Hearts and minds and nanotechnology

New research by social scientists is presenting a clearer picture of the factors that influence the public perception of nanotechnology and, as **Chris Toumey** reports, the results present challenges for those working to increase public acceptance of nanoscience and technology.

In 2004 and 2005 two surveys of knowledge and attitudes about nanotechnology found, not surprisingly, that few people in the US knew much about nanotechnology at the time[1,2]. They also reported that those who were knowledgeable about nanotechnology had positive attitudes and expected the benefits to outweigh the risks.

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One way to interpret this last finding would be to assume that when people become more familiar with nanotechnology, they like it more. This so-called familiarity hypothesis is attractive because it supposedly shows an easy path to achieving public support and government funding for nanotechnology. As more information is disseminated, funding will become more politically acceptable. However, the same finding could also mean that when people already find nanotechnology attractive — possibly because they have read *Engines of Creation* by Eric Drexler, for example — they seek additional information. In other words, they are knowledgeable because they are supporters, instead of being supporters because they are knowledgeable. If so, then acceptance of nanotechnology will depend not on science-based education initiatives, but rather on the persuasive powers of visionaries like Drexler and others whose views are not always widely shared in the nanotechnology community.

These issues of knowledge, attitudes and support for funding have been rehearsed prior to the nanotechnology surveys of 2004 and 2005. Brian Wynne of Lancaster University and others have effectively discredited the 'deficit model' that posited that the problem of inadequate public support for government funding of scientific research could be traced to insufficient quantities of scientific information delivered from scientists to the lay public. This is another name for the familiarity hypothesis. Wynne insisted that other factors (such as whether non-experts trust the scientific experts and whether scientists can appreciate the knowledge and values of non-experts) are much more important[3]. This is where science really touches the people who have to live with the consequences of government science policy, and Wynne is right to point out the folly of ignoring the importance of non-experts' knowledge and values.

A related point is that public support for government funding of scientific research is largely independent of public knowledge of science in the US and the UK[4]. Non-experts usually believe in science and government support of science, without needing to know much about science.

So, we come back to the question of how non-experts will feel about nanotechnology when they take an interest in it, and what this means for public acceptance of the tangible applications of nanotechnology. For a few years, those in the social sciences and humanities could speculate about this while awaiting good data. One study in 2005 by George Gaskell of the London School of Economics and co-workers was particularly teasing: in the US, Canada and the EU, many people trusted scientific experts to lead us through science and technology policy, but this kind of trust declined as levels of educational achievement declined. Moreover, Gaskell and co-workers reported that "in the United States, religious beliefs were strongly related to critical attitudes to science and technology"[5].

What do the public think of nanotechnology?

Four years and many more surveys later, an eye-opening picture of the factors that influence the public perception of nanotechnology is emerging and, I caution you, it might discomfort some readers of this journal. I will look at four recent reports — two published in *Nature Nanotechnology* and two published elsewhere.

In Spring 2008, the UK Engineering & Physical Science Research Council sponsored an exercise in modelling public reactions to six possible applications of nanomedicine[6]. Four groups, balanced for gender and ethnicity, pondered this topic in a two-stage process. Together they concluded that better diagnosis of diseases and better drug-delivery were the two most attractive applications of nanomedicine, whereas the two least attractive were drug discovery and 'theranostics' (the idea of combining diagnosis and therapy in a single, automatic device). The other two applications were infection control and regenerative medicine.

What caused the participants to rank the applications that way? They embraced a set of value-laden themes that prefer: (1) personal empowerment and responsibility, as opposed to institutional control of one's health; (2) protecting

the privacy of the patient; and (3) a sense of social equity which controls the costs of health care and disdains public funding that leads to private profits. Thus, theranostics was believed to take away choice and responsibility, but diagnosis of disease gave patients the information to act on their own conditions. Drug discovery was felt to be equivalent to public support for private gain, but better drug-delivery represented a benefit for everyone.

Dan Kahan of Yale University and co-workers conducted an online survey of 1862 adults in the US about the risks and benefits of nanotechnology[7]. They found that reactions to nanotechnology were not strongly influenced by information about nanotechnology; instead, the principal determinant was a set of ideological predispositions to technological risk that were shaped by earlier issues such as global warming and nuclear power. These predispositions take the form of a pair of well-established polarized ideologies that the authors call individualistic–hierarchical (strongly pro-business) and egalitarian–communitarian (suspicious of big business). When people in these categories acquire information about nanotechnology, they principally use it to reinforce their preconceptions, with the result that scientific knowledge does not change these dispositions. Instead, it intensifies the ideological polarization: "Individuals in the real world are likely to select information in a biased fashion that matches their cultural and political dispositions"[7].

The more secular nations found nanotechnology more morally acceptable.

Two of the recent studies correlated attitudes about nanotechnology with religious beliefs. In one of these studies Dietram Scheufele of the University of Wisconsin-Madison and co-workers looked at the US and 12 European countries and found that they all had comparable levels of science and technology, but varied on a scale of religious to secular[8]. The more secular nations found nanotechnology more morally acceptable than the more religious nations who found it less so. "Religiosity is the dominant predictor of moral acceptance of nanotechnology," they conclude. "Public attitudes towards issues such as nanotechnology are increasingly driven by personal values and beliefs." Scientific knowledge about nanotechnology was distinctly less influential — the US ranked as the most religious of the thirteen nations.

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In a second study — based on a survey of 706 people in the US — Dominique Brossard, also from the University of Wisconsin-Madison, and co-workers found that the "strength of religious beliefs is negatively related to support for funding of" nanotechnology[9]. Religious apprehensions that developed earlier, in response to biotechnology, served as a template for reactions to nanotechnology. People for whom religion was not very important were more supportive of funding for nanotechnology. Once more, knowledge of nanotechnology had little influence.

Together, these studies alert us that reactions to nanotechnology will be shaped by a landscape of values, beliefs, concerns and other strong sentiments that were established in peoples' hearts long before most people heard or cared about nanometres, van der Waals forces or carbon nanotubes. This affirms Wynne's critique of the deficit model and his agenda for appreciating the knowledge and values of the non-experts who have to experience the realities of science policy. For those who expect that people will embrace nanotechnology when they learn more about the science, the second message from these four recent reports is that the scientific knowledge in our minds is a weak companion to the strong values and concerns in our hearts.

One more thing to think about: social scientists can deliver these studies and interpret them. Publicists and other image-makers can manipulate them to some extent. Yet, we know that even when we understand the lives of atoms and molecules in great detail, our ability to manipulate the behaviour of these entities is ultimately limited. Scientists can do a lot with matter at the nanoscale, but they cannot break the laws of physics. Something similar is true of the well-entrenched values that fill people's hearts. We can imagine how one institution or another might try to spin its scientific work by suggesting that its agenda for nanotechnology is goodly or virtuous, and perhaps hint that someone else's scientific agenda is less so. However, this will only work to a limited extent. Trust in scientists, fear of environmental harm, optimism about new cures for old diseases and pessimism about assaults on one's privacy: these and other concerns are strong and legitimate and deserve our respect. They are not trivial toys that someone can play with.

I realize that my account of these surveys might sound like a recipe for a war between good science and good values. I hope as much as you to avoid that kind of situation. There is no easy formula for reconciling good extra-scientific values with good scientific work. However, the arrival of these four reports tells us it is time to take the values that are important to the public as seriously as we take the science.

One place to start is the question of sectarian variations within a given nation. We can note, for example, that the US is distinctly more religious than most of the EU, but this raises the question of which religious groups will be more accepting of nanotechnology, and which less so, and why. If a denomination has an established position on science and technology, anchored in a clear line of theological teaching, will the individual members conform to that thinking, or will they vary in their feelings about nanotechnology depending, for example, on their level of educational achievement? Which believers will see nanotechnology as the second coming of a morally problematic biotechnology, and which will diagnose it as something that is more neutral, like information technology?

These questions are worth asking today because the real-world applications of nanotechnology are arriving on a regular basis, and the values that will shape reactions to these applications are already well-established. ❐

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