

The social shaping of nanotechnologies

Giving a voice to the public

Nanotechnologies are developing rapidly. As basic technologies they can be applied in different domains. However, while knowledge as to their possible benefits is already at hand, possible risks to men or the environment are widely unknown. To ensure their social acceptance a more intense public discourse is needed.

By Gerd Scholl and Ulrich Petschow

The debate on new technologies is focusing on nanotechnologies since the beginning of the 90ies, at the latest. Comprehensive public research programmes were initiated due to a promising economic potential and prospective environmental benefits arising from nanotechnologies. While placing emphasis on imminent chances of an utilisation of nanotechnologies, associated risks were initially widely ignored. Only in the course of the nanotechnology debate, questions on risks, such as carbon nanotubes acting potentially similar to asbestos, arose (Huczko 2001; Colvin 2002; Diabaté et al. 2002). Already from an early stage on, it was referred to debates on genetic engineering. Accordingly an assumption of new technologies being assertive without the public discourse is no longer prevalent (Colvin 2003; Hoet et al 2004).

Potential risks were initially broached as an issue within the scientific context and were only subsequently picked up in public. A study on impending risks of nanotechnology undertaken for the Canadian non-governmental organisation etc in 2003, treated this subject inter alia (etc 2003; etc 2002). Etc called for a moratorium causing connotative public attention. At latest with the Royal Academy bringing forward a report referring to potential risks, the debate on chances converted to a chances and risk debate (Royal Academy 2004). In consequence, scientific research on potential risks was initiated.

At the same time manifold lateral discourses on nanotechnologies opened up. Examples are ethical considerations, specific risk debates, questions on governance of nanotechnologies and possibilities of standardisation. These discourses might contribute to the shaping of nanotechnologies (Rip et al. 1995; Steinfeldt et al. 2007). Considering the idea of upstream communication as well as the recognition of scientific risk-assessment being connotatively different to the evaluation of consumers, citizens themselves become actors in the debate on nanotechnologies and gain an opportunity to exert influence on technology

shaping at an early stage. Consequently the perception of nanotechnologies plays a considerable role in the assertiveness of these technologies and products being based upon them. Meaning subsequently, consumers are able to influence technology shaping already before nanotechnology-enabled products have to be assertive at the counter.

The early integration of the general public is a major innovation in the discussion on nanotechnology regarding experiences gained in the debate on genetic engineering. Accordingly, several analyses regarding the perception of nanotechnologies, as well as processes of public engagement, will be depicted (Rogers-Hayden/Pidgeon 2007). Presently it is clearly not yet possible to give "hard" facts on the effects of these processes.

Perceptions of nanotechnologies in Recent Consumer Surveys

Citizens' perceptions of and attitudes towards nanoscience and nanotechnology have been surveyed for a couple of years now. Starting with the 2002 Eurobarometer on Biotechnology and the Life Science, nanotechnologies have been empirically explored from the consumers' point of view, particularly, in the United Kingdom and in the United States (Gaskell/Allum/Stars 2003; Cobb/Macoubrie 2004, Royal Society and Royal Academy of Engineering 2004; Macoubrie 2005, Kahan et al. 2007). For instance, in the years 2006, 2007, and 2008 the Washington based Woodrow Wilson Centre conducted three nationwide surveys, each covering a sample of 1,000 US adults (Hart 2006; Hart 2008). These investigations find that:

- public awareness of nanotechnology remains low (in 2008, 49 percent of all respondents say that they heard "nothing at all" about nanotechnology, 26 percent "just a little", 17 percent "some", 7 percent "a lot") and is greatest among men and adults with higher incomes and education levels;
- the majority of those, who are willing to make a judgement at all, think that risks and benefits will be about equal (25 percent), while 20 percent believe that benefits will outweigh risks and only 7 percent regard risks bigger than benefits;
- when being provided information on possible benefits and risks of nanotechnology, this finding does not change substantially, except for the fact that the number of those with a critical assessment increases a bit more strongly.

In the United Kingdom, research on public perceptions of nanotechnologies was conducted in the years 2004 to 2006. The activities comprised ten group discussions with citizens and the so called "nanodialogues" that included four experiments in →

upstream public engagement (Kearnes et al. 2006; Stilgoe 2007). The focus groups revealed an ambivalent attitude toward nanotechnology and some public concern with respect to possible un-intended side-effects. Interestingly, this ambivalence has not diminished as participants learnt more about this new technology. Rather, the sceptical assessment of the capability and willingness of government and business to manage the potential risks properly slightly increased. The concerns related to potential toxic risks in bodily applications, to possibly new forms of control of government and business over people's everyday lives, to increased inequality and concentration of power in the hands of large corporations, and to limited capacities of the government to govern and regulate technology development. Several respondents referred to the mishandling of genetically modified foods and crops by government and business when arguing for a more cautious approach in case of nanotechnology.

In Germany, major surveys on consumer perceptions of nanotechnologies have been conducted lately. Grobe et al. (2008) find in a study for the "Verbraucherzentrale Bundesverband", the Federation of German Consumer Organisations, that:

- while only one third (32 percent) of the respondents is able to give a definition of nanotechnology, the average respondent knows seven to eight nano-applications;
- people articulate their attitudes at the example of certain applications, such as medical applications (mentioned by 85 percent of the sample), food (63 percent), automobiles (62 percent), electronics (61 percent), and textiles (55 percent);
- the general attitudes toward nanotechnology are positive (64 percent), and only 5 percent of the sample expresses a negative attitude; 31 percent are ambivalent;
- the generally positive assessment of nanotechnologies, which is based on perceived benefits in several consumer-related areas, does, however, strongly rely on certain conditions, such as product safety and proper risk communication;

- as regards the provision of credible information about nanotechnologies people express high trust in science and consumer organisations, while business is regarded more critical;
- citizens ask for a broad information-mix containing information, for example on function and effects of nano-enabled products, on the ingredients used, on the risks for health and environment, and on long-term impacts.

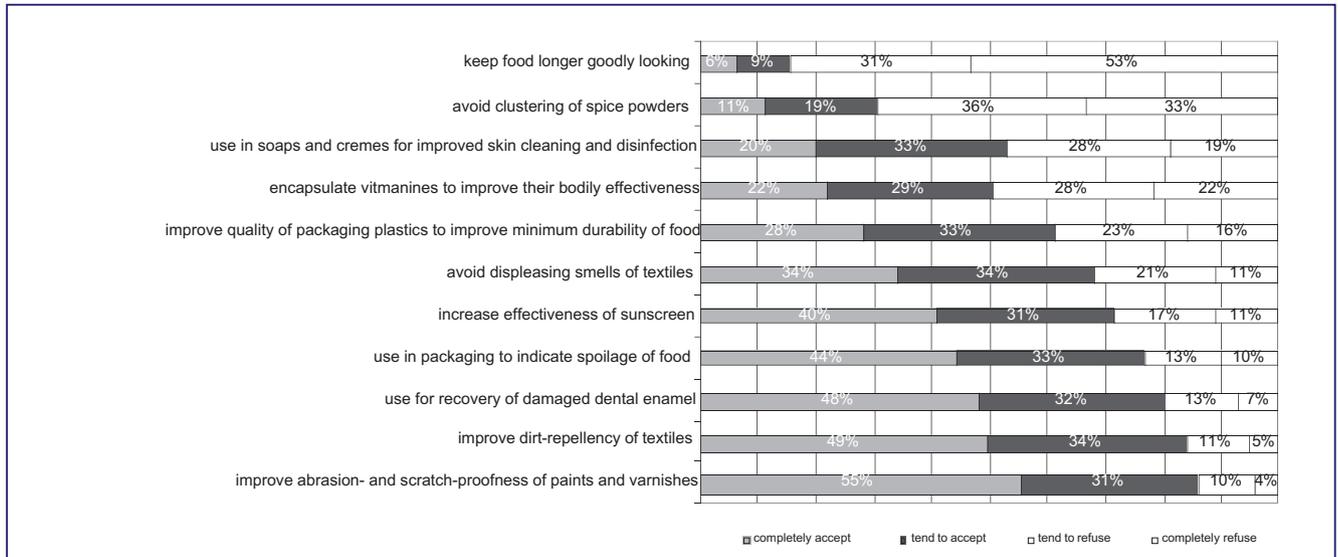
The authors conclude, on the one hand, that the leap of faith that nanotechnology currently enjoys is rather fragile bearing in mind that 87 percent of the respondents associate possible health risks with this new technology. On the other hand, the depths of the answers provided in the survey and the constructive proposals made with respect to risk communication strategies indicate that research into consumer perceptions of nanotechnologies is worthwhile and may yield substantial added-value to public governance of nanotechnologies.

In 2007, the German Federal Institute for Risk Assessment commissioned research into the perceptions of nanotechnologies of the general public. The study aimed to explore the factors that influence public perception and the directions into which public opinion might evolve (Zimmer et al. 2008a).

According to these surveys, about half of the German population is unfamiliar with the term "nanotechnology". The other 50 percent are capable of defining the term in some way. Compared to previous years knowledge has increased. The majority of respondents (66 percent) think that benefits outweigh the risks of nanotechnologies and 77 percent report a very good or good feeling toward it. Both indicators rise with higher levels of knowledge about nanotechnologies. It is also revealed that consumer assessment of nanotechnologies varies by application (see figure 1).

But the assessment is not necessarily the more critical the closer the application to the human body, as the dental enamel example shows. Apparently, more decisive is a combination bet-

Figure 1: Consumer assessment of nanotechnologies according to applications



Source: Zimmer et al. 2008a

ween bodily application and presumed low consumer benefit, for example clustering of spice powder. But in general, there are no pronounced risk perceptions and fears towards nanotechnologies but rather a fascination with regard to its technical possibilities. If at all, fears may be stoked by perceived risks emanating from free nano-particles and by certain applications in the area of food. The latter is motivated by the fact that since nanotechnologies are perceived as something artificial they do not fit within the common scheme of evaluating natural ingredients as positive and non-natural as negative. As regards citizens' trust in public bodies to manage possible risks properly the survey finds a low agreement (34 percent) to a statement, such as "One can rely on the government to protect the public from environmental and technical risks". The authors of the study conclude, that adequate risk communication should reflect the different fields of application and employ easy-to-grasp images and explanations enabling citizens-consumers a differentiated learning on the benefits and possible risk of nanotechnologies.

Public Engagement with Citizens

First experiences with engaging the public in discussion about nanoscience and nanotechnologies were made in Australia and Denmark in 2004 (Mee et al. 2004; Katz et al. 2005). In the following year, the Nanojury UK was established (Gavelin et al. 2007). This public engagement exercise aimed to influence policy-making by systematically building and articulating a public opinion on the matter. 25 randomly selected citizens formed the jury which, amongst others, called for more openness on public spending on nanotechnology research, that publicly funded research focuses on solving long-term environmental and health problems, and that all nano-enabled products are tested for safety and properly labelled.

The Madison Area Citizens' Conference on nanotechnology held in April 2005 represents the first major public engagement exercise in the United States (Kleinman/Powell 2005; Gavelin et al. 2007). The process took place over three Sunday meetings and involved a group of thirteen citizens from a variety of backgrounds. The recommendations prepared by the lay panel refer to health and safety regulations like testing of nanomaterials, media coverage and information availability like product labelling, research and research funding like increased funding of research into social and ethical implications and public involvement like effective mechanisms for citizen involvement in nanotechnology policy development.

One year after the American citizen conference, the German Federal Institute for Risk Assessment (BfR) conducted a "Consumer Conference on the perception of nanotechnology in the areas of foodstuffs, cosmetics and textiles" as part of its risk communication activities (Zimmer et al. 2007; Zimmer et al. 2008b). Over three weekends, including an expert hearing, the group of 16 citizens prepared a consumer vote that calls, amongst others, for comprehensible labelling, clear definitions, terms and standards for nanomaterials as well as for more research into the

potential risks before nanotechnology is used to a larger extent in consumer products. The vote names foodstuffs as the most sensitive area for the use of nanomaterials. Regarding the use of nanotechnology in cosmetics and textiles, however, the consumers felt that the already foreseeable benefits clearly outweighed potential risks.

In Switzerland, a major process of public deliberation on nanotechnologies was the publifocus discussion forum on "Nanotechnology, Health and Environment" (Rey 2006). The publifocus consisted of four focus group discussions with 53 citizens carried out in different regions in Switzerland in September 2006. In all discussion groups, hopes as to the potentials of this new technology, for example in medical and environment-related applications, outweighed reservations. Most concerns were again articulated for nano-applications in foodstuff. Moreover, the majority expresses a demand for product declaration and labelling, at least for products that contain engineered nanoparticles.

The National Citizens Technology Forum, conducted in the United States in March 2008, was a deliberative process simultaneously run across six different sites in the United States (Hamlett et al. 2008). At each of these sites, panels of lay citizens were recruited to discuss, debate and give recommendations on converging technologies for human enhancement, that is nanotechnology, biotechnology, information technologies, and cognitive science (NBIC). The Citizens' Technology Forum involved a total of 74 citizens completing questionnaires about these technologies both before and after the process, discussing and debating what they saw as the important issues, formulating and asking questions of invited experts in the field and developing a final report with recommendations for policymakers on how to manage these new technologies. There were face to face meetings within the individual groups while interactions across the different groups occurred in online sessions. In this deliberative process, all groups shared concern over the effectiveness of regulations over NBIC technologies and the need for more public information. Hamlett et al. conclude that "average citizens want to be involved in the technological decisions that might end up shaping their lives. Citizens remain strongly supportive of research that might lead even to transformational technologies, provided that reliable information about and attentive and trustworthy oversight of their development exists" (Hamlett et al. 2008).

Conclusions

Until now, there is limited public awareness of nanotechnologies, its benefits in certain applications and its potential risks. This limited knowledge contrasts with the huge innovation potential that this new technology is attributed with, in science and in business. Hence, information and awareness raising among the general public is key for ensuring broad social acceptance of nanoscience and nanotechnologies in the future.

If people know something about this new field of technology, they show, on average, positive attitudes which are, how- →

ever, strongly associated with concerns over nano-applications in areas such as food and nutrition. The empirical evidence available so far clearly reveals that easy-to-grasp communication of the benefits and risks in different applications is a must, if one wants to avoid public refusal similar to the one encountered in the debate on genetically modified organisms. Processes of public engagement are one proper means to contribute to this goal.

Moreover, it has to be remarked, that the surveys on the attitudes of citizens include consistently a chances and risks assessment and that a general rejection of these technologies does therefore not occur. Typifying engagement processes clarified furthermore, that the chances and risk evaluation of well-informed consumers and citizens differs in parts only marginally from those of scientists. The transparency of these processes and the information available on nano-particles in products play a central role for citizens and consumers at least as long as no hard facts on their harmlessness exist. Therefore, consumers gain an important position at an early stage, which might impact on product development in applied scientific research and businesses.

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