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PERSPECTIVES

Comparing nanoparticle risk perceptions to other known EHS risks

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Abstract Over the last decade social scientific researchers have examined how the public perceives risks associated with nanotechnology. The body of literature that has emerged has been methodologically diverse. The findings have confirmed that some publics perceive nanotechnology as riskier than others, experts feel nanotechnology is less risky than the public does, and despite risks the public is optimistic about nanotechnology development. However, the extant literature on nanotechnology and risk suffers from sometimes widely divergent findings and has failed to provide a detailed picture of how the public actually feels about nanotechnology risks when compared to other risks. This study addresses the deficiencies in the literature by providing a comparative approach to gauging nanotechnology risks. The findings show that the public does not fear nanotechnology compared to other risks. Out of 24 risks presented to the participants, nanotechnology ranked 19th in terms of overall risk and 20th in terms of "high risk."

Keywords Nanoparticles · Risk perception · Public opinion · Ranking · Comparative analysis · Nanotechnology · ELSI

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Introduction

Researchers and commentators have expressed optimism as well as pessimism about nanoparticle environmental health and safety. Policy makers and other interested parties began funding research into public sensitivities about nanoparticles to learn more about reactions, as well as to plan response strategies in cases of controversy. In turn, the Social Science of Science research community has collected data on public perceptions of nanotechnology and nanoparticle safety. Over the last decade, a significant body of literature has emerged.

Not quite a decade ago, public perception of nanotechnology was significantly understudied (Roco 2003; Scheufele and Lewenstein 2005). It would be difficult to make the same argument today. However, despite the increasing number of publications analyzing public perception of nanotechnology risk, there has been a failure to comparatively analyze nanotechnology. This article rectifies this failure by presenting survey results that directly compare perceptions of nanoparticles to other risks. Before the authors present the findings, however, it waws briefly review the extant literature on nanotechnology and risk perception, highlighting how many of these studies face methodological deficiencies that might partly explain their widely divergent findings.

Public opinion of nanotechnology and nanoparticles

The literature on public perceptions of nanotechnology and nanoparticles reaches consensus on a few points. One is that the European general public is more skeptical of nanotechnologies than respondents in the United States (Burri and Belluci 2008; Einsiedel 2005; Gaskell 2005; Gaskell et al. 2004). Studies have also consistently shown that—regardless of whether publics are surveyed in Europe or the United States—expert opinion and public opinion about nanotechnology is widely divergent (Priest et al. 2009; Scheufele et al. 2007; Siegrist et al. 2007). Experts are more optimistic about nanotechnology, and they also differ from the public regarding nanotechnology's most serious risk areas. Experts tend to believe that environmental risks are the most serious and most in need of regulation (Besley et al. 2008; Scheufele et al. 2007), whereas the public tends to focus on areas such as privacy, economic impact, and other social implications (Priest et al. 2009). Despite evidence that some publics believe nanotechnology is riskier than experts do, there is also wide consensus in the academic literature that the public believes the benefits outweigh the risks (BMRB Social Research 2004; Bainbridge 2002; Bundesinstitut Fur Robiew 2007; Burri and Belluci 2008; Einsiedel 2005; Gavelin et al. 2007; Hart 2006, 2007, 2008, 2009, 2010; Kahan 2009; Macoubrie 2006; Scheufele and Lewenstein 2005; TA Swiss-Centre for Technology Assessment 2006).

While the literature agrees on these two points, there are other areas where findings show significant divergence. At the most basic—and possibly most important—level, surveys have done little to inform researchers about the percentage of the citizenry that is knowledgeable about nanotechnology or nanoparticles as potential environmental hazards. In an examination of the existing literature, Satterfield et al. (2009) found that, after they pooled the results of existing studies, 51% of people have never heard of nanotechnology. These findings also feature remarkable variance: at the low end, merely 25% of respondents had ever heard of nanotechnology, while at the high-end 75% had heard of it.

The disparity in findings about the percentage of people who are aware of nanotechnology is troubling at the policymaking level for at least two reasons. First, policy makers are asked to respond to public concerns and are unable to do so. Second, depictions of public awareness are rebutted from multiple and sometimes inconsistent directions. At least a portion of the variance in findings cited above can be attributed to differing methodological approaches. The authors have identified three main methods used in the study of public perception of nanotechnology: (1) public opinion surveys, (2) focus groups, and (3) quasi-experimental designs, such as consensus conferences.

Regarding research narrowly focused on particular issues, most of the public do not possess pre-formed attitudes at the level of specificity demanded in a survey (Bishop et al. 1984; Zaller and Feldman 1992). All risk research might be viewed as suspicious since the public associates a negative valence to the concept of risk, especially if negative information is presented (MacGregor et al. 1994; Berube et al. 2010b). The ordering of information used to elicit data can also impact the results (Entin et al. 1989; Tourangeau et al. 1989). Defining the subject of the evaluation can prime survey respondents to think of the issue in a certain way (Tourangeau et al. 2000).

Survey questionnaires often include definitions and exemplar cases. This form of priming can potential threaten measurement reliability (Vitale et al. 2008), especially when survey responses are not wholly stable. For example, Zaller and Feldman (1992) found "[i]f the same people are asked the same question in repeated interviews, only about half give the same answers" (p. 589). The authors can reduce this phenomenon through comparative analysis (Kunreuther and Slovic 1996).

The potential drawbacks of focus groups and consensus conferences are different. These activities typically begin by giving the participants information about the issue (sometimes repeatedly). Scholars have learned that involving the public in exercises involving debate over issues and their effects "consistently reduces the predictive reliability of attitude reports, especially for persons less knowledgeable about the given attitude subject" (Wilson and Hodges 1991). This effect is aggravated when participants are primed by inherently unbalanced cost and benefit definitions of nanotechnology (Berube et al. 2010b). The ensuing discussions amplify the convergent effect. In addition, the expectations of the researcher in these settings can compound the priming phenomena and threaten the external validity of findings. Indeed, merely creating an environment used to generate data may encourage opining which, but for the event, would not have been expressed.

In addition, potential nanoparticle risks are not fully understood by the scientific community (Balbus et al. 2007; Kreyling et al. 2006). Many of the benefits are finite portrayals of what nanotechnology is through such risk/benefit definitions may be unduly priming audiences to have heightened negative risk perceptions (Berube et al. 2010b). These problems help to explain the divergent findings in public perceptions of risks and benefits as seen in Satterfield et al. (2009).

Of course, the drawbacks the authors have highlighted are strongly associated with the goals of the study and are less problematic when the goal is to paint a hypothetical picture of ideal public opinion (as in consensus conferences) or to gauge public opinion based upon some baseline-level of information (as in survey research). An advantage, therefore, of comparing unprimed perceptions of multiple risks is to gain evidence of how the public feels about nanoparticles compared to other potential environmental risks. The authors asked about nanoparticles rather than nanotechnology for three reasons: first, the authors have been funded to examine the risk associated with the toxicological footprints of nanoparticles; second, when assessing risks in environmental health and safety the subjects studied are nanoparticles rather than nanotechnology per se; and third, nanoparticles seem to be the foundational component of nanotechnologies and most problematic in life cycle analysis and other analytical constructs. It was decided that rather than comparing multiple technologies against one another, the authors would choose to situate nanoparticles within a previously reported battery of environmental hazards (see Flynn et al. 1994) in order to gain insight of baseline risk perceptions of nanoparticles devoid of risk/benefit priming issues. Most studies, regardless of their methodology, fail to situate perceptions of nanotechnology in a comparative context by allowing respondents to make direct comparisons to other risks (the authors discuss exceptions below). Studying risks of nanoparticles and nanotechnology as independent entities does little to inform researchers and policymakers about the greater context of risk perceptions. Survey questionnaires, pre- and post-tests, focus groups, and consensus conferences designed to measure nanotechnology risk perceptions in isolation can instantiate impressions and fail to provide understandings of nanotechnology risk perceptions relative to the other risks the public navigates on a daily basis.

With two notable exceptions, there is little research that examines public perceptions of nanotechnology from this relativistic perspective. Among the exceptions, the 2005 Eurobarometer survey asked respondents, "Which science and technology developments are you most interested in?" and "nanotechnologies" was partnered with "medicine, genetics, etc." It ranked eighth of nine options and the nineth option was "none of these" (European Commission 2005, p. 14). The other notable exception focused on respondents' risk and benefit perceptions of different technologies; nanotechnology fell squarely in the middle (Currall et al. 2006). The public did not regard it as particularly risk compared to other technologies, nor did the public regard it as particularly beneficial. This study importantly showed that the public does not have strong feelings about the risks or benefits of nanotechnology compared to other technologies, but unlike the data it was report on in this article, Currall et al. (2006) did not ask respondents to rank nanotechnology against other risks.

More recently, Nature and Scientific American partnered for an online poll of over 20,000 self-selected scientific literates (In science the authors trust 2010). While the sample was hardly representative, the survey reported "techno fears" comparing the unknown risks of nanotechnology to primate, non-primate, and embryo research as well as some other phenomena. Berube et al. (2010a) developed risks rankings for nanoparticles based on a Delphi rather than a literature review but restricted the samples to experts as well. Other studies have attempted to rank nanoparticles against other nanoparticles. For example, Robichaud et al. (2005) completed a relative risk analysis of several manufactured nanomaterials predicted based on current or anticipated near term potential for commercialization and production beyond laboratory scale. The risk rankings were generated from a review of the literature and insurance databases.

The existing data fail to paint a more robust picture that places nanotechnology in context by comparing it to other risks people fear. Researchers ask subjects to report their perceptions on the risk of nanoparticles and nanotechnology at a point in time, providing a snapshot of sensibilities. While valuable in and of itself, these snapshots are taken isolated from other risks that may be vying for their interest and attention. As a result, there seems to be little empirical basis for an explicit hypothesis situating individuals' perceptions of nanoparticles, in particular, in relationship to other environmental, health, and safety risks. With this in mind, the authors propose the following research question:

RQ1: How do public evaluations of nanoparticles compare to public perceptions of other environmental health and safety risks?

In order to investigate this question, it was relied on two methods: (1) exploratory factor analysis to group perceptions of a range of risks in systematic, empirically-based manner, and (2) a descriptive analysis of response distributions to glean greater detail of empirical similarities and differences. The data it was report below are therefore unique since they represent perceptions of nanoparticles relative to other non-nanotechnology risks, resulting in a comparative analysis. In addition, there was no priming event in the methodology of the this study. It was intentionally avoided providing respondents with a definition of "nanoparticles" including any reference to risks or benefits (see field version definition found below).

Method—the questionnaire

In the survey, respondents were asked to indicate their feelings about 24 risks, which were taken from an existing battery of hazard evaluations (Flynn et al. 1994). It was maintained the integrity of the list but added three phenomena (nanoparticles, obesity, and cell phones) while removing five (ozone depletion, climate change, food irradiation, high-voltage power lines, and video display terminals). Both the original list and the one in this study measured responses on a four-point ordinal scale (1 = "almost no health risk," 2 = "slight health risk," 3 = "moderate health risk," and 4 = "high health risk").

In order to avoid potential priming effects, the questionnaire did not include any discussion of potential risks and known benefits of nanotechnology or nanoparticles. Rather, the only information consisted of the following definition: "Recent scientific developments are allowing researchers to make modifications to very small particles. These particles are measured at the nanoscale (1 inch equals 25,400,000 nm). For example, one strand of human hair is over 60,000 nm wide. Nanoparticles can exhibit unique properties when their size is reduced far enough, which makes nanoparticles interesting for business and industry." This definition appeared in the survey after the comparative risk analysis and is coupled with a question asking respondents to rate their concerns with specific nanoparticle applications (this data will be formally reported in another publication).

Data collection

From September through October 2009, a probability sample of 1,250 households in the continental United States was selected by Marketing Systems Group from its sampling frame, the delivery sequence file. The mail survey was carried out according to the tailored design method (Dillman et al. 2008) and consisted of four separate mailings to minimize non-response bias. First, selected households were sent an advance letter informing them that they would be receiving a questionnaire from the "Citizens, Science, and Emerging Technology" project being conducted by researchers at several universities as part of a study of how citizens feel about risks to health and safety and the ways in which people get information about these issues. One week later, the second mailing was sent, which included a cover page, the survey questionnaire, a postage-paid return envelope, and a $5 dollar gift card as an incentive.

The mailer explained the purpose of the study, the respondent selection process, the confidentiality of responses, and a request for participation from the person living in the household who was "18 years of age or older and who will have the next birthday." A toll-free telephone number and contact information for project staff were also provided for those respondents who had further questions about the study. The third mailing was sent 2 weeks after the second mailing and consisted of a reminder postcard. This postcard thanked those households that had already completed and returned the questionnaire (completed questionnaires from some households might not yet have been received prior to the mailing of the postcards), and requested that those households that had not yet had a chance to complete this questionnaire do so within a week. Two weeks after the reminder postcard, a final follow-up letter was sent to those households that had not yet responded. This letter stressed the importance of returning their completed questionnaire for getting accurate, truly representative results. Completed questionnaires were received from 307 households; following guidelines established by the American Association for Public Opinion Research for Response Rate 1, the response rate was 24.56%.[1]

Analysis

Exploratory factor analysis (EFA) was employed as a method to identify potential latent constructs from within the 24-item instrument of risk evaluations. EFA can be useful for revealing latent structures between measures through the analysis of their shared variance (Park et al. 2002). EFA is regarded as a "heuristic model of reality" that allows the researcher to examine the dimensionality of relationships between variables through commonly correlated factors and make inferences about the observed commonalities (Morrison 2009). Unlike confirmatory factor analysis, no expectations of latent variable existence are judged a priori (Levine 2005). Thus, EFA is suitable for the current analysis for numerous reasons. First, the instrument introduced by Flynn et al. (1994) 15 years ago was not theoretically derived and the choice of phenomena to study was not intended to represent latent constructs. Second, the authors wanted to learn how nanoparticles were similar or different from other risk phenomena as well as add more substance to suppositions about risk subsets to which nanoparticles may belong. The number of factors was not determined previous to analysis, but rather factor extraction was based on Eigenvalues of one or greater. Promax rotation, a nonquadratic form of oblique rotation, and maximum likelihood estimation were employed in this analysis.

Despite the gains from analyzing a set of public evaluations to see how perceptions of nanoparticles may be similar or different from other potential risks, there are limits to what the results of EFA can tell us. For this reason—and for the reasons outlined above—it was also carried out a second analysis, consisting of an item-by-item descriptive comparison of how the respondents rated nanoparticles relative to other risks. This descriptive analysis relies on a comparison of response distributions to gain more substantive understanding of how public perceptions of nanoparticle risks might be related to other theoretically relevant societal risks.

Results

Table 1 below shows the mean scores and standard deviations of the 24 evaluations.[2] This table ranked nanoparticles as 19th highest risk using the full range of risk estimations.

EFA resulted in three latent factors with Eigen values greater than one, and the three factors accounted for approximately 43% of variance in the raw measures. The first factor accounted for approximately 31% of the variance and included the highest loadings for nanoparticles and eight other risks: nuclear power plants, bacteria in food, blood transfusions, cell phone use, radon in the home, genetically engineered bacteria, cloning, and medical X-rays. Factor 2 accounted for

[1] As noted by Dillman et al. (2008), two factors that could have affected this response rate were its length and the difficulty of the questions. The topic "science and emerging technology" may have been intimidating or uninteresting to the general public.

[2] In the calculations of these mean scores, high risk responses were give a value of 4; moderate risk a 3; slight risk a 2; and almost no health risk a 1. Higher mean scores represent a greater perceived health risk.

Table 1 Descriptive statistics for 24 risk evaluations

Risk	Mean	SD	N
Cigarette smoking	3.61	0.85	306
Street drugs	3.58	0.95	294
Chemical pollution	3.35	0.89	306
Nuclear waste	3.32	1.11	296
Obesity	3.32	0.98	304
AIDS	3.18	0.92	305
Stress	3.18	0.92	284
Pesticides in food	3.01	1.18	303
Motor vehicle accidents	2.97	1.05	306
Sun tanning	2.82	1.13	296
Bacteria in food	2.75	1.19	298
Air pollution	2.67	1.15	306
Genetically engineered bacteria	2.66	1.29	305
Radon in the home	2.63	1.24	297
Drinking alcohol	2.56	1.23	306
Cloning	2.4	1.36	289
Coal or oil burning plants	2.34	1.18	304
Nuclear power plants	2.28	1.30	306
Storms and floods	2.12	1.20	300
Nanoparticles	1.94	1.20	269
Blood transfusions	1.91	1.14	298
Medical X-rays	1.71	1.05	307
Cell phone use	1.67	1.06	298
Commercial air travel	1.57	1.02	304

Note: Risk evaluations are sorted in descending order according to the mean. Original question-wording: "Please indicate whether you think that each of the following poses almost no risk, a slight risk, a moderate risk, or a high risk to your health:" Responses were measured on an ordinal scale from 1 ("almost no risk") to 4 ("high risk")

Table 2 Promax rotation of three factor solution for the risk index ($N = 307$)

Risk	Factor 1	Factor 2	Factor 3
Nuclear power plants	**0.71**	0.36	0.52
Bacteria in food	**0.64**	0.41	0.54
Blood transfusions	**0.63**	0.20	0.37
Cell phone use	**0.63**	0.09	0.35
Radon in the home	**0.62**	0.5	0.59
Nanoparticles	**0.60**	0.25	0.38
Genetically engineered	**0.59**	0.33	0.57
Cloning	**0.5**	0.43	0.43
Medical x-rays	**0.53**	0.19	0.37
Commercial air travel	**0.49**	0.01	0.25
Storms and floods	**0.47**	0.28	0.44
Street drugs	0.19	**0.83**	0.35
AIDS	0.30	**0.78**	0.37
Cigarette smoking	0.16	**0.73**	0.49
Obesity	0.25	**0.67**	0.58
Nuclear waste	0.49	**0.62**	0.53
Air pollution	0.60	0.35	**0.74**
Sun tanning	0.40	0.39	**0.68**
Chemical pollution	0.43	0.59	**0.66**
Pesticides in food	0.61	0.43	**0.65**
Coal or oil burning plants	0.55	0.28	**0.60**
Stress	0.42	0.44	**0.55**
Drinking alcohol	0.41	0.38	**0.53**
Motor vehicle accidents	0.19	0.15	**0.32**

Note: $\chi^2 = 298.53$ ($df = 207$, p < 0.001)

approximately 9% of the variance and was comprised of street drugs, AIDS, cigarette smoking, obesity, and nuclear waste. Factor 3 accounted for approximately 3% of the variance and included air pollution, sun tanning, chemical pollution, pesticides in food, coal or oil burning plants, stress, and drinking alcohol. Items that did not load highly on any of the three factors included commercial air travel, storms and floods, and motor vehicle accidents. The goodness-of-fit test revealed that this model did not fit the data well ($\chi^2 = 298.53$, $df = 207$, $p < 0.001$), although this is not an uncommon result when employing EFA (Kaplan 2009). Table 2 displays the resulting factor loadings. Bolded values note the highest factor loading for each risk.

Regarding the initial research question, evaluations of nanoparticles—with their highest loading on factor 1—were most closely associated with evaluations of nuclear power plants, bacteria in food, blood transfusions, cell phone use, radon in the home, genetically engineered bacteria, cloning, and medical X-rays. This factor seems to suggest that people make judgments based on similarity, especially in instances involving reduced levels of information and comprehension.

In addition to the exploratory factor analysis, it was engaged in a descriptive analysis of response distributions to all of the risks included in the survey. Figure 1 displays the distribution of responses for five of these risks: AIDS, nuclear waste, nanoparticles, blood transfusions, and cell phone use for comparison. This figure further illustrates the highly divergent risk perceptions of nanoparticles as compared to other risks like nuclear waste or cell phone use.

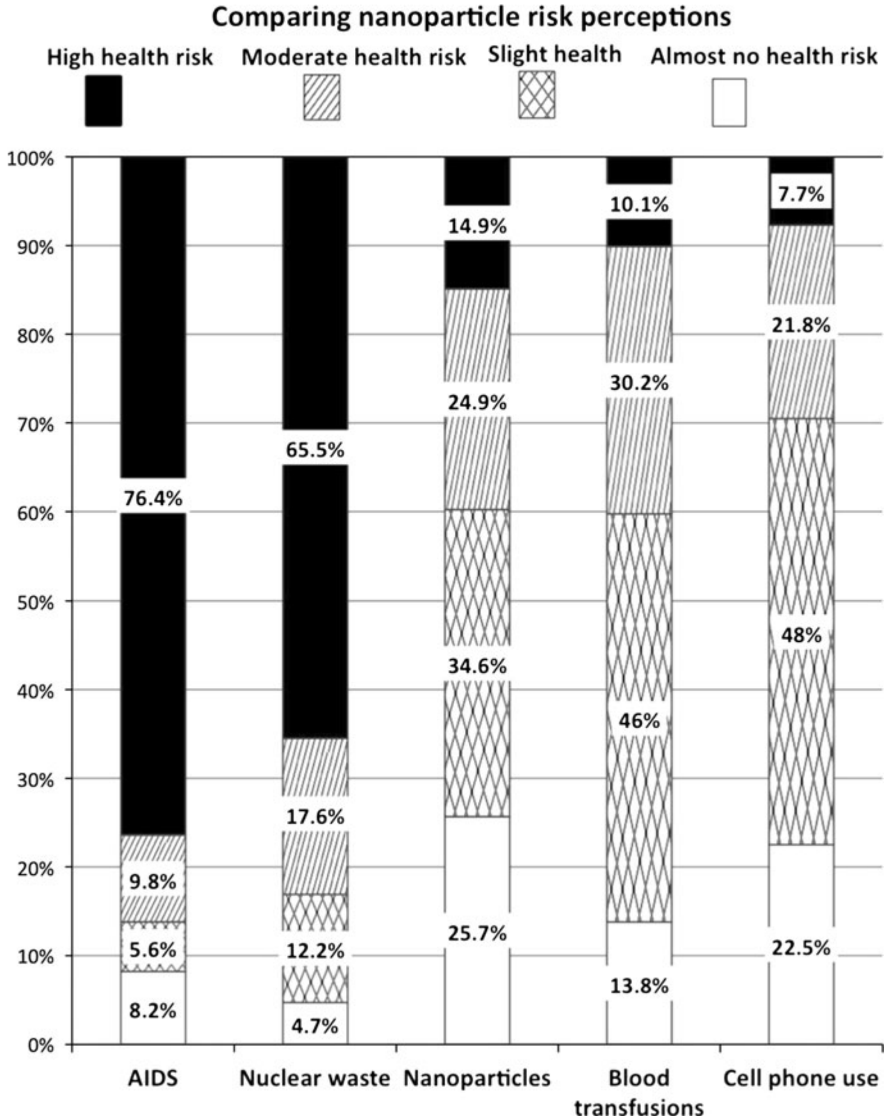

Fig. 1 Comparing nanoparticle risks perceptions

Figure 2 provides a comparative set of the risk related phenomena under study. The list is presented in bar chart form in decreasing order of "high risk" from street crime through medical X-rays, with nanoparticles as 20th out of 24. Note nanoparticles ranks 19th in terms of overall risk but 20th in terms of "high risk". In order to simplify the figure, it was reported "high health risk" (black) excluded the data on "moderate health risk" and combined the data on "slight health" and "almost no health risk" (white) for all 24 phenomena.

Figure 2 displays the rankings of each health risk organized by the percentage of reported "high health risk" perceptions. The secondary measure reported here as "low health risk" is a combined measure of both "almost no health risk" and "slight health risk" as rated on the four-point scale. The top five reported high risks included street drugs, cigarette smoking, AIDS, nuclear waste, and obesity. Nanoparticles rank 20th on the list, above only blood transfusions, cell phone use, commercial air travel, and medical X-rays.

Conclusions

This comparison of risk perceptions yields data that directly demonstrate how the public perceives

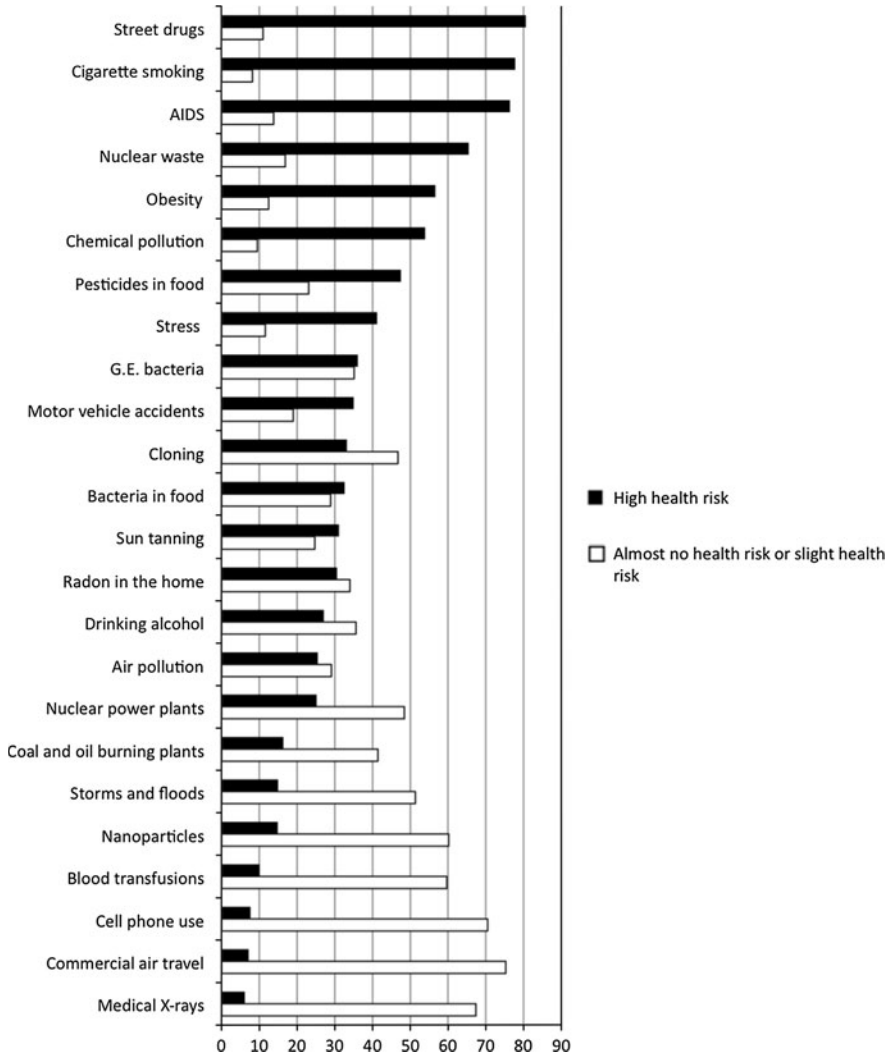

Fig. 2 Rankings by high health risk perceptions

nanoparticle risks compared to other environmental health and safety risks. Placing evaluations of nanoparticles within the constellation of other risks is important because few people consider nanoparticle risks independently from a larger set of other risks they may or may not encounter. This is especially true in cases of high levels of uncertainty (Fox and Irwin 1998), and nanoparticles are surrounded by uncertainty in both expert and lay communities (Berube et al. 2010b).

Most individuals will possess multiple opinions on most issues. By and large, individuals tend to answer survey questions by averaging across the considerations that happen to be salient at the moment of response, and saliency is determined by the availability heuristic (Tversky and Kahneman 1973). Zaller and Feldman (1992), however, argue "[i]f people … could be artificially induced to retrieve a larger than normal number of considerations, it should improve the reliability of their responses to closed ended items" (p. 603). As such, it was developed a questionnaire without a "no opinion" option and presented the phenomenon of nanoparticles against a set of other risk phenomena to improve reliability. Asking respondents to compare risks provides a setting for individuals to play through a series of hypothetical risk phenomena. Kunreuther and Slovic (1996) suggest a gaming metaphor whereby the individuals confront the social negotiation of rules in the context of specific decision problems as viable.

As previously noted, EFA provides a heuristic model that allows for the systematic comparison of similarities between respondents' evaluations. The risk phenomena that were grouped together in Factor 1—including evaluations of nanoparticles—share some characteristics, including but not limited to: (1) high levels of technology; (2) technologies that are less understood by the inexpert public; and (3) linked via the heuristics of availability and representativeness (Kahneman et al. 1982). Testing these relationships may allow us to comprehend which attitudinal anchors (Mussweiler and Strack 2001) have become associated with nanoparticles. This information could help us design strategies and tactics to resolve some troubling hurdles in the debate over the environmental health and safety risks associated with nanoparticles. Rather than engaging in varied activities drawn by intuitive and unsystematic assessments of the state of public understanding of the risks associated from nanoparticles, the authors should proceed from empirical data. Many challenges for risk communicators remain when discussing risk-related information steeped in high levels of uncertainty, including but not limited to the association of a higher reliability to unsolicited information on risks from experts (Fischhoff 1995), the assignment of greater valence to risks and risk events when the communicator is a government source (Grice 1975), or the appearance of choice shifts following some discussions but not others (Burnstein and Vinokur 1975).

Of course, this study does not overcome all limitations associated with survey research on public perceptions of nanotechnology. First, recent research suggests that "single-item measures that ask respondents to make complex judgments of a potentially unfamiliar attitude object can be plagued by error" (Binder et al. 2011). This study, of course, was subject to space constraints in the survey questionnaire, and it was opted to maximize the measurement of many different types of risk evaluations in order to conduct a valid comparative analysis. The authors view the resultant ability to situate public perceptions of nanoparticles in relation to perceptions of other risks as a significant strength, and future research should focus on rectifying the trade-offs between single-item versus multi-item measures of these risks.

Second, other recent research suggests that public opinion of nanotechnology is best understood relative to specific applications (Cacciatore et al. 2009). The wording of the survey instrument restricted respondent evaluations to potential damage from nanoparticles specifically, rather than nanotechnology more broadly. This choice was made in an effort to standardize a set of attitude objects (cf. the choice of nuclear waste rather than nuclear technology) as unique potential risks for two reasons: (1) to enable respondents to place each risk on a consistent evaluative continuum and (2) facilitate the valid comparison of their evaluations. Of course, there may be significant overlap between these areas (e.g., the use of nanotechnology to augment scientific procedures within cloning or synthetic biology), and the degree to which the public associates these areas with nanotechnology is an empirical question that merits future investigation.

Finally, the study is bound in the scope and size of the sample of respondents who tended to be older and more educated than the population at large. Nonetheless, the addition of a comparative element to judging public risk perceptions is an essential step toward informing decision-makers and risk communicators alike. Other social scientific methods should be explored for evaluating risk perceptions across a diverse set of hazards and associated risk perceptions. While this survey establishes baseline data other methods may elaborate on the findings.

Comparing public risk perception of nanoparticles re-situates the debate over the inherent hazards of nanoparticles. While much needs to be understood about how nanoparticles interact with the world from production through disposal, it is safe to say the public does not perceive a substantial risk from them at this time. The authors argue that cross-sectional insights derived from surveys focusing solely on public perceptions of nanotechnology (or any other emerging technology) may inherently limit the ability to understand public opinion within the broader realm of research on perceptions of risks and benefits of the hazards present throughout modern society. Comparative data helps reflect the sense of the public in terms of risk estimations. What this translates into for government regulators is for them to decide.

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