe. The questions were (1) Yeast for brewing beer or making wine consists of living organisms; (2) Ordinary tomatoes do not contain genes, while genetically modified tomatoes do; (3) The cloning of living things produces genetically identical copies; (4) Eating genetically modified fruit would alter their own genes; (5) It is possible to find out in the first few months of pregnancy whether a child will have (Down's Syndrome, trisomy, Mongolism; (6) Genetically modified animals are always bigger than ordinary ones; (7) More than half of human genes are identical to those of a chimpanzee; (8) It is not possible to transfer animal genes into plants; (9) Human cells and human genes function differently from those in animals and plants; (10) Embryonic stem cells have the potential to develop into normal humans. Respondents were coded one if they correctly answered the questions, otherwise they were coded zero. Each respondent obtained a score ranging from zero to 10, based on the number of questions they answered correctly. Higher scores, therefore, indicated more knowledge in general sciences and technologies (*M*=5.13, *SD*=2.50).

Science discussion. The frequency of science discussion was measured by asking people how frequently they “discuss science and technology with other people.” The variable ranged from one to four and was reversely coded so that four indicates frequent discussion and one indicates no discussion at all (*M*=2.27, *SD*=1.00). Again, this variable was only available in the Eurobarometer.

Ambivalence about nanotechnology. To measure the degree of ambivalence, I compared the respondents’ opinion on questions about morality, usefulness, and risk. In particular, if respondents agreed (including somewhat agreed and strongly agreed) that nanotechnology is useful and risky at the same time, they were coded as 1. They were also coded 1, which indicated the presence of ambivalence, if they considered nanotechnology as not useful and not risky simultaneous. Otherwise, respondents were coded zero. A similar transformation process was applied to create the ambivalence index for morality versus usefulness and morality versus risk. Consequently, three dichotomous variables were created, with 1 indicating the presence of ambivalence. In the total sample, 4 percent of the respondents were found to hold contrasting views about morality and usefulness. The proportion of ambivalent respondents was similar with respect to morality versus risk (19%) and usefulness versus risk (20%).

Controlling variables

This study included age and gender as controls. The respondents' age ranged from 18 to 98, with a mean of 48.49 and standard deviation of 17.52. It should be noted that the Eurobarometer included respondents younger than 18. In order to make it comparable with the US survey, these minor respondents were excluded. About 45 percent (44.65%) of the respondents were male.

In addition, this study also took into account public perception of other emerging technologies—genetically modified food (GMF) and genetically modified plant (GMP). These two technologies were selected not only because they aroused a similar degree of controversy in the society, but also they were the only two technologies that allow meaningful comparisons with nanotechnology.

Making sense of new ideas based on existing experience or frame of reference is a common act in the human's learning process, as many cognitive theories have suggested (Pan & Kosicki, 2005; Price & Tewksbury, 1997; Rogers, 1999). The learning process is also applicable in public understanding of nanotechnology because how people make sense of the technology is subject to various frames produced by activists and interest groups. For example, nanoscientists are using the failure of biotechnology as a lesson when they communicate with the general public and policy makers about nanotechnology (Sandler & Kay, 2006; Wilsdon, 2004). These two technologies are inter-related because developing biotechnology at the nanoscale helps bring about progress in areas such as material detection, imaging, and DNA sequencing (May & Heebner, 2006). This "biotech-nanotech" analogy serves as an effective heuristic for people to make sense of the swift-developing, prosperous nanotechnology. This study, therefore, included public perception of the two technologies as controls.

The unsure attitudes toward the three controversial technologies were measured by the proportion of respondents who answered “don’t know” about the following questions asked in Eurobarometer 64.3: “Overall, which of the following best describes your views about nanotechnology (GMF/ GMP)?” The response categories included: (1) I approve of nanotechnology as long as the usual levels of government regulation are in place; (2) I approve of nanotechnology if it is more tightly regulated; (3) I do not approve of nanotechnology except under very special circumstances; (4) I do not approve of nanotechnology under any circumstances; (5) Don’t know. The proportion of respondents answering “don’t know” was 11.25 percent for GMF, 11.56 percent for GMP, and 24.20 percent for nanotechnology.

The third set of variables this study controlled is the public’s attitude strength about the moral acceptability, benefits, and risks of nanotechnology. Specifically, I folded the original variables in a way that answers with the same magnitude but a reverse sign (e.g., -2 and 2) were merged. These variables now range from 0 to 2, with higher numbers indicating stronger opinions or attitudes.

Variables at the aggregate level

Religiosity. I imputed aggregate responses on religiosity for each country from the World Values Survey. Possible responses ranged from one to ten, with one indicating that religious guidance was “not at all important” and ten indicating “very important” in respondents’ lives.

Confidence. The average level of confidence was measured by aggregating the responses at the individual level about people's confidence in regulatory systems. Each country obtained a score ranging from -2 to 2.

Government funding (GDP adjusted). This funding variable was adjusted by GDP. I divided government funding on nanotechnology, obtained from the European Commission, by each county's GDP per capita, retrieved from the International Monetary Fund (IMF).

Scientific knowledge. This variable was measured by the mean scores of 10 true/ false knowledge questions from two datasets—the 2006 general social survey and Eurobarometer 63.1. They are (1) the center of the Earth is very hot; (2) All radioactivity is man-made; (3) It is the father's gene that decides whether the baby is a boy or a girl[1]; (4) Lasers work by focusing sound waves; (5) Electrons are smaller than atoms; (6) Antibiotics kill viruses as well as bacteria; (7) The continents on which we live have been moving their locations for millions of years and will continue to move in the future; (8) Human beings, as we know them today, developed from earlier species of animals; (9) Does the Earth go around the Sun, or does the Sun go around the Earth? (10) How long does it take for the Earth to go around the Sun: one day, one month, or one year?[2] Therefore, each country's level of scientific knowledge was indicated by a score ranging from zero to 10.

Cultural dimensions

Individualism vs collectivism. Each country's individualism scores were imputed based on Hofstede's individualism index, which included 50 countries and three regions (Hofstede, 2001). The individualism index (IDV) was one of the four

[1] In EB 63.1., the question wording was "It is the mother's genes that decide whether the baby is a boy or a girl."

[2] In EB 63.1., the question wording was "It takes one month for the Earth to go around the Sun."

"dimensions of culture" developed by Hofstede. The other three dimensions are power distance, uncertainty avoidance, and masculinity/femininity. The values for IDV and the masculinity index were derived from the two factors generated based on 14 questions about employee's "work goals." Specifically, IDV was associated with the six questions about employ's personal time, freedom, challenge, use of skills, physical condition, and training. It accounted for 24 percent of the variance in the average country scores about work goals.

Uncertainty avoidance index (UAI). UAI is also one of Hofstede's (2001) four dimensions of national culture. It signifies the amount of uncertainty and ambiguity a society is willing to tolerate. The index was computed on the basis of the country mean scores of three survey questions—(1) whether people agree that "company rules should not be broken even when the employee thinks it is in the company's best interest (rule orientation); (2) the employee's intention to work with the company either for 2 years at the most or for more than 2 years (employment stability, reversely coded); (3) the frequency at which employs in a given country feel nervous or tense at work (stress). The average scores of the three questions were computed with some algorithm developed by Holfstede. The resulting values of UAI for more than 60 countries[3] range from 8 (lowest UAI: Singapore) to 112 (highest UAI: Greece).

Power distance index (PDI). PDI was measured by three survey questions, with two pertaining to subjective perception and the other about personal values. First, respondents were asked about the frequency at which they were afraid of expressing disagreement with their managers. Second, they were asked about their managers'

[3] Hofstede included data for only 50 countries and three regions in his *Culture's Consequence* (2001). Among the 53 regions/ countries, 15 were relevant for this study. As a result, IDV and UAI values of Poland and Czech Republic were obtained from Gert Hofstede's Web site at http://culturevalues.wordpress.com/. Furthermore, IDV and UAI values of Latvia and Lithuania were imputed based on Huettinger's (2008) research.

decision making styles; i.e., whether the boss communicated with the subordinates in an autocratic way, a paternalistic way, a consultative way, or a democratic way. Third, respondents were also asked about their preferred styles of decision making. These variables were combined and calculated so that the final scores of PDI ranged from zero (small power distance) to 100 (large power distance).

Masculinity index (MAS). As mentioned earlier, the values for MAS and IDV were derived from the two factors generated based on 14 questions about employee's "work goals." Specifically, MAS was derived from eight items that measured the role of men and women. They were manager, cooperation, desirable area, employment security, challenge, advancement, recognition, and earnings. These variables accounted for 22 percent of the variance in the country mean "work goals" scores.

Since this study examined variables at both the individual level and the national level, the Hierarchical Linear Modeling (HLM) seems to be a pertinent approach. In the following section, I will explain the basic ideas of HLM and what advantages it may bring compared with ordinary least squares regressions, which is often used in the study of public opinion.

The Hierarchical Linear Modeling Approach

The ability to examine the contribution of these aggregate-level factors is made possible with the hierarchical linear modeling approach (HLM). This approach is appropriate because, methodologically, public opinion data in Europe were collected using a multi-stage sampling technique, where respondents were selected based on the country, region, and city in which they live. These respondents were, therefore, subject to the influence of the same factors, such as the information environment, moral values, and preferred ways of life. Traditionally, there are two ways to handle such data. The first is to disregard the major sampling unit (i.e., a country) and treat the sample as if it was randomly selected. However, this approach violates the assumption of independence in ordinary least square (OLS) regression analysis (Cohen, Cohen, West, & Aiken, 2003). The second way is to examine the data at the aggregate level (e.g., whether the mean level of religiosity is associated with the mean level of moral acceptability). This approach not only ignores individual differences but could suffer from "ecological fallacy" (Bauer, 2005).

HLM solves the problem by taking into account both individual characteristics and the cultural milieu in which people live. In other words, it accounts for the nested feature of the data (Raudenbush & Bryk, 2002). Furthermore, it also allows variability at the aggregate level. For example, each country or culture was assumed to have the same intercept in OLS regression; i.e., different cultures were hypothesized to have the same level of, say, risk perception. This is, however, not true (Douglas & Wildavsky, 1982). HLM is able to tap into the differences at the aggregate level and allows for multivariate analysis of the factors resulting in such differences.

The analyses in this study were mainly based on a sample of 21 countries However, the analysis pertaining to individual-level scientific knowledge, science discussion, as well as the perception of GMF and GMP, was based on a sample of 20 countries, with the US being excluded. I ran separate analyses, one with the US and the other without it, also because the surveys in these two areas were not conducted in an identical manner. Specifically, while the US survey was a computer-assisted telephone interview, the Eurobarometer survey was collected via face-to-face interview. Research has shown that the mode of the survey may result in differences in responses (Schwarz, Strack, Hippler, & Bishop, 1991). It is, therefore, helpful to see if results obtained from these separate analyses can match. The descriptive statistics of the variables used in this study in both samples can be found in table 1 and table 2.

[Insert Table 1 and Table 2 about here]

Results

All the hypotheses and research questions were examined with the technique of Hierarchical Linear Modeling in light of the nested nature of the data.

H1 stipulated a negative relationship between individual science knowledge and the likelihood of answering “don’t know.” The hypothesis was supported as the results indicated that, in the 20 European countries under study, people were less likely to answer “don’t know” as their level of science knowledge increased. **H2** hypothesized that awareness of nanotechnology had a negative relationship with the likelihood of answering “don’t know.” The hypothesis was supported. In both the samples, those who were aware of nanotechnology revealed a lower chance of answering “don’t know.” **H3** suggested a negative relationship between science discussion and the likelihood of answering “don’t know.” The hypothesis was not supported as the frequency of discussion about science and technology was not found to be associated with the chance of answering “don’t know.”

[Insert Table 3 and Table 4 about here]

H4 suggested a relationship between ambivalence and the choice of “don’t know.” The results, which were consistent in both samples, provided only partial support for the hypothesis. People who considered nanotechnology to be useful but risky (also not useful and not risky) at the same time tended to have difficulty yielding substantive answers. In other words, their chance of saying “don’t know” was higher than those who did not possess equally strong views about the two properties of nanotechnology. This finding was consistent in both samples, although the result derived from the European sample was only marginally significant.

The ambivalence between moral acceptability and risk of nanotechnology also affected the likelihood of answering “don’t know.” However, the results suggested a reverse direction of influence. That is, the ambivalence actually decreased the chance of item non-response. Quite differently, the ambivalence between moral acceptability and the perceived benefits of nanotechnology did not exert any impact on item non-response.

H5 stipulated that the prevalence of the uncertainty avoidance value in a given culture will be associated with the likelihood of its people to answer “don’t know.” Before testing the hypothesis, it is necessary to examine whether there exists variability in the mean level of “don’t know” respondents. In both samples, I found statistically significant *random intercept residuals*, an indication of variability at the aggregate level (see Table 3 and Table 4). This difference in terms of the tendency to choose “don’t know” was also shown in Figure 1.

[Insert Figure 1 about here]

Given the between-country differences, it will make sense to proceed and examine what constituted the variability. The results indicated that those who lived in a culture emphasizing uncertainty avoidance were less likely to choose “don’t know” when asked about their attitudes toward nanotechnology. This relationship was again identified in both samples.

H6 hypothesized a negative relationship between power distance and the tendency to answer “don’t know.” This hypothesis was not supported as both the overall sample and the European sample did not suggest an association between the two variables. However, the results from both samples indicated a positive relationship between masculinity and the tendency to answer “don’t know.” Those who lived in cultures emphasizing characteristics such as assertiveness and aggressiveness were more likely to answer “don’t know” than those who lived in societies where the differentiation of gender objectives were not demarcated as clearly. This finding, therefore, is contrary to the prediction of **H7**, which postulated a negative relationship between the two variables.

In addition, **H8**, which stipulated a negative relationship between individualism and answering “don’t know,” was supported. Those who lived in a society which emphasized personal freedom and individual entitlement were less likely to answer “don’t know” than those who lived in a culture where group relationship was valued.

In terms of the effects of the control variables, age was found to have a positive association with item non-response. However, older people showed a greater tendency to answer “don’t know” only in the overall sample with 21 countries, but not in the European sample. Whereas religiosity did not affect item non-response, the strength of confidence was associated with a lower chance of answering “don’t know” in both samples. In addition, those who had strong views about the moral acceptability and usefulness of nanotechnology were also less likely to answer “don’t know.” The findings were again consistent in both samples. However, the strength of risk perception was only found to exert an impact in Europe. People who possessed a certain opinion about the risks of nanotechnology were less likely to answer “don’t know.”

At the national level, science knowledge was negatively associated with item non-response in both samples. Living in a country where its people know more about science and technology would help decrease the likelihood of item non-response.

However, in the overall sample, whereas religiosity was found to decrease the chance of saying “don’t know,” confidence was found to exert an opposite effect.

After presenting the results, it will be useful to know how much between-country variance was explained by the variables at the national level. The variance component section in Table 3 showed a reduction of variance from 0.56 to 0.21 after the seven country-level variables were included in the analysis. In other words, these variables accounted for more than 60 percent of the variance across the 21 countries about their tendency to answer “don’t know.” These same variables, however, explained a less amount of variance in the sample including only the European countries (from 0.032 to 0.028, a reduction of about 12%), as the variance component section at the bottom of Table 4 showed. Nonetheless, the residual variance became statistically marginally significant after the inclusion of the variables, which suggested that these variables account for the between-country variability well.

Discussion and conclusion

Understanding public opinion regarding nanotechnology has been increasingly important as industry and policy makers start to recognize the ability of the general public to affect the prosperity and development of a technology (Scheufele, 2006a). However, the general public still does not appear determined and assured in their attitudes towards nanotechnology. Why does this happen?

This study tested the influence of four cultural factors, along with the “uncertainty hypothesis” and “ambivalence hypothesis” at the individual level, on item non-response. The results indicated a complex picture of the public’s mind by showing that the tendency to answer “don’t know” was attributable to various factors, some of which are not directly related to nanotechnology. Such results suggested that although increasing public awareness of nanotechnology could increase the likelihood of providing substantive responses, it may only have a limited effect. This is because increased awareness, or scientific knowledge, may reduce the feeling of uncertainty, but it cannot reduce the feeling of ambivalence and the chance of applying attitudes toward other technologies to nanotechnology. Consequently, in order for people to form substantive opinions, scientists or pollsters will need to do more than merely increase the level of awareness and knowledge of the public, although it might be the most effective and easiest way of achieving the objective.

In fact, an increased level of scientific knowledge may not always be beneficial. Knowledge may not be directly related to more support for emerging technologies or a decreased chance of having "no-opinion" because different pieces of knowledge may be contradictory to each other. This is especially pertinent in areas of controversial sciences and technologies (e.g., global climate change, genetic engineering, etc.) where uncertainty is ubiquitous and a consensus has not yet been reached by key policy-makers or scientists (Corbett & Durfee, 2004; Dunwoody, 1999; Giles, 2002). As a result, it is imperative for future research to further examine the role of scientific knowledge so that it can be used more effectively and precisely as a tool to popularize science.

The close relationship found between nanotechnology, GMF, and GMP has great implications. Proponents of nanotechnology or nano-scientists should understand how closely GMF and GMP are connected with nanotechnology in people's minds. People have reserved attitudes toward nanotechnology because they had the same attitudes towards other similar technologies. Although the same debacle that happened in biotechnology may not occur in the case of nanotechnology, outreach personnel should make clear distinctions between nanotechnology and other controversial ones to prevent inappropriate analogies from being used by the public as "mental templates" when making decisions (Sandler & Kay, 2006).

The statistically significant role of "uncertainty avoidance," "individualism," and "masculinity" merits discussion. The relationship between uncertainty avoidance and people's undetermined mind about nanotechnology is straightforward because, as mentioned earlier, people still do not know much about how the technology may affect the environment, society, and human health. This feeling of uncertainty is reflected in the opinion surveys differently, depending on the amount of ambiguity people in specific societies are willing to tolerate. Furthermore, the link between individualism at the national level and the decreased chance to answer "don't know" at the individual level is also clear. This is because people in individualistic cultures tend to emphasize the expression of personal perspectives. They care less about the consequence of rendering strong opinions because interpersonal harmony is not their main concern.

However, the fact that masculinity exerted a positive effect was contradictory to the prediction of this study, which assumed a negative relationship. As mentioned earlier, the hypothesized negative relationship between the two variables was based on the assumption that people in masculine societies tend to emphasize assertive and daring behaviors (Hofstede, 1998). Nonetheless, the emphasis on daring and decisive behaviors could also result in the choice of "don't know" because they are not afraid of admitting ignorance. In fact, previous research had mixed findings regarding the association between masculinity and response styles. For instance, whereas Johnson et al. found a positive relationship between masculinity and the extreme response style, this result was not replicated in another study (i.e., Smith & Fischer, 2008). Their finding about the relationship between masculinity and acquiescence was also inconsistent with other research (e.g., Smith, 2004; Smith & Fischer, 2008). This suggested that future research should examine the characteristics of masculine culture in greater detail and across different topic domains in order to have a more comprehensive understanding about the way it affects public opinion.

At first blush, these cultural factors seem to address people's general orientations and, therefore, should exert invariant effects across issues. For example, those living in individualistic societies are supposed to answer survey questions in the same way regardless what the questions are about. However, comparing the results of this study and those from previous research does not suggest that this is the case. Specifically, in a study examining employee satisfaction, Johnson and colleagues (Johnson et al., 2005) found that power distance and masculinity were positively related to respondents' tendency to give extreme answers. Quite differently, uncertainty avoidance and individualism were found in this study to increase the chance of providing substantive answers, with masculinity being found to exert an opposite effect. Although the dependent variables in the two studies were not exactly the same, the distinct results at least provide preliminary evidence about the differential role of these cultural orientations in different survey contexts. This difference directly addresses the concerns raised by Johnson and his colleague (Johnson et al., 2005) at the end of their research that caution should be used in generalizing their findings because their measures and data were designed to evaluate employ satisfaction and attitudes.

In short, the fact that most individual-level factors remained statistically significant after controlling for the influence of cultural orientations on response styles suggested that the two concepts examined—uncertainty and

Item non-response and nanotechnology ambivalence –indeed played a critical role in shaping item non-response in relation to support for nanotechnology.

Table 1

Descriptive statistics of variables used in predicting non-response (21 countries)

Variables	N	Mean	SD	Minimum	Maximum
Level-1 descriptive statistics					
Age	10,776	48.71	17.62	18.00	97.00
Sex	10,776	44% male		0.00	1.00
Awareness	10,776	44% aware		0.00	1.00
Attitude strength: Confidence	10,776	-0.01	1.11	-2.00	2.00
Religiosity	10,776	2.52	1.13	1.00	4.00
Attitude strength: Moral acceptability	10,776	0.98	0.76	0.00	2.00
Attitude strength: Usefulness	10,776	1.00	0.75	0.00	2.00
Attitude strength: Risk	10,776	0.86	0.71	0.00	2.00
Ambivalence: moral & useful	10,776	4%		0.00	1.00
Ambivalence: moral & risky	10,776	19%		0.00	1.00
Ambivalence: useful & risky	10,776	20%		0.00	1.00
DK for nano support	10,776	22%		0.00	1.00
Level-2 descriptive statistics					
GDP per capita	21	35306.19	16876.31	9840.00	75880.00
Science knowledge	21	6.25	0.90	4.57	7.78
Nano awareness	21	45.24	15.23	26.00	68.80
Uncertainty avoidance	21	67.05	24.17	23.00	112.00
Power distance	21	44.62	16.34	11.00	71.00
Individualism	21	63.71	17.42	27.00	91.00
Masculinity	21	43.67	23.26	5.00	79.00

Table 2

Descriptive statistics of variables used in predicting non-response, 20 European countries

Variables	N	Mean	SD	Minimum	Maximum
Level-1 descriptive statistics					
Age	9,739	47.99	17.58	18.00	97.00
Sex	9,739	44% male		0.00	1.00
Attitude strength: Moral acceptability	9,739	1.00	0.75	0.00	2.00
Attitude strength: Usefulness	9,739	1.01	0.75	0.00	2.00
Attitude strength: Risk	9,739	0.87	0.69	0.00	2.00
Awareness	9,739	43% aware		0.00	1.00
Science knowledge	9,739	5.19	2.49	0.00	10.00
Science discussion	9,739	2.27	1.00	1.00	4.00
Confidence	9,739	0.89	0.66	0.00	2.00
Religiosity	9,739	3.66	2.22	1.00	8.00
Ambivalence: moral & useful	9,739	4%		0.00	1.00
Ambivalence: moral & risky	9,739	19%		0.00	1.00
Ambivalence: useful & risky	9,739	20%		0.00	1.00
DK for nano support	9,739	24%		0.00	1.00
DK for GMF support	9,739	11%		0.00	1.00
DK for GMP support	9,739	11%		0.00	1.00
Level-2 descriptive statistics					
Religiosity	20	5.83	1.39	3.76	8.37
Science knowledge	20	6.26	0.93	4.57	7.78
Confidence	20	0.06	0.33	-0.71	0.47
Uncertainty avoidance	20	68.10	24.30	23.00	112.00
Power distance	20	44.85	16.72	11.00	71.00
Individualism	20	62.35	16.68	27.00	89.00
Masculinity	20	42.75	23.47	5.00	79.00

Table 3

Predicting "don't know" in the US and 20 European countries

Variables	Coefficient	S.E.	T-ratio	Odds ratio	P-level
Individual-level					
Age	0.01	0.00	2.64	1.01	**
Sex	-0.01	0.09	-0.15	0.99	
Religiosity	0.04	0.04	1.18	1.05	
Awareness	-0.88	0.11	-7.97	0.41	***
Attitude strength: Confidence	-1.42	0.06	-22.40	0.24	***
Attitude strength: Moral acceptability	-0.82	0.11	-7.50	0.44	***
Attitude strength: Usefulness	-1.49	0.12	-12.54	0.23	***
Attitude strength: Risk	-1.00	0.11	-9.04	0.37	
Moral & usefulness	-0.47	0.32	-1.46	0.63	
Moral & risky	-0.47	0.26	-1.80	0.62	†
Usefulness & risky	0.49	0.25	1.99	1.64	*
Country-level					
Religiosity	-0.38	0.13	-2.90	0.69	*
Science knowledge	-0.97	0.22	-4.30	0.38	**
Confidence	1.79	0.49	3.63	6.01	**
Uncertainty avoidance	-0.04	0.01	-3.08	0.96	**
Power distance	0.01	0.01	1.18	1.01	
Individualism	-0.04	0.01	-4.14	0.96	**
Masculinity	0.01	0.01	2.03	1.01	†
Variance component	SD	Variance (U_0)	DF	X^2	P-level
Random intercept model	0.75	0.56	20	324.27	***
Random intercept model with 2nd level predictors	0.46	0.21	13	92.63	***

Note. (1) The dependent variable is binary, with 1 indicates the answer of "don't know." Therefore, the Bernoulli multilevel analysis was used. (2) The individual level sample size is 10,776.

***p<.001, **p<.01, *p<.05, †p<.10.

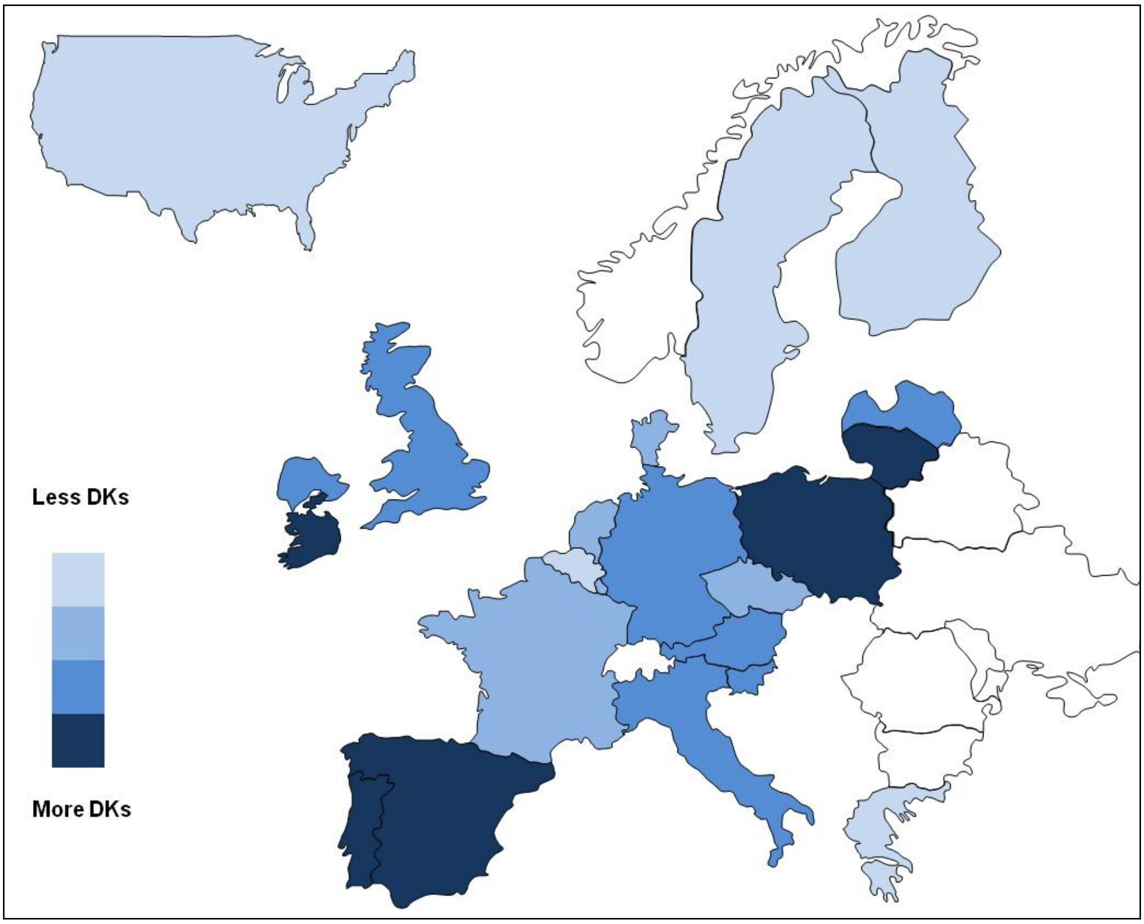
Table 4

Predicting "don't know" in 20 European countries: the influences of science discussion, science knowledge, and other controversial technologies at the individual level

Variables	Coefficient	S.E.	T-ratio	Odds ratio	P-level
Individual-level					
Age	-0.00	0.00	-0.45	1.00	
Sex	-0.01	0.09	-0.16	0.99	
Religiosity	0.03	0.02	1.29	1.03	
Awareness	-0.79	0.12	-6.49	0.45	***
Science discussion	0.03	0.05	0.54	1.03	
Science knowledge	-0.06	0.02	-2.57	0.95	*
Attitude strength: confidence	-1.42	0.07	-20.88	0.24	***
Attitude strength: Moral acceptability	-0.79	0.12	-6.81	0.45	***
Attitude strength: Usefulness	-1.48	0.13	-11.50	0.23	***
Attitude strength: Risk	-0.89	0.12	-7.48	0.41	***
DK-GMF	1.61	0.15	10.73	5.02	***
DK-GMP	1.17	0.14	8.35	3.24	***
Moral & usefulness	-0.41	0.32	-1.27	0.67	
Moral& risky	-0.50	0.27	-1.85	0.61	†
Usefulness & risky	0.44	0.26	1.72	1.56	†
Country-level					
Religiosity	-0.12	0.08	-1.50	0.89	
Science knowledge	-0.30	0.14	-2.20	0.74	*
Confidence	0.39	0.31	1.23	1.47	
Uncertainty avoidance	-0.02	0.01	-2.96	0.98	*
Power distance	0.01	0.01	1.39	1.01	
Individualism	-0.02	0.01	-2.45	0.98	*
Masculinity	0.01	0.00	1.88	1.01	†
Variance component	SD	Variance (U_0)	DF	X^2	P-level
Random intercept model	0.18	0.0321	19	35.44	**
Random intercept model with 2nd level predictors	0.17	0.0280	12	19.76	†

Note. (1) The dependent variable is binary, with 1 indicates the answer of "don't know." Therefore, the Bernoulli multilevel analysis was used. (2) The individual level sample size is 9,739.

***p<.001, **p<.01, *p<.05, †p<.10.



Lithuania	47.6%	Italy	28.5%	Sweden	10.0%
Ireland	44.3%	Germany	19.5%	Finland	9.8%
Portugal	43.8%	Austria	19.3%	Greece	4.8%
Spain	39.1%	Luxembourg	18.2%	Belgium	4.3%
Poland	34.7%	Czech	17.2%	US	2.4%
Latvia	31.7%	France	16.0%		
UK	30.5%	Denmark	14.6%	*Mean*	22.71%
Slovenia	30.0%	Netherlands	10.6%	*SD*	13.97%

Figure 1. Percentage of “Don’t know” respondents in each country

References

Almond, G. A., & Verba, S. (1963). *The civic culture: Political attitudes and democracy in five nations*: Princeton University Press Princeton;.

Bauer, M. W. (2005). Public Perceptions and Mass Media in the Biotechnology Controversy. *International Journal of Public Opinion Research, 17*(1), 5.

Beatty, P., & Herrmann, D. (2002). To answer or not to answer: Decision processes related to survey item nonresponse. *Survey nonresponse*, 71-85.

Bradburn, N. M., & Sudman, S. (1988). *Polls & surveys : understanding what they tell us* (1st ed.). San Francisco: Jossey-Bass.

Brossard, D., Scheufele, D. A., Kim, E., & Lewenstein, B. V. (2008). Religiosity as a perceptual filter: examining processes of opinion formation about nanotechnology. *Public Understanding of Science,* 0963662507087304.

Cobb, M. D., & Macoubrie, J. (2004). Public perceptions about nanotechnology: Risks, benefits and trust. *Journal of Nanoparticle Research, 6*(4), 395-405.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences*: L. Erlbaum Associates Mahwah, NJ.

Converse, J. M. (1976). Predicting No Opinion in the Polls. *The Public Opinion Quarterly, 40*(4), 515-530.

Corbett, J. B., & Durfee, J. L. (2004). Testing public (un)certainty of science: Media representations of global warming. *Science Communication, 26*(2), 129-151.

Douglas, M., & Wildavsky, A. (1982). *Risk and Culture: An Essay on the Selection of Technical and Environmental Dangers*. Berkeley, CA: University of California Press.

Dunwoody, S. (1999). Scientists, Journalists, and the Meaning of Uncertainty. In S. M. Friedman, S. Dunwoody & C. L. Rogers (Eds.), *Communicating Uncertainty: Media Coverage of New and Controversial Science* (pp. 59-80). Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.

Francis, J. D., & Busch, L. (1975). What We Now Know about" I Don't Knows". *Public Opinion Quarterly*, 207-218.

Giles, J. (2002). Scientific uncertainty: When doubt is a sure thing. *Nature, 418*(6897), 476-478.

Groothuis, P. A., & Whitehead, J. C. (2002). Does dont know mean no? Analysis of dont know responses in dichotomous choice contingent valuation questions. *Applied Economics, 34*, 1935-1940.

Hofstede, G. (2001). *Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations*. Thousand Oaks, CA: Sage Pubns.

Hofstede, G. H. (1998). *Masculinity and femininity: The taboo dimension of national cultures*: Sage.

Huettinger, M. (2008). Cultural dimensions in business life: Hofstede's indices for Latvia and Lithuania. *Baltic Journal of Management, 3*(3), 359-376.

Johnson, B. B., & Slovic, P. (1995). Presenting Uncertainty in Health Risk Assessment: Initial Studies of Its Effects on Risk Perception and Trust. *Risk Analysis, 15*(4), 485-494.

Johnson, B. B., & Slovic, P. (1998). Lay views on uncertainty in environmental health risk assessment. *Journal of Risk Research, 1*(4), 261 - 279.

Johnson, T., Kulesa, P., Cho, Y. I., & Shavitt, S. (2005). The relation between culture and response styles: Evidence from 19 countries. *Journal of Cross-Cultural Psychology, 36*(2), 264.

Kaase, M., & Marsh, A. (1976). *The matrix of political action: Protest and participation in five nations*.

Krosnick, J. A. (2002). The causes of no-opinion responses to attitude measures in surveys: They are rarely what they appear to be. *Survey nonresponse*, 64-65.

Krosnick, J. A., Holbrook, A. L., Berent, M. K., Carson, R. T., Michael Hanemann, W., Kopp, R. J., et al. (2002). The Impact of "No Opinion" Response Options on Data Quality: Non-Attitude Reduction or an Invitation to Satisfice? *Public Opin Q, 66*(3), 371-403.

Lee, C., & Scheufele, D. A. (2006). The influence of knowledge and deference toward scientific authority: A media effects model for public attitudes toward nanotechnology *Journalism & Mass Communication Quarterly, 83*(4), 819-834.

Nelson, M. R., & Shavitt, S. (2002). Horizontal and vertical individualism and achievement values: A multimethod examination of Denmark and the United States. *Journal of Cross-Cultural Psychology, 33*(5), 439.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods*: Sage Publications Inc.

Scheufele, D. A. (2006a). Five lessons in nano outreach. *Materials Today, 9*(5), 64.

Scheufele, D. A. (2006b). Messages and heuristics: How audience form attitudes toward emerging technology. *Engaging science: Thoughts, deeds, analysis and action,* 20-25.

Scheufele, D. A., Corley, E. A., Shih, T.-j., Dalrymple, K. E., & Ho, S. S. (2009). Religious beliefs and public attitudes toward nanotechnology in Europe and the United States. *Nature Nanotechnology, 4*(2), 91-94.

Schwarz, N., Strack, F., Hippler, H. J., & Bishop, G. (1991). The impact of administration mode on response effects in survey measurement. *Applied Cognitive Psychology, 5*(3).

Shackley, S., & Wynne, B. (1996). Representing uncertainty in global climate change science and policy: Boundary-ordering devices and authority. *Science, Technology, & Human Values, 21*(3), 275-302.

Shoemaker, P. J., Eichholz, M., & Skewes, E. A. (2002). Item nonresponse: Distinguishing between don't know and refuse. *International Journal of Public Opinion Research, 14*(2), 193.

Sicinski, A. (1970). " Don't Know" Answers in Cross-National Surveys. *The Public Opinion Quarterly, 34*(1), 126-129.

Smith, P. B. (2004). Acquiescent response bias as an aspect of cultural communication style. *Journal of Cross-Cultural Psychology, 35*(1), 50.

Smith, P. B., & Fischer, R. (2008). Acquiescence, extreme response bias and culture: A multilevel analysis. In F. J. R. v. d. Vijver, D. A. v. Hemert & Y. H. Poortinga (Eds.), *Multilevel Analysis of Individuals and Cultures* (pp. 285-314). London: Lawrence Erlbaum Associates.

Smithson, M. (1993). Ignorance and science: Dilemmas, perspective, and prospects. *Knowledge: Creation, Diffusion, Utilization, 15*(2), 133-156.

Triandis, H. C., Carnevale, P., Gelfand, M., Robert, C., Wasti, S. A., Probst, T., et al. (2001). Culture and deception in business negotiations: A multilevel analysis. *International Journal of Cross Cultural Management, 1*(1), 73.

Triandis, H. C., & Gelfand, M. J. (1998). Converging measurement of horizontal and vertical individualism and collectivism. *Journal of Personality and Social Psychology, 74*, 118-127.

Walker, W. E., Harremoes, P., Rotmans, J., van der Sluijs, J. P., van Asselt, M. B. A., Janssen, P., et al. (2003). Defining uncertainty: A conceptual basis for uncertainty management in model-based decision support. *Integrated Assessment, 4*(1), 5 - 17.

Wilson, K. M. (2000). Drought, debate, and uncertainty: Measuring reporters' knowledge and ignorance about climate change. *Public Understanding of Science, 9*(1), 1-13.