Federal Institute for Risk Assessment

Nanoview – Influencing factors on the perception of nanotechnology and target group-specific risk communication strategies

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Nanoview – Influencing factors on the perception of nanotechnology and target group-specific risk communication strategies

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1 Foreword

In addition to its remit of assessing the risks that can emanate from foods, substances and consumer products, the Federal Institute for Risk Assessment has the legal task of risk communication. This includes the accompanying research of the perception of risks from a social science point of view and the conducting of interactive dialogue processes with various social groups. In this connection, trends regarding the perception of risks by large sections of the population are examined, thereby making important contributions to the discussion within society about the handling of risks between experts, stakeholders, politicians and the general public.

Nanotechnology is a collective term for the development of innovative materials and applications in various scientific and technical disciplines. Nanotechnology is regarded worldwide as one of the technologies of the future and a driving force for innovation. Due to the current developments in nanotechnology and those expected in the future in all areas of daily life, increasing production quantities and thereby the increased release of many different nanomaterials has to be assumed. Parallel to the mainly positive economic outlooks, a degree of uncertainty exists about the possible risks of nanotechnology. It is currently being discussed among experts whether and how nanomaterials can have health-damaging effects for humans. This makes nanotechnology a topic which falls into the range of tasks of the BfR.

The level of knowledge of nanotechnology among the general public in Germany is low. This is the finding of a representative survey of the perception of nanotechnology in the population conducted by the BfR in 2007. In addition to this, the survey showed that public perception of nanotechnology in Germany tended to be positive and geared more towards the potential than the risks. As the technology is relatively new and large sections of the population do not have any definite opinions on or knowledge of it, big shifts in basic attitudes are still possible. To examine shifts of this kind, the BfR conducted a follow-up survey with the title “Nanoview” in 2012, five years after the first survey. Although it leans heavily on the 2007 survey, to enable the direct evaluation of the study results, the additional question was dealt with in Nanoview as to which communication measures for conveying risk-relevant information regarding nanotechnology are particularly well suited to reach the majority of the population even better than is currently the case.

Professor Dr. Dr. Andreas Hensel
President of the Federal Institute for Risk Assessment

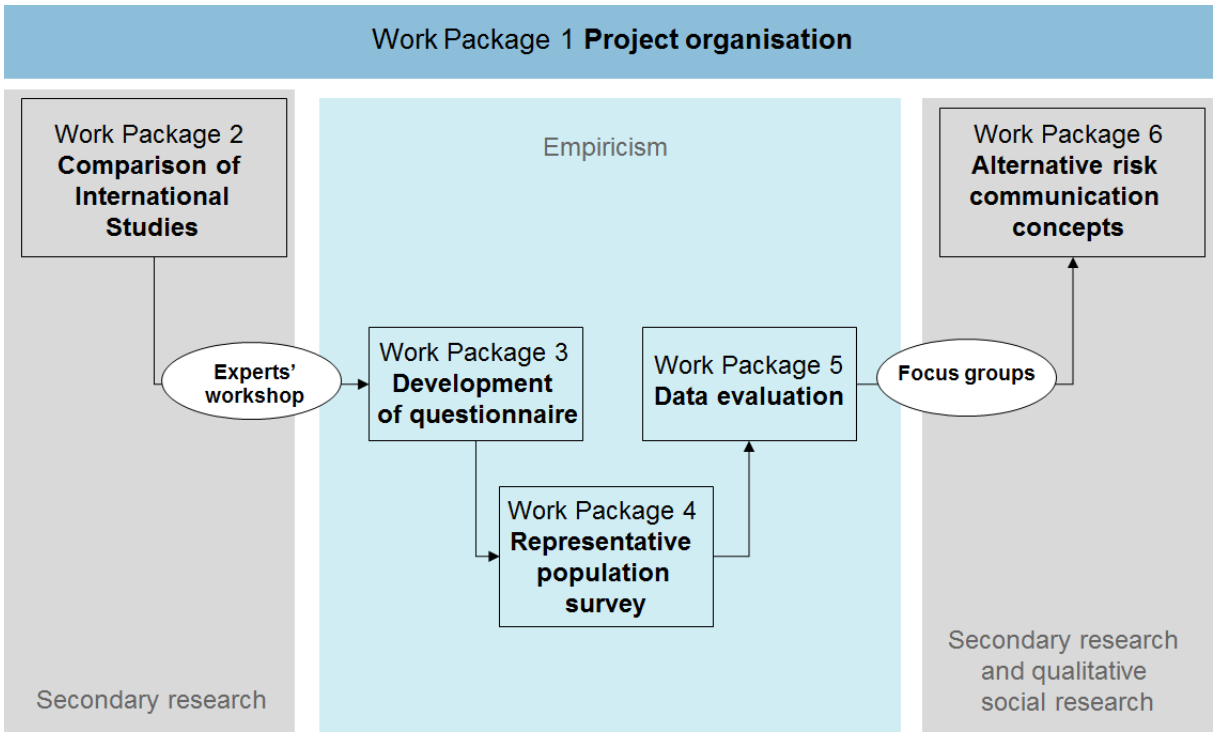
2 Project Nanoview

The consumer-oriented applications of nanotechnology are growing all the time, especially in the areas of bodycare, clothing and cosmetics. While nanoproducts are therefore of increasing relevance to consumers, the level of knowledge concerning nanotechnology and their fields of application in areas that affect consumers is still relatively low among the general public (e.g. Zimmer et al. 2008, Grobe et al. 2012).

To increase consumers' risk awareness with regard to nanotechnology and utilise the potential of the technology to become a key technology and basic innovation, differentiated risk analysis and effective risk communication are imperative. Both of these are among the key tasks of the Federal Institute for Risk Assessment (BfR).

A comparison of international studies on the perception of nanotechnology and a representative survey within the population of Germany as a further development and continuation of the BfR survey of 2007 are essential components of the "Nanoview" project (Zimmer et al. 2008). Two alternative concepts for the target group-oriented risk communication of nanotechnology in areas relevant to consumers have been developed on this basis.

Fig. 1: An Overview of Project Nanoview



This report summarises the studies from Work Packages (WP) 2 to 6. The results of the comparison of international studies, which dealt among other things with the development of the survey instrument for the representative survey, are presented in Chapter 0. The results of this survey and the conclusions derived from it form the main theme of Chapter 0. Finally, Chapter 0 deals with the conception of the target group-specific communication approaches, as well as their validation and further development in focus groups made up of consumers.

3 Comparison of International Studies

3.1 Introduction

3.1.1 Background and objective

The rapid development and increasing significance of **nanotechnology** for the consumer are not perceived to any great extent by the public in general (Zimmer et al. 2008). In 2010, a good third of the German population had never heard of the term “nanotechnology” and almost two thirds of all Germans had never tried to find out anything about the subject (Gaskell et al. 2010). In addition to this lack of knowledge, there are reservations about this new technology with only a good quarter (tending) to agree with the statement “nanotechnology is safe for our own health and that of the whole family”, while almost 40 % feel “(somewhat) uneasy” with the idea of nanotechnology (ibid.). Compared with the European average, Germany comes off better where the level of awareness is concerned, but the reservations are also a bit stronger than they are in other European countries (ibid.).

In an international meta-analysis of more than 20 surveys on the **perception of nanotechnology**, Satterfield et al. (2009) conclude among other things that large sections of the population are not sure how to judge the new technology. The risk estimations of this group are therefore not very stable and can tend in one direction or the other, depending on the information situation.[1] The direction in which risk perception can develop in future depends on various factors which include socio-cultural aspects, such as moral concepts and political attitudes (e.g. Kahan et al. 2007, Cacciatore et al. 2009, Siegrist 2010), as well as psychosocial factors such as trust in institutions, perceived risk control and scepticism towards the technology (e.g. Siegrist et al. 2007b, Satterfield et al. 2009). Finally – depending on the media utilisation behaviour of the population – reporting on nanotechnology in the print, TV and online media will also play a role in the appraisal of the benefits and risks (e.g. Lee & Scheufele 2006, Priest et al. 2009).

Chapter 3 of this report summarises the results of Work Package 2 **“Comparison of International Studies”**. The work package pursues the following objectives:

- Conducting of a systematic literature study in the sense of a qualitative meta-analysis of existing international surveys on the perception of nanotechnology in the population
- Drawing up a results report showing the results of the literature study on the basis of research questions. The report should also contain justified recommendations on the factors that influence perception which should be taken into account in the population survey.

The central **research questions** on which the literature evaluation is oriented are:

- How does the population in Germany and abroad perceive nanotechnology?
- What does the general public know about nanotechnology and where do they get their information?
  - Does the population perceive nanotechnology more in terms of risk or benefit aspects?
  - How does knowledge of nanotechnology influence the risk-benefit assessment?
- What hopes and fears do people associate with nanotechnology?
- Can differences be recognised in the perception patterns in Germany and other countries? If so, what are they and what are the possible reasons for the differences?

[1] A similar conclusion is drawn by Grobe et al. (2008), who regard the leap of faith currently enjoyed by the nanotechnologies as “fragile” (ibid. P. 85).

- How does perception of nanotechnology vary in Germany and other countries depending on the areas in which it is used and the context in which it is placed (e.g. is the potential of nanotechnology presented with or without mention of the possible risks)?
- Can changes in the perception of nanotechnology over the last ten years be recognised in the comparison of international studies? If so, in which direction are the trends going and what are the possible reasons for the changes? Can trends be observed in other countries which have already been recognised or are still to be expected in Germany?

3.1.2 Procedure

The analysis of the comparative literature study is based on the evaluation of international publications which have appeared since 2000. Before the methodical procedure is explained in detail, the selection and determination of the relevant studies is outlined more closely in the following chapters.

3.1.2.1 Literature research

The literature was researched in the main by using the online-based literature database "Web of Science" (WOS). The full-text search inside Web of Science worked with (combinations of) search terms which associate nanotechnology with consumers, citizens and aspects of the perception of benefits and risks.[2]

A second access channel to research was provided by international experts[3] who provided advice within the scope of the project. As they each have a more specific view of the research landscape in their respective home countries, they were able to supplement the comprehensively researched literature in certain areas.

Going back to the year 2000, a total of 88 studies were identified which relate in a wider sense to the perception of nanotechnology. After an initial review it was established, however, that not all of these publications were suited in the same way for individual evaluation and meta-analysis, so an additional selection stage was introduced for the purpose of prioritising the studies. In the end, 56 studies were taken into consideration for the analysis. The decisive selection criterion here was the methodical foundation for conducting a survey on the public perception of nanotechnology. Studies which generate their findings on the basis of dialogue processes, focus groups and comparable qualitative methods were given a lower ranking in terms of priority than studies based on a quantitative research design which make a direct contribution to the overall goals of the project on which they are based. Care was also taken to ensure that studies by the same authors with identical content which were published in different contexts were only taken into account once. In addition to this, certain individual studies were included which summarise primary surveys of public perception, thus providing meta-statements in this regard which provide non-binding orientation for this literature study. A list of the 56 studies taken into consideration for individual and meta-evaluation is included in Annex 9.1.

[2] The actual entries for the full-text search in the titles and abstracts of publications were "nanotech* AND (perceptions OR value OR risk* Or benefit*)" and "nanotech* AND (consumer* OR citizen*)".
[3] These were the consumer researcher Prof. Dr. Lucia Reisch, Copenhagen Business School, Denmark, the risk researcher Dr. Fern Wickson, GenØk – Centre for Biosafety, Tromsø, Norway, and Prof. Phil Macnaghten, Durham University, United Kingdom, who conducts research on the governance of new technologies. All three have references relevant to the subject of nanotechnologies.

3.1.2.2 Evaluation

The selected studies were evaluated in a two-phase, complementary process. In the first step, the publications were evaluated individually with the help of an analysis matrix and condensed into tabular form in line with the categories under consideration (see Annex 9.1 for the evaluation diagram). This has the advantage of reducing the sometimes complex research designs and references to their essential aspects, thus making them comparable with one another. In addition to the initial hypotheses and their operationalisations, it is above all the variables for measuring public perception of nanotechnology that are of key interest among the findings. The development of a typing method by means of which the wide spectrum of relevant variables can be classified is useful here to sharpen the focus of analysis. In this regard, the following variable types were recorded in the schematic evaluations:

- **Object-related factors:** e.g. level of knowledge/information, area of application, product acceptance, assessment of benefits and risks (also in relation to one another), familiarity, ways of distributing knowledge etc.
- **Sociodemographic factors:** e.g. gender, age, marital status, highest level of academic achievement, household size, income (breadwinner or household), migration background etc.
- **Psycho-social factors:** milieu affiliation[4], trust in institutions, general values (attitude to science etc.), attitude to technological progress, religious beliefs, attitude towards interference with nature (against the background of religious views, for example), fascination, worry, feeling of control/controllability, concern, optimistic or pessimistic outlook, party membership etc.
- **Other factors:** media usage, differences between experts and lay people etc.

The second evaluation step pursued the objective of generating a comparative overview of the international studies. To do so, the individual evaluations were set in relation to one another within the scope of a meta-analysis in order to identify the options, trends and variations in the surveying of the attitude characteristics regarding nanotechnology. On top of this, findings on the typed factors were successively condensed and further developed in the course of a cross-analysis of the individual evaluations in order to make them useable for the survey planned within the project. In this analysis step, chronological and spatial dimensions played a role in addition to the actual content when it was examined, for example, how the variables for measuring the perception of nanotechnology and the instruments used to conduct the survey have changed since 2000, as well as the extent to which the cultural context (regarding nationalities, for instance) has had an influence on public opinion formation to a degree that has to be taken into consideration.

3.2 Trends and developments in the perception of nanotechnology

This chapter deals with the basis for evaluating national and international studies on how nanotechnology is perceived by the general public. It elaborates on awareness and level of knowledge, as well as general attitudes to this technology and the perception of different fields of application. Chronological developments regarding the aspects named are illustrated where the data situation permits. It is not the purpose of these explanations to name the factors which have a decisive influence on the perception of nanotechnology. These are dealt with in detail in the following chapter.

[4] The social status to which an individual belongs is usually determined by his or her social situation, values and fundamental orientation.

3.2.1 Measuring perception

The evaluated studies show that there are various ways of measuring perception of nanotechnology in the population. Binder et al. (2011) differentiate between ***"single-item[5]" a***nd ***"multi-item" measures***. The former are based on a central question with different answer categories, such as the perceived ratio of benefits and risks in terms of "great", "small" or "equal". A global measure of this kind is by nature less meaningful than so-called *"multi-item"* indicators which determine perception on the basis of several statements, such as different aspects of benefits and risks, where respondents are asked about their agreement in each instance. Examples of these kinds of differentiated measures are mentioned below.

The most widespread perception measure is measurement of the **awareness** of nanotechnology. This can be operationalised via the question *"Have you heard of nanotechnology?"* with the simple answer options *"yes"* or *"no" (e.g.* BMRB Social Research 2004) or with the slightly differentiated answer options *"nothing, a little, some, a lot"* (e.g. Cobb & Macoubrie 2004, Farschi et al. 2011). In more recent studies, i.e. against the background of the increasing spread of the "nano issue", more extensive answer scales are used which also record either information behaviour[6] or information level[7].

The latter has similarities with the measurement of the **level of knowledge** (*nano literacy*), where either factual knowledge of nanotechnology is determined on the basis of various statements which have to be evaluated with "true" or "false" (e.g. Cobb & Macoubrie 2004, Scheufele & Lewenstein 2005, Cacciatore et al. 2011), or a self-estimation is made along the lines of a scale from 1 (*little knowledge*) to 10 (*a lot of knowledge*) (e.g. Vandermoere et al. 2009 a, b). Grobe et al. (2008) measure the level of knowledge in a more extensive way by asking for a definition of nanotechnology or about possible areas of application.

One pivotal factor in the measurement of perception of nanotechnology is the **ratio of risks to benefits** (*risk-benefit trade-off*). There are various possibilities here:

- The question as to a direct comparison by means of the attributes "larger, smaller, same, uncertain" (e.g. Cobb & Macoubrie 2004, Macoubrie 2005, Cobb 2005, Vandermoere et al. 2009 a, b)
- The measurement of risk perception on a multi-stage scale (e.g. Kahan et al. 2008, komm.passion GmbH 2004)[8]
- The measurement of risk/benefit perception by means of a compilation of three items (e.g. Retzbach et al. 2011), four items (e.g. Lee et al. 2005) or an even larger number of different items (e.g. Siegrist et al. 2008, Ho et al. 2011)[9]

Sum indices in particular provide numerous indications for the formulation of various types of risks/benefits of nanotechnology.[10]

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[5] In empirical social research, the term "item" is used to describe the smallest component of a survey instrument. In the survey instrument "questionnaire", for example, the individual questions are items. Similarly, the tasks to be solved in the survey instrument "IQ Test" are also items.

[6] E.g. Gaskell et al. (2010): *"not heard, heard only, talked about or searched for information occasionally, talked about or searched for information frequently"*.

[7] E.g. Retzbach et al. (2011): *"Have you ever heard about nanotechnology, and if so, how much knowledge do you have about it? 1 = never heard about it; 2 = very little knowledge; 3 = little knowledge; 4 = some knowledge; 5 = good knowledge; 6 = very good knowledge*".

[8] Kahan et al. (2008), for example, use a scale of 6 from *"strongly disagree", "moderately disagree", "slightly disagree", "slightly agree", "moderately agree"* to "*strongly agree*" to allow respondents to evaluate items such as "*The risks of nanotechnology are likely to be very large"*.

[9] E.g. Retzbach et al. (2011) use the items *"Nanotechnology can help to cure diseases", "Nanotechnology can help to improve everyday products" and "Nanotechnology can help to solve environmental problems"* which the respondents then evaluate on a scale of 6 (*strongly disagree, disagree, tend to disagree, tend to agree, agree, strongly agree*).

[10] Cf. Scheufele/Lewenstein (2005), Siegrist et al. (2007), Scheufele et al. (2008) and Farshchi et al. (2011) in addition to the studies mentioned.

A further key parameter for measuring perception is the **attitude** towards nanotechnology. There are various approaches here too, according to the evaluation:

- With Gaskell et al. (2006), all that is asked is concurrence with the statement *"Application should be encouraged"*.[11] In other studies, the respondents evaluate statements such as "Public promotion of nanotechnology" (e.g. Scheufele & Lewenstein 2005, Brossard et al. 2009, Ho et al. 2011), "Nanotechnology is useful for society" (e.g. Cacciatore et al. 2011) or "Nanotechnology is morally acceptable" (Scheufele et al. 2008).
- Vandermoere et al. (2009a) use a direct measure for attitudes to nanotechnology by formulating the question: "*How would you describe your opinion about nanotechnology?"* (1 = *rather positive*, 2 = *rather negative*, 3 = *not positive, nor negative*).
- In Einsiedel (2005) and Scheufele et al. (2008), on the other hand, questions are asked about the acceptance of nanotechnology depending on certain prerequisites, e.g. with regard to regulation and control.[12]
- Finally, attitudes towards nanotechnology can also be measured by the acceptance of certain areas of application (e.g. Zimmer et al. 2008, Gardner et al. 2010).

In contrast, the question as to whether this new technology will improve or impair people's **way of life** or have no influence on it (Gaskell et al. 2003) is seldom used as a measure for the perception of nanotechnology.

Moreover, the **affective reaction** to nanotechnology is measured in some studies. Cobb (2005), for example, uses the simple measure "*hopeful, worried, angry"* here, and Lee et al. (2005) ask along a scale of ten how concerned people are about nanotechnology.

In more recent studies, **willingness to buy or pay for** specific nano-applications in the area of food, for example, is often measured. This can be done in different ways. Siegrist et al. (2007, 2009), for instance, ask about willingness to purchase nano-foods on a scale from 1 to 7, whereas Marette et al. (2009) record willingness to pay for nanoproducts on a predetermined price scale.

The possibilities for measuring perception of nanotechnology are therefore many and have become even more differentiated in recent times. It must therefore be taken into account in each instance when analysing the factors which influence perception which perception measure was used as the basis.

3.2.2 Awareness and level of knowledge

Awareness of nanotechnology is an important perception measure. In a comparison of several international studies, the following table shows that the majority of the population has still not heard of the term.

[11] Similar to Cacciatore et al. (2011) with the statement *"Overall, I support the use of nanotechnology".*

[12] E.g. in Einsiedel (2004): *"Relaxed: I approve the use of NT as long as the usual levels of government regulation and control are in place", "Strict: I approve of NT as long as it is more tightly controlled and regulated", "Limited: I do not approve of NT except under very special circumstances", "Never: I do not approve of NT under any circumstances".*

Tab. 1: Awareness of nanotechnology in selected European countries

Reference area	Study	Year of survey	n=	*Have you heard of nanotechnology?* (percentage yes)
EU 25	Gaskell et al. 2006	2005	25,000	40.0 %
EU 27	Gaskell et al. 2010	2010	26,676	46.3 %
CH	Siegrist et al. 2007b	2007	375	65.0 %
CH	Gaskell et al. 2010	2010	1,026	75.7 %
DE	komm.passion GmbH 2004	2004	1,019	45.0 %
DE	Zimmer et al. 2008	2007	1,000	67.3 %
DE	Vandermoere et al. 2009a	2009	750	60.3 %
DE	Gaskell et al. 2010	2010	1,531	64.7 %
FR	Vandermoere et al. 2009b	2008	750	42.4 %
FR	Gaskell et al. 2010	2010	1,018	53.9 %
UK	BMRB Social Research 2004	2004	1,005	29.0 %
UK	Gaskell et al. 2010	2010	1,316	47.5 %

Although awareness has increased in recent years in all of the European countries mentioned by way of example, there are still big differences between the countries themselves. Where awareness of nanotechnology is very high in Switzerland, for example, it is still very low in the UK. With 64.7 % in 2010, Germany lies clearly above the European average of 46.3 %. Apart from Switzerland, only the Scandinavian countries – Norway (77.7 %), Denmark (77.1 %), Sweden (74.8 %) and Finland (73.3 %) – achieve higher values with regard to awareness of nanotechnology (Gaskell et al. 2010).[13]

The answers to the questions regarding the level of awareness of nanotechnology which have been frequently used in American studies (cf. Tab. 2), show, on the one hand, that despite increasing familiarity with the topic over time, a good third of the US population has never heard of the term to this day. It becomes clear on the other hand that, placed in relation to the survey year 2006 for example, the studies by Kahan et al. (2007) and Peter D. Hart Associates (2006) arrive at very different results. This suggests the conclusion that the determined values should be viewed more as orders of magnitude rather than exact determinations of the level of awareness. Ultimately, the data highlight the finding that there are very big differences in the level of knowledge among those persons who have already heard of nanotechnology.[14]

Tab. 2: Level of awareness of nanotechnology in the USA

Reference area	Study	Year of survey	n=	*How much have you heard of nanotechnology?*			
				nothing	a little	some	a lot
USA	Cobb & Macoubrie 2004	2004	1,536	51.8 %	31.8 %	16.4 %	
USA	Kahan et al. 2007	2006	1,850	53.0 %	28.0 %	14.0 %	5.0 %
USA	Peter D. Hart Associates 2006	2006	1,014	42.0 %	27.0 %	20.0 %	10.0 %
USA	Peter D. Hart Associates 2008	2008	1,003	49.0 %	26.0 %	17.0 %	7.0 %
USA	Peter D. Hart Associates 2009	2009	1,001	37.0 %	31.0 %	22.0 %	9.0 %

More extensive findings on awareness and level of knowledge are available for **Germany**. In the survey documented in Zimmer et al. (2008), 23 % (n=1,000) of the respondents state – after they have been given a brief definition of nanotechnology – that they have never heard of it, while 68 % say “some” and 9 % “a lot”. In reply to the unaided question about nano-

[13] All of the information is taken from the representative survey “Eurobarometer” by Gaskell et al. (2010). The sample sizes amounted to roughly 1,000 cases per country.

[14] See also the study by Retzbach et al. (2011), where 32.5 % of the American population has never heard anything about nanotechnologies, 45.9 % has “*very little”* or *“„little knowledge”,* 16.0 % has *“some”* and 5.6 % has *“good”* or *“very good knowledge”*.

technology, almost a third (32.5 %) state that they have never heard of it while 15 % have heard “something” about it, without being able to elaborate on this in any detail.

Among persons who have already heard of nanotechnology Grobe et al. (2008) report, albeit on the basis of a qualitative, non-representative random sample of 100 persons (Germany and German-speaking part of Switzerland), that although 62 % of those questioned estimate their level of knowledge as low, (25 % medium and 5 % high), as many as 32 % of all respondents are able to give a reasonably precise definition of nanotechnology. In addition to this, the respondents can name an average of seven to eight different areas of application for nanotechnology which suggests to the authors an unexpectedly high level of knowledge (cf. Tab. 3). The areas most frequently mentioned are medicine, surface coating, food, cars and information technology/electronics.[15]

Tab. 3: Frequently mentioned nano application areas

Area	Frequency of mentions (n=100, multiple answers possible)
Medicine	85 %
Surface coating	78 %
Food	63 %
Cars	62 %
IT/Electronics	61 %
Textiles	55 %
Paints/Varnishes	49 %
Construction materials	41 %
Detergents	41 %
Cosmetics	34 %

Cf. (Grobe et al. 2008)

The following can be concluded from this regarding awareness and knowledge of nanotechnology:

- In many European countries (e.g. Germany, Switzerland, Scandinavia) as well as the USA, roughly two thirds of the population at least has heard of nanotechnology. Up to a third of the population is not familiar with the term.
- In a European comparison and also compared to the USA, awareness in Germany is high. Only in the Scandinavian countries and in Switzerland are higher awareness levels achieved.
- The majority of those in Germany who have already heard of nanotechnology estimate their level of knowledge as low. At the same time, roughly a third of this section of the population can define nanotechnology fairly well. They can also associate a number of areas of application with the term.

3.2.3 Attitudes towards nanotechnology

3.2.3.1 Unaided attitudes

In many studies, the respondents are not given any information about the benefits or possible risks of the technology before assessing nanotechnology. The so-called unaided attitudes which result are presented below. Overall, the evaluation of the international studies shows that with this type of questioning, a large portion of the population has a positive and only a

[15] In Zimmer et al. (2008), the areas of application “Paints, varnishes and surface treatment”, “Medicine” and “Textiles” are most frequently mentioned in reply to the open-ended question as to what people know about nanotechnologies.

small minority a negative attitude towards nanotechnology. A considerable percentage of the population is still undecided in this regard, however.

Asked whether the new technology will have a positive, a negative or no influence on our future **way of life**, a total of 41 % of people in Europe answered with “positive”, 10 % with “negative” and 40 % with “don’t know” (cf. Gaskell et al. 2010 and Tab. 4).

Tab. 4: General attitude towards nanotechnology in Europe

Reference area	Study	n =	*Do you think it [nanotechnology] will have a positive, a negative or no effect on our way of life in the next 20 years?*							
			positive	Δ to EU ∅	negative	Δ to EU ∅	no effect	Δ to EU ∅	don’t know	Δ to EU ∅
EU 15	Gaskell et al. 2003	16,067	28.0 %		5.0 %		14.0 %		53.0 %	
EU 25	Gaskell et al. 2006	25,000	40.0 %		5.0 %		13.0 %		42.0 %	
EU 27+	Gaskell et al. 2010	26,676	**41.0 %**		**10.0 %**		**9.0 %**		**40.0 %**	
CH	Gaskell et al. 2010	1,026	47.3 %	15.4 %	10.3 %	3.0 %	12.7 %	41.1 %	29.7 %	-25.8 %
DE	Gaskell et al. 2010	1,531	43.4 %	5.9 %	12.6 %	26.0 %	7.1 %	-21.1 %	37.0 %	-7.5 %
DK	Gaskell et al. 2010	1,006	61.5 %	50.0 %	8.7 %	-13.0 %	11.2 %	24.4 %	18.7 %	-53.3 %
ES	Gaskell et al. 2010	1,004	42.4 %	3.4 %	7.7 %	-23.0 %	3.3 %	-63.3 %	46.6 %	16.5 %
FI	Gaskell et al. 2010	1,001	58.1 %	41.7 %	6.9 %	-31.0 %	12.5 %	38.9 %	22.5 %	-43.8 %
FR	Gaskell et al. 2010	1,018	45.5 %	11.0 %	8.2 %	-18.0 %	7.6 %	-15.6 %	38.7 %	-3.3 %
IE	Gaskell et al. 2010	1,007	27.2 %	-33.7 %	10.2 %	2.0 %	4.9 %	-45.6 %	57.7 %	44.3 %
SE	Gaskell et al. 2010	1,007	63.3 %	54.4 %	4.6 %	-54.0 %	8.0 %	-11.1 %	24.1 %	-39.8 %
UK	Gaskell et al. 2010	1,316	39.9 %	-2.7 %	5.4 %	-46.0 %	8.1 %	-10.0 %	46.6 %	16.5 %

The situation in Germany roughly reflects the European average. In countries in which the percentage of undecided individuals lies significantly below the European average, the pattern is irregular with the percentage of the group which does not apportion any special effect to nanotechnology rising overproportionately in Switzerland and Finland, for example, and those who have a positive attitude towards it in Denmark. In Sweden, on the other hand, the percentage of people with a positive attitude is around 50 % higher than the European average while the percentage of those with a negative attitude is lower by the same margin.

Regarding the question as to whether nanotechnology should be **encouraged**, the pattern for Europe also shows a majority of those who approve, although this is balanced off by the many who are critical of it and those who are still undecided (cf. Tab. 5). Although there are significantly fewer undecideds In Germany than on European average, not only the percentage of those with a positive attitude is relatively high but also that of persons with a critical view.

Tab. 5: Support for nanotechnology in Europe

Reference area	Study	n =	*Nanotechnology should be encouraged*		
			totally agree + tend to agree	*tend to disagree + totally disagree*	*don’t know*
EU 25	Gaskell et al. 2006	25,000	55.0 %	k.A.	k.A.
DE	Gaskell et al. 2006	n.i.	60.0 %	k.A.	k.A.
EU 27+	Gaskell et al. 2010	26,676	**39.5 %**	**24.9 %**	**35.6 %**
CH	Gaskell et al. 2010	1,026	44.2 %	26.1 %	29.7 %
DE	Gaskell et al. 2010	1,531	45.6 %	29.1 %	25.3 %
DK	Gaskell et al. 2010	1,006	47.8 %	30.2 %	21.9 %
FI	Gaskell et al. 2010	1,001	64.4 %	18.5 %	17.1 %
FR	Gaskell et al. 2010	1,018	40.8 %	27.1 %	32.2 %
SE	Gaskell et al. 2010	1,007	50.1 %	25.1 %	24.9 %
UK	Gaskell et al. 2010	1,316	38.3 %	21.4 %	40.4 %

A mixed pattern of opinion has also been observed in the US with regard to the encouragement of nanotechnology. With Brossard et al. (2009), for instance, average approval of the statement *"Overall I support federal funding of nanotechnology"* on a scale from 1 to 10 lies at 5.36 (n=706). Ho et al. (2011, n=1,015) achieve similar results where this statement is concerned.[16] Regarding the statement *"Overall, I support the use of nanotechnology",* Lee et al. (2005) measure an average approval of 5.98 (n=706)[17] on a scale from 1 to 10.

American studies in which the **ratio of benefits to risks** is surveyed tend to show an irregular pattern where attitudes towards nanotechnology are concerned (cf. Satterfield et al. 2009 and Tab. 6).

Tab. 6: Perception of benefits in relation to risks in selected American studies

Reference area	Study	n =	Ratio of benefits to risks "There is a lot of talk about the potential risks and benefits of nanotechnology. What do you think? Do you think the benefits of nanotechnology will outweigh the risks, the risks will outweigh the benefits, or will the risks and benefits be about equal?", Cobb & Macoubrie 2004)			
			Benefits > risks	Benefits < risks	Benefits = risks	Uncertain
USA	Cobb & Macoubrie 2004	1,536	39.8 %	21.9 %	38.3 %	-*
USA	Peter D. Hart Associates 2006	1,014	15.0 %	35.0 %	7.0 %	42.0 %
USA	Kahan et al. 2007	1,850	53.0 %	36.0 %	-*	11.0 %
USA	Peter D. Hart Associates 2008	1,003	20.0 %	7.0 %	25.0 %	48.0 %

* Answer category was not available

According to the surveys conducted by Peter D. Hart Associates (2006, 2008), the majority of the American population is uncertain as to how to assess the ratio, whereas with Kahan et al. (2007), the majority has a positive attitude and only one person in ten is uncertain.

3.2.3.2 Aided attitudes

If respondents are given information about nanotechnology before being asked for their assessment of it, this is referred to as an "aided attitudes". How these will turn out depends essentially on the type of information provided ("framing"). Vandermoere et al. (2009a, n=750), for example, presented the respondents with a short description of the new technology which also outlined the benefits as well as the possible risks[18] and arrived in this way at a slightly more critical assessment of the new technology than in unaided surveys: only 20.3 % of the respondents described their opinion as *"rather positive"*, 21.9 % as *"rather negative"* and 57.9 % as *"neither positive nor negative"*.

In the survey documented in Zimmer et al. (2008, n=1,000), the persons involved were asked about their estimation of the ratio of the benefits and risks after a number of nano-application fields had been briefly presented without any reference to possible risks. The verdict here is very positive with 20 % stating that the "benefits are far greater than the risks" and for 46 %, the benefits are still "slightly greater" than the risks. Accordingly, two thirds of the respondents assessed nanotechnology as positive while a third remained critical.

[16] On a scale from 1 (*"Do not agree at all"*) to 5 (*"Agree very much"*), a mean values of 3.22 results (Ho et al., P. 180).
[17] Brossard et al. (2009) and Lee et al. (2005) use the same random sample from 2004, which is why the scope of the samples is identical in both cases (n=706).
[18] *"Nanotechnology refers to materials, systems, and processes which exist or operate in the range of about 1–100 nanometers (nm). One nanometer (nm) is one millionth of a millimetre (mm). It involves the creation of structures and systems on the scale of atoms and molecules, the nanoscale. Materials at the nanoscale show novel properties that lead to novel applications in diverse fields like medicine, cosmetics, biotechnology, energy production, and environmental science. The same novel properties that may provide benefits relate to uncertainty regarding how nanomaterials may interact with human health and the environment"* (Vandermoere et al. 2009a, P. 375).

3.2.3.3 Nanotechnology in comparison with other technologies

In several studies, nanotechnology is evaluated in comparison with other technologies or risk areas (benchmark studies). By doing so, Currall et al. (2006) were already able to observe for the US that nanotechnology tends to be perceived as risk neutral compared to biotechnology, genetic engineering or nuclear energy. Berube et al. (2011) also ascertain for the US that in relation to other health risks such as smoking, obesity, pesticides in food, cloning and alcohol consumption, the perceived health risks that can be posed by nanotechnology are sometimes assessed as being considerably lower.

In their European survey of 2005, Gaskell et al. (2006) conclude that measured on the basis of moral acceptability, usefulness for society, perceived risk (*"nanotechnology benefits some people but puts others at risk"*) and support (*"should be encouraged"),* nanotechnology is sometimes assessed significantly more positively than genetic therapy, pharmacogenetics and genetically manipulated foods. Compared to genetically engineered foods and in relation to the cloning of animals, this impression is essentially confirmed in the follow-up study of 2010 with regard to the concern that a technology can cause (*"fundamentally unnatural"* and *"makes you feel uneasy"*), perceived safety (*"safe technologies for food production"*) and perceived benefits (*"good for the national economy"* and *"not good for you and your family"*) (Gaskell et al. 2010, P. 84ff.).

3.2.3.4 Synopsis

The following conclusions can be derived from the empirical findings presented above:

- If people are asked about their attitude towards nanotechnology without providing advance information on the subject, the responses are mainly positive and to a far lesser extent negative. At the same time, a considerable section of the population is still undecided in this regard.
- It can also be seen that a low percentage of undecided respondents does not automatically go hand in hand with a correspondingly higher proportion of persons with a positive attitude. Fewer undecideds can also mean among other things that there are more people with critical attitudes, which in turn indicates that it is difficult to make predictions regarding the forming of opinions on nanotechnology.
- When people are asked about their attitude to nanotechnology after they have been provided with information on the subject, the assessment of the technology depends on the type of information provided, i.e. on the framing. The tendency is that the less the framing emphasises the risks, the more positive attitudes are.
- Compared to other technologies, such as genetically modified organisms (GMO) or animal cloning, people tend to have a more positive attitude towards nanotechnology.

3.2.4 Perception of selected areas of application

3.2.4.1 Areas of application in comparison

As the following table shows, people in Germany are very open to a number of application fields for nanotechnology according to the representative survey conducted by the BfR in 2007 (Zimmer et al. 2008). These include surface coating-related applications, above all with regard to paints, varnishes and textiles, but interestingly enough also food packaging and for the repair of tooth enamel. The latter can be regarded in a wider sense as a *"nano-inside"* application, which usually tend to be seen critically (see below).

Tab. 7: Acceptance of the use of nanotechnology in various areas

Area of application	Would give it my full approval	Would tend to approve of it	Would tend to reject it	Would reject it completely
Improvement of the scratch and abrasion-proofing of paints and varnishes	55 %	31 %	10 %	4 %
Improvement of the dirt-repellent properties of textiles	49 %	34 %	11 %	5 %
Repair of damaged tooth enamel	48 %	32 %	13 %	7 %
Inclusion in packaging materials so that the decay of foods can be recognised	44 %	33 %	13 %	10 %
Increase the effectiveness of sunscreen	40 %	31 %	17 %	11 %
Prevention of unpleasant odours in textiles	34 %	34 %	21 %	11 %
Improvement of film quality to extend the shelf life of foods	28 %	33 %	23 %	16 %
Encapsulation of vitamins to improve their effect in the body	22 %	29 %	28 %	22 %
Use in soaps and crèmes to improve skin cleaning and disinfection	20 %	33 %	28 %	19 %
Prevention of lumping in spice powders (e.g. paprika powder)	11 %	19 %	36 %	33 %
Keeping foods visually appealing for longer	6 %	9 %	31 %	53 %

Question: “I’ll now read out a few different areas of application for nanomaterials and would like you to tell me whether you approve of or reject each application. Please differentiate here between “Would give it my full approval”, “Would tend to approve of it”, “Would tend to reject it” and “Would reject it completely” (Zimmer et al. 2008, n=1,000).

Acceptance is lowest with food-related applications, which is probably attributable to the fact that the benefits associated with the specific applications (easier pouring, longer visual appeal of foods) are presumably perceived as low.

Measured by willingness to purchase, different levels of acceptance can also be determined depending on the area of application (Zimmer et al. 2008). Accordingly, acceptance gets lower the closer the application is to the body (cf. Tab. 7).

Tab. 8: Willingness to purchase various nanoproduct areas

Area of application	Yes, I would buy it	No, I wouldn’t buy it
Surface sealing and care products	86 %	14 %
Clothing	75 %	25 %
Cosmetics	36 %	64 %
Food	20 %	80 %

Question: “Would you buy products from the following groups if they contained nanomaterials?”
(Zimmer et al. 2008, n=1,000)

As already indicated, the varying levels of acceptance are connected with the perceived benefits (cf. Tab. 8). In a comparison of the different areas of application, these are associated less with consumer products and food and above all with the field of medicine and environmental technology.

Tab. 9: Perceived benefits of nanotechnology in various areas

Area of application	Percentage of mentions
Improved medical treatment possibilities	41 %
Improved environmental technology	25 %
Improved protection and safety technology	18 %
Improved consumer products	12 %
Improved foods	4 %

Question: "In which of the following areas do you see the greatest benefits of nanotechnology (only one answer possible")? (Zimmer et al. 2008, n=1,000).

On the basis of a sample of American students, Gardner et al. (2010) also arrive at the result that medical applications are regarded as especially useful – in particular more useful than use in sun protection products, for antibacterial food packagings or as freshness sensors for foods. The same survey also shows, however, that acceptance can change if the perceived benefits are compared with the perceived risks (cf. Tab. 10). Accordingly, nanotechnology for the treatment of tumours, for example, is perceived as particularly usefully while also involving a great risk at the same time.

Tab. 10: Benefits and risks of various nano-applications

Area of application	Perceived benefits	Perceived risks
Freshness sensors for foods	3.65	2.11
Nano-capsules for improved intake of medications	4.43	2.57
Tumour treatment	4.53	2.67
Antibacterial food packagings	3.88	2.41
Sun protection products	3.62	2.31

Answer options on a scale from 1 (no risk/benefit) to 5 (very high risk/very great benefit) (Gardner et al. 2010, n=102)

The study by Siegrist et al. (2007b) only asks about the perceived risks in 20 possible areas of application for nanotechnology. Accordingly, sun protection products (average 3.15 on a scale from 1 to 5), food packagings (3.02), bio-sensors (2.92) and clothing (2.78) among others are regarded as particularly risky applications. Applications for car paint (2.43), photo-paper (2.32) and skis (1.99) etc are seen as less risky on the other hand.

3.2.4.2 Use in the food sector

Evaluation of the empirical studies shows that acceptance of nanotechnology has been examined most frequently up to now using the example of food and food packaging.[19] Tab. 10 gives an overview of the studies which have analysed specific sample applications.

As already mentioned above, the reason why foods have been examined so intensively has to do with the comparatively high level of scepticism towards nanotechnology in this area of application (cf. also Conti et al. 2011). The level of knowledge in this regard is also very low, however. Thus, for example, not quite one third of the German population has heard that nanoparticles are used as additives in food (Dialego AG 2010).

A finding that all of the evaluated studies have in common is that the use of nanomaterials for food packagings (*"nano outside"*) is more likely to be accepted than use with the foods themselves (*"nano inside"*) (e.g. Bieberstein et al. 2009, Siegrist et al. 2008, Stampfli et al. 2010, Rollin et al. 2011).

[19] Cf. Cook/Fairweather (2007), Siegrist et al. (2007a), Siegrist et al. (2008), Bieberstein et al. (2009), Marette et al. (2009), Siegrist et al. (2009), Vandermoere et al. (2009b), Dialego AG (2010), Stampfli et al. (2010), Frewer et al. (2011), Rollin et al. (2011) and TNS BMRB (2011).

In their evaluation of the literature on the seven different food-related technologies, including nanotechnology, Frewer et al. (2011) also come to the conclusion that a perceived benefit increases the **willingness to purchase** nanoproducts and that willingness to purchase can diminish if more possible risks are perceived. The former can also be seen in the study conducted by Siegrist et al. (2007a). Using the example of the products bread, tomatoes, juice and packaging, each with different nano-induced benefits (cf. Tab. 10), it becomes clear that a low perception of any **benefits** goes hand in hand with a low level of willingness to purchase. At the same time, however, it is also established that the perceived benefits are not a sufficient predictor of willingness to purchase because with the examined food packaging, the perceived benefit was considerably higher than the willingness to buy it. In a later study using the example of ice-cream and yogurt, Siegrist et al. (2009) observe that an additional health benefit attributable to the use of nanotechnology is hardly appreciated while an additional health-related benefit caused by natural additives can greatly increase willingness to purchase. According to TNS BMRB (2001), nano-applications are regarded as useful if, for example, they make unhealthy foods more healthy by reducing the salt or fat content without altering the taste.

Tab. 11: Examined examples in selected food-related nano-studies

Reference area	Study	Example(s) for food	Example(s) for food packagings
NZ	Cook & Fairweather 2007	Fat-reduced lamb and beef	None
CH	Siegrist et al. 2007a	Coated tomatoes with a longer shelf life, bread enriched with Omega-3 fatty acids, beta-carotene enrichment for juices	Antibacterial packaging for meat
CH	Siegrist et al. 2008	Individually alterable foods, health-promoting feed, dietary supplement capsules, antibacterial poultry feed, dietary supplements to prevent cancer, bread with a higher nutritional value, health-enhancing green tea, salmonella detector, bacteria recognition spray	Antibacterial milk bottles for babies, packaging film that prevents decay, antibacterial food packaging, oxygen-absorbing packaging, oxygen-filtering plastic bottles, stronger packaging film, UV-filtering packaging, barcodes for food safety
DE, FR	Bieberstein et al. 2009	Orange juice enriched with vitamin D	UV-filtering orange juice packaging
DE	Marette et al. 2009	Orange juice enriched with vitamin D	UV-filtering orange juice packaging
CH	Siegrist et al. 2009	Health-promoting ice-cream, health-promoting yogurt	None
FR	Vandermoere et al. 2009b	Foods enriched with vitamins and other substances, fat-reduced foods	Edible food coatings which maintain freshness
DE	Dialego AG 2010	Pouring aid for salt and spices; milk shakes/pizzas which change their taste; milk that changes colour when it goes off	None
CH	Stampfli et al. 2010	Individually alterable foods, dietary supplements that prevent cancer, bread with a higher nutritional value	UV-filtering packaging, packaging film that prevents decay, antibacterial food packaging
UK	TNS BMRB 2011	Foods with less salt, sugar, fat etc, foods with a higher nutritional value and/or higher vitamin levels, foods that satisfy hunger more quickly	None

Looking at the perceived **benefits** and perceived **risks**, it can also be seen that nano-packagings are perceived more positively overall than nano-foods (Siegrist et al. 2008, cf. Tab. 12). In the field of packaging too, however, the perceived risks can put the perceived benefits into perspective, as the example of antibacterial milk bottles for babies shows.

Tab. 12: Benefits and risks of various nano-applications in the food sector

Area of application, e.g.	Perceived benefit	Perceived risk
Foods		
Individually alterable foods	2.13	4.00
Dietary supplement capsules	2.49	3.50
Dietary supplements to prevent cancer	2.97	3.41
Bread with a higher nutritional value	2.65	3.35
Food packaging		
Antibacterial milk bottles for babies	2.57	3.26
Packaging film that prevents decay	3.15	2.74
Antibacterial food packaging	3.03	2.67
UV-filtering packaging	3.14	2.34

Question: "How beneficial (risky) do you consider each of the following applications to be for Swiss society as a whole?"'; possible answers on a scale from 1 (very low) to 5 (very high) (Siegrist et al. 2008, n=337)

That there can also be **cultural differences** regarding the acceptance of nanotechnologies in the food sector can be seen in the study by Vandermoere et al. (2009), which is based on a large random sample of the French population (n=752), as well as the study by Bieberstein et al. (2009) in which a French random sample (n=152) is compared with a German one (n=143). Though the acceptance difference between foods and food packaging may not be very great in the first survey (cf. Tab.), Bieberstein et al. (2009) conclude that – contrary to customary perception – the use of nanomaterials in foods is viewed less critically than their use in food packaging in France.

Tab. 13: Perceived risk-benefits ratio with foods and food packagings (Vandermoere et al. 2009b)

Reference area	Application	Percentage of approval among respondents			
		Benefits > risks	Benefits < risks	Benefits = risks	Rest
FR	Foods	16.6 %	32.9 %	42.8 %	7.7 %
	Food packagings	20.7 %	29.4 %	44.1 %	6.0 %

(Vandermoere et al. 2009b)

3.2.4.3 Synopsis

The overview shows that acceptance of nanotechnology depends on each area of application. It also becomes clear that:

- the perceived risk-benefit ratio has a decisive influence on acceptance
- the perceived benefits are not a sufficient predictor for a corresponding willingness to purchase
- the acceptance of applications close to the body (e.g. food) is lower than for areas away from the body (e.g. surface treatment, leisure equipment), with the exception of medical applications as some of these are associated with great benefits
- use in the food sector is viewed mainly critically and much more critically than in the food packaging sector
- country-specific differences in the perception of different areas of application can exist

3.2.5 Country-specific perception differences

Reference has been made several times in the preceding chapters to the fact that, depending on the country context, differences can exist not only in the awareness and level of knowledge of nanotechnology but also in the attitudes towards this new technology and its various application possibilities. This is best illustrated by the European comparative studies by Gaskell et al. (2006, 2010), as well as several other surveys.

In their meta-analysis of studies on new technologies in the food sector, Frewer et al. (2011) ascertain that Europeans are less optimistic about nanotechnology than Americans. On the other hand – according to Scheufele et al. (2008), who compared the data of the Eurobarometer (Gaskell et al. 2006) with those of an American random sample – respondents in the US agree significantly less often with the statement that nanotechnology is morally acceptable than respondents in most European countries. The authors attribute this to the comparatively high level of religiosity in the US, one factor among others which has far less of an influence on the acceptance of nanotechnology in Germany.[20] The US-related finding of the significance of religion for the perceived moral acceptance of nanotechnology is also strengthened by the literature study by Rollin et al. (2011) according to which the benefits of nanotechnology outweigh the risks among religious people to a lesser extent than they do with non-religious people.

Generally speaking, international comparative studies are seldom conducted on an empirical basis. Although differences are reported in the few available surveys, the influencing factors on which they are or could be based are not usually addressed.

3.3 Relevance of influencing factors on the perception of nanotechnology

The variables for measuring the factors that influence the perception of nanotechnology are analysed in more detail below. To this end, all of the individual evaluations are viewed which examine the dependence relationships between variables and establish in a narrower sense representative statements on the causes and characteristics of public perception of nanotechnology. This also means that studies which relate to the explanation of specific interpretative contexts (framing) (Schütz & Wiedemann 2008; Cobb 2005) or to methodological topics (Binder et al. 2011), as well as summarisations in the form of an overview (Macoubrie 2006; Rollin et al. 2011; Priest 2008) or technology benchmarks (Berube et al. 2011; Currall et al. 2006), are only taken into account in the margin of this evaluation. If the studies in question are disregarded, 42 studies remain which form the empirical core of the following analysis.

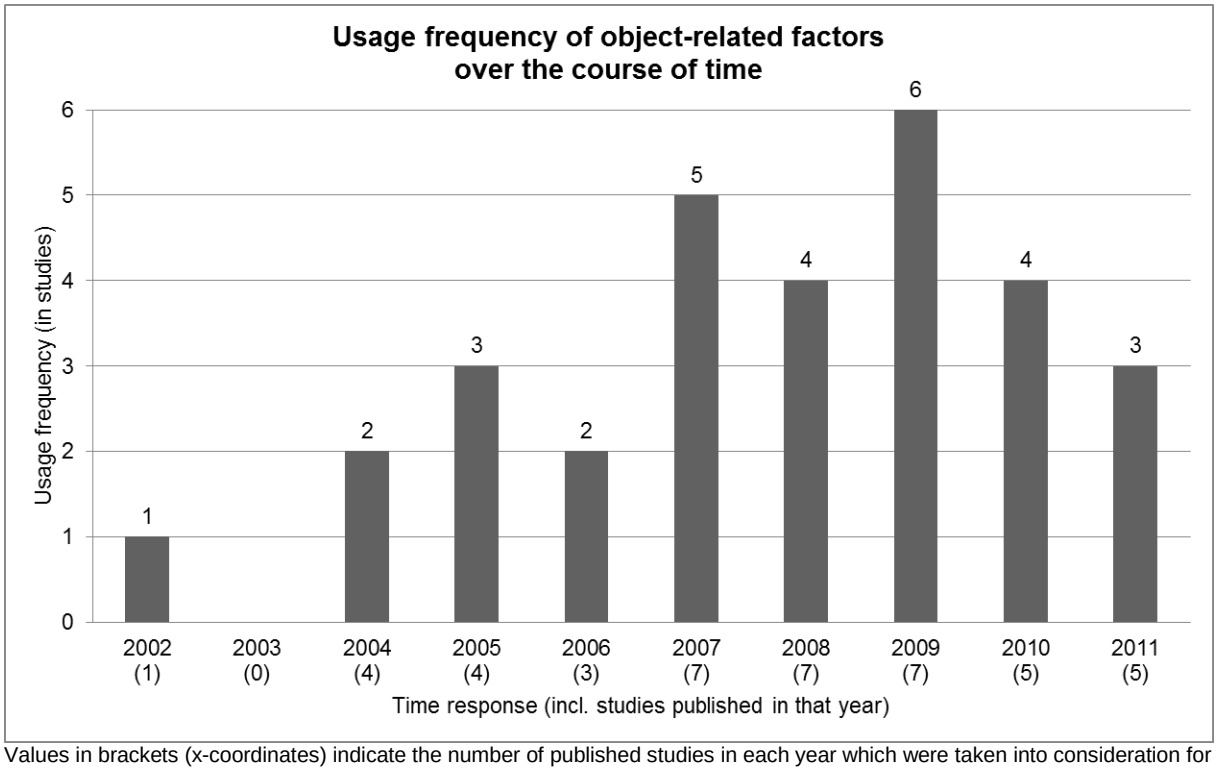
Beginning with the evaluations of the individual studies, the factors which influence perception of nanotechnology are subdivided initially into four categories: object-related factors, sociodemographic factors, psycho-social factors and others. Within each of these categories, findings from the studies under consideration are condensed in order to make general statements on general dependencies and trends. As a great many studies flowed into this analysis, some of these general statements are ambiguous. The different findings between the various studies result from varying study designs, explanation models and random sample properties. In cases of this kind, only tendency statements can be made regarding the dependencies and trends to be identified.

[20] This is also validated by the study by Vandermoere et al. (2009) according to which religious beliefs have very little significance in Germany where attitudes towaeds nanotechnology are concerned.

3.3.1 Object-related factors

Object-related factors pick up on attitudes which arise from the respondents' concrete engagement with the issue of nanotechnology. A total of 30 of the 43 studies taken into consideration survey object-related factors in order to set them in relation to characteristics of public perception of nanotechnology. Within the framework of the evaluated publications, they thus form the most frequently represented indicator category in terms of quantity along with the sociodemographic factors (see Chapter 4.2). Where the relevance of the object-related factors is concerned, no distinct development tendencies have been determined in the period since 2000; in fact, it can be seen that they constitute an important explanatory context in the majority of the publications and are still surveyed in this respect (cf. Fig. 2).

Fig. 2: Relevance of object-related factors over the course of time



Values in brackets (x-coordinates) indicate the number of published studies in each year which were taken into consideration for the analysis; the y-axis shows the number of studies which surveyed object-related factors in each respective year.

Distinct topic areas can be recognised within the object-related factors. An essential aspect is formed by those variables which indicate the **level of knowledge** or **familiarity** in relation to nanotechnology. The way and means in which these factors are measured differs greatly sometimes, however:

Several authors (e.g. Scheufele & Lewenstein 2005; Brossard et al. 2009) work with concrete questions on nanotechnology which survey factual knowledge of nanotechnology by allowing the respondents to answer with "true" or "false". Others (e.g. Cobb & Macoubrie 2004; Kahan et al. 2007) ask more non-specifically in their study designs by asking the respondents to state how much they have already heard about nanotechnology in their opinion. It is ultimately a question of the study design whether the epistemological interest tends to lie on the objective or subjective (in the sense of self-ascribed) level of knowledge.

It is conspicuous that most of the authors place their focus on the latter aspect, which makes good sense against the background of empirical epistemological interest. Interestingly, Scheufele & Lewenstein (2005) show that factual knowledge of nanotechnology among respondents suggests a higher level of knowledge of the subject than their self-estimation

would have us believe. That this self-ascribed level of knowledge still tends to be assessed as low is demonstrated in the study by Satterfield et al. (2009) in which they descriptively compare the values surveyed in various other studies. It can be seen here that when estimated subjectively, the majority of the population only has layman's knowledge if any at all.

With reference to the connections between estimations of knowledge levels and attitudes towards nanotechnology, the findings appear to be more neutral and dependent to a high degree on each of the variables which have to be explained. Where these affect the generally perceived risk-benefit ratio of nanotechnology, it becomes clear that in most cases the technology tends to be evaluated positively, with the expected benefits usually outweighing the risks, irrespective of the ascribed level of knowledge. On the basis of this general finding, several studies explicitly address the effects which result from an altered level of knowledge. The corresponding panel studies arrive at very different results, however. Peter Hart Research Associates (2008), for example, as well as Rosenbladt et al. (2007), show that what is already a positive estimation of nanotechnology is additionally enhanced by more familiarity. Gaskell et al. (2010) formulate a contrary finding for Europe, where public perception tended to become more critical between 2005 and 2010, but the extent to which these differences are marked by chronological and spatial differences remains open. Another variable which should be taken into account in this context concerns **general knowledge of science and technology**, which is alleged to have more of a positive influence on the acceptance of nanotechnology in several studies, including those by Lee & Scheufele 2006 and Lee et al. (2005).[21]

A second relevant group within the category of object-related factors comprises variables for the **risk and benefit perception** of nanotechnology, which are often used as explanatory variables for general acceptance or perception but which also permit significant conclusions on the willingness to purchase of potential users of nanoproducts.

Studies which survey both aspects (risks and benefits) and relate to general attitudes and acceptance (cf. Einsiedel 2005; Scheufele & Lewenstein 2005; Brossard et al. 2009; Cacciatore et al. 2011) have a fundamentally high estimation of the influence of risk and benefit perception. It is of little wonder here that the extent of the perceived benefits correlates with increasing approval and the extent of ascribed risks with increasing scepticism on the part of the respondents.

Scheufele & Lewenstein (2005) identify a link between risk-benefit perception and level of knowledge by determining that lay respondents who are relatively familiar with the subject of nanotechnology estimate its benefits as being significantly higher than others. Concurrent with this, Scheufele et al. (2007) establish that experts (very familiar with nanotechnology compared to lay people) have a perception of the benefits of individual areas of nanotechnological applications which is similar to significantly higher than those of lay people. Ho et al. (2011), who analysed the same data as Scheufele et al. (2007), combine the benefit perceptions for various areas of nanotechnological applications and arrive at the conclusion that the overall benefit perception determined in this way is significantly higher with experts than with lay people. This finding is contradicted by the results produced by Siegrist et al. (2007b), however, which ascertain that lay people (less familiar with nanotechnology compared to experts) estimate the overall benefits of the technology on a similarly high level as the experts. Where the perception of benefits is concerned, therefore, there is no clear connection between familiarity with the technology and the extent of the perceived benefit. This is different with risk perception where Siegrist et al. (2007b) observe that if risk perception is combined for different nanotechnological areas of application, lay people estimate the overall risk of nanotechnology to be higher than the experts do. Ho et al. (2011) also arrive at the result

[21] See also the significance of impulse in Chapter 4.3 in this regard.

that the overall risk perception of lay people is significantly higher than that of experts[22]. Scheufele et al. (2007) point out here though that there are clear differences in risk perception between experts and lay people where individual risks are concerned. Accordingly, the risk perception of experts regarding new health problems or environmental pollution through nanotechnology is more pronounced than that of lay people. Conversely, the risk perception of lay people regarding the loss of jobs or an arms race through nanotechnology is considerably stronger than that of experts.

There is a difference in the influence of risk and benefit estimations if, instead of the general attitude towards nanotechnology, the dependent variables focus on the concrete willingness to purchase products which nanotechnology was used to manufacture (see e.g. Siegrist et al. 2009; Stampfli, Siegrist et al. 2010). In this regard, it is above all the type of application which determines the influence of the perceived risks. Thus, for example, a perceived health benefit has hardly any effect on the consumer acceptance of "nano-foods", which tends to be low overall (Siegrist et al. 2009).

It would very much appear here that the **areas of application of nanotechnology** constitute a further relevant indicator in the context of object-related factors (cf. also Chapter 3.2.4). This estimation is supported by a number of other studies.

Several authors differentiate the perceived risk-benefit ratio as a dependent variable between various areas of application for nanotechnology (e.g. Siegrist, Keller, et al. 2007; Conti et al. 2011; Cacciatore et al. 2011; Gardner et al. 2010). As a general finding, Conti et al. 2011 ascertain that with reference to specific areas of application (in this case energy, food, medicine), the respondents generally tend to respond sceptically to nanotechnology, which is initially in contrast to the findings which relate to the non-specific perception of nanotechnology. In their study, which was conducted in the US, they did establish, however, that in relation, medical areas of application ("nano-pills") and nano-fuels tend to be perceived as more useful than applications in the food sector to which an above average risk is ascribed. Gardner et al. (2010) also implement a similar study design by asking American students about the expected risks and benefits of various nanotechnology application areas. The participants attribute a particularly high risk with low benefits to applications in the context of the manufacture of munitions; a high risk with equally great benefits to the field of medical applications and a low risk with great benefits to the field of data storage media and microchips, for example.

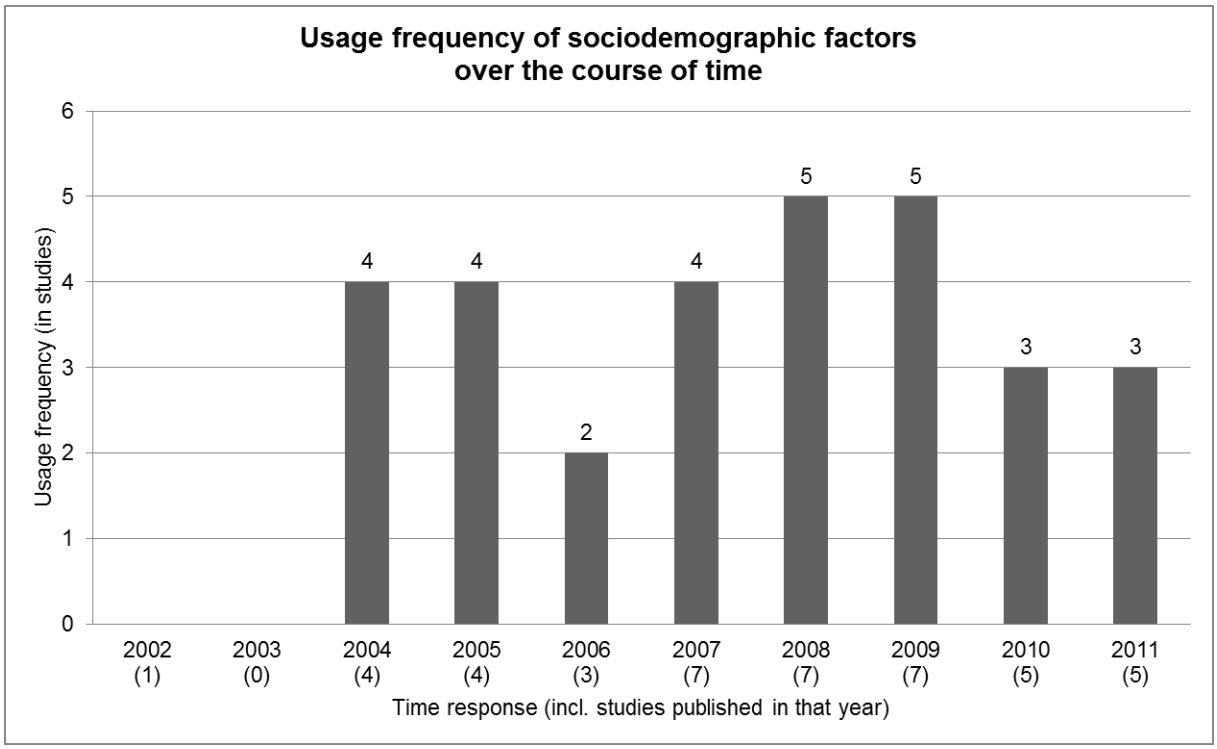
As it would appear that applications in the food sector constitute a particularly relevant case in the context of public perception, these are made the focus of research in some studies. Although willingness to purchase foods produced using nanotechnology is declining on average (Bieberstein et al. 2009), a distinction has to be made between applications in packagings ("*nano outside"*) and applications in the foods themselves ("*nano inside"*). If consumer acceptance as well as the perceived benefits in relation to the former tend to appear high, the latter are perceived very critically, at least in the German-speaking world (Siegrist et al. 2008; Stampfli, Siegrist et al. 2010). Interestingly enough, Bieberstein et al. (2009) ascertain the opposite where French respondents are concerned, which is why cultural differences can be presumed in this regard (see also Chapter 3).

[22] In the comparison of the results of Siegrist et al. (2007b) and Ho et al. (2011), it should be taken into account that Siegrist et al. (2007b) observe the risks of specific applications, such as medical nano-robots and car paints. The persons questioned were asked to state on a scale from one to five how great they estimated the risk of each application to be for (Swiss) society (from 1 = very low to 5 = very high). Ho et al. (2011), on the other hand, observed concrete risk scenarios for nanotechnology in which the study participants had to state on a scale from 1 to 5 the extent to which they agreed with each risk scenario (e.g. the scenario: "Nanotechnology can lead to a new arms race between the USA and other countries"). When comparing the results of Siegrist et al. (2007b) und Ho et al. (2011), it must therefore be taken into account that risk perception was compared with regard to different things, namely applications on the one hand and scenarios on the other. As we are dealing here with a qualitative comparison of different study results and not a quantitative meta analysis, reference is made in the continuous text in general and in the summary to the risk perception of nanotechnology without differentiating between the perception of the risks of applications and scenarios.

3.3.2 Sociodemographic factors

In addition to object-related factors, sociodemographic factors are a further important reference point for the explanation of public perception of nanotechnology which are still used in many studies.

Fig. 3: Relevance of sociodemographic factors over the course of time



Values in brackets (x-coordinates) indicate the number of published studies in each year which were taken into consideration for the analysis; the y-axis shows the number of studies which surveyed sociodemographic factors in each respective year.

Within the scope of the 30 studies which include sociodemographic factors in the explanatory model, variables relating to gender, age and education constitute a widespread triad which is surveyed in most explanatory models. These variables often form the first approach to contrasting the general attitudes, familiarity, risk-benefit estimations and consumer acceptance of nanoproducts.

Where **gender** is concerned, several interesting findings can be summarised in this regard. One finding which is confirmed by several authors (e.g. Smith et al. 2008; Vandermoere et al. 2009a) relates to the general level of knowledge of and familiarity with nanotechnology. In this connection, it was established that on average men know more about or ascribe themselves a higher degree of familiarity with nanotechnology than women. A similarly clear pattern is shown with regard to the risks and benefits perceived in the context of nanotechnology. Several authors (Kahan et al. 2007; Rosenbladt et al. 2007; Conti et al. 2011; Cacciatore et al. 2011; Ho et al. 2011) establish that men assess the benefits of the technology significantly higher than women who in turn perceive the risks to a greater extent (Siegrist et al. 2007; Kahan et al. 2008). The significance of gender is not seen as being as great in all studies, however. Cobb & Macoubrie (2004), as well as Brossard et al. (2009), for instance, only determine a moderate influence of gender on the perceived risk-benefit relationship. Where the willingness to buy nanoproducts is concerned, the influence of gender does not appear to be of any great consequence either (Siegrist et al. 2009).

It is not clear either what influence the variable **age** has on the perception of nanotechnology. Where the level of knowledge is concerned, for example, Smith et al. (2008) and Rosenbladt et al. (2007) conclude that it diminishes on average with increasing age. The results of the BMRB Social Research Study (2004) show, on the other hand, that respondents under the age of 35 as well as those over 54 have a lower degree of familiarity on average than participants in the middle age cohort. A third finding is formulated by Grobe et al. (2006) and Vandermoere et al. (2009b) in which they describe the influence of age as fundamentally low. The connection between the age of the respondents and their estimations of the risk-benefit ratio, which most authors assess as low, appears to be a bit more consistent (Cobb & Macoubrie 2004; Scheufele & Lewenstein 2005; Kahan et al. 2007; Conti et al. 2011; Cacciatore et al. 2011). Although Siegrist et al. (2008) do not establish any direct influence of age on consumer acceptance in relation to concrete applications of nanotechnology in the food sector, their study of 2009 (Siegrist et al. 2009) indicates that at least the benefits of nano-packagings tend to be assessed more highly by older respondents.

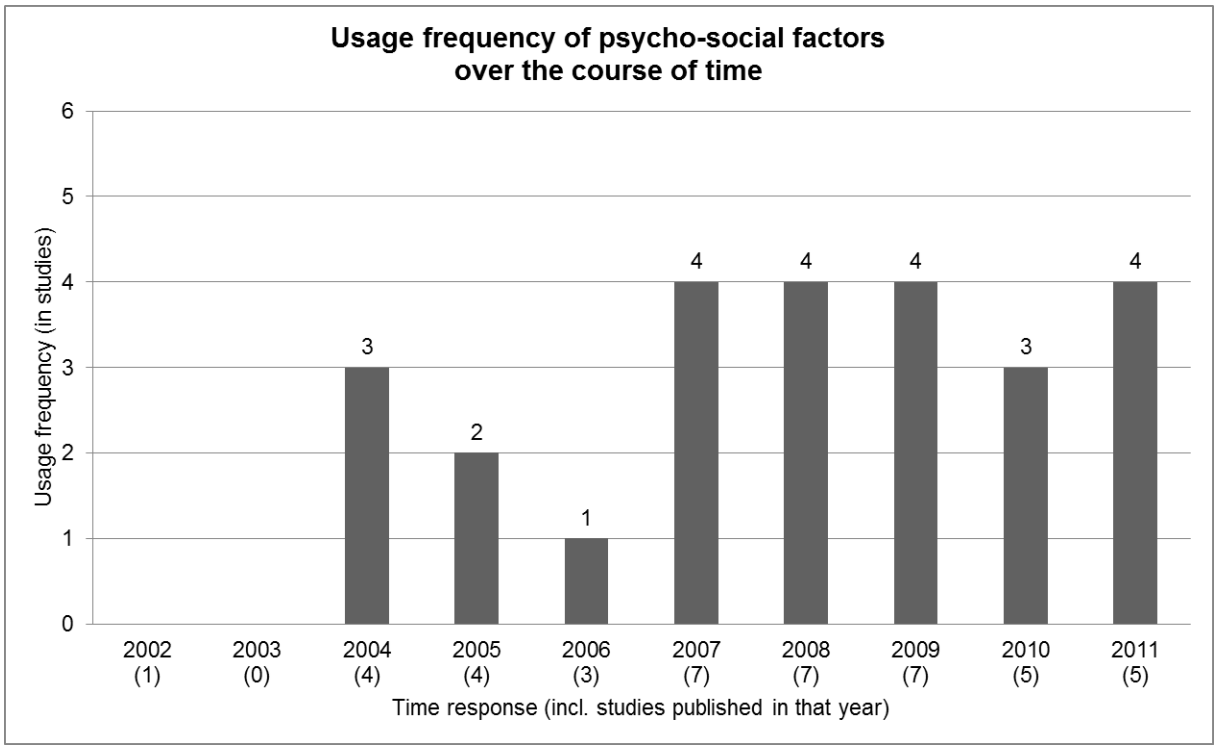
The third sociodemographic factor which is included in many of the studies under consideration is the **level of education** or **academic achievement** of the respondents. In this regard too, the recorded connections have to be viewed in different ways. In relation to the level of knowledge, several studies (Rosenbladt et al. 2007; Smith et al. 2008; komm.passion 2010; Vandermoere et al. 2009b) emphasise that higher education or academic achievement among the respondents correlate positively with knowledge of nanotechnology. Grobe et al. (2008) could not verify this finding, however, at least not for Germany and the German-speaking parts of Switzerland. In relation to basic attitudes and general approval, most studies identify a low (Einsiedel 2005; Cacciatore et al. 2011) to moderate (Bainbridge 2002; Scheufele & Lewenstein 2005; Brossard et al. 2009) influence of the level of education, if at all. The connection between education and perceived benefits and risks, on the other hand, would appear to be ambiguous, because where Conti et al. (2011) determine no significant influence, Cobb & Macoubrie (2004) describe it as great. Cacciatore et al. (2011) and Zimmer et al. (2008) also show that, on average, respondents with a higher level of academic achievement estimate the usefulness of nanotechnology to be higher.

Apart from the three indicators mentioned, which are generally widely distributed in the context of sociodemographic factors, various others are used more individually to explain public nano-perception. Interestingly, these also include **income**, which was surveyed only three times overall but which also appears to have only a moderate influence on knowledge of or attitudes towards nanotechnology (Scheufele & Lewenstein 2005; Conti et al. 2011). In the US, **ethnicity** also formed a variable which is ascribed a much higher influence on risk-benefit perception. The finding that the non-white population of America assesses nanotechnology as risky to an above average degree (cf. Kahan et al. 2008; Conti et al. 2011), whereas the white population tends to place more emphasis on the potential benefits is, however, presumably an expression of cultural embeddedness more than anything else, an aspect which is viewed along with others in more detail in Chapter 4.3. The study by BMRB Social Research (2004) also covers the possible influence of **migration backgrounds** on familiarity with or perceived future influence of nanotechnology for the UK without determining any significant dependency. A specifically German relationship is examined in the study by komm.passion (2008) in which the risk-benefit perception of **eastern and western Germans** is compared. No significant influence is determined for this variable either, however. Only Kahan et al. (2007) survey the influence of **parenthood** and **party membership**, neither of which permits any conclusions regarding significant dependencies. Interestingly, Kahan et al. (2007) detect a strong influence on risk-benefit estimation of the less specific variable of **political preferences** (liberal vs. conservative) in contrast to party membership, although the significance of implicit moral concepts and beliefs is certain to have an effect too in this context.

3.3.3 Psycho-social factors

The category of psycho-social factors is marked by a high level of variety, as cultural and emotional characteristics, as well as basic attitudes towards politics, religion and science were taken into account along with subjective values and norms. These have gained in significance in the course of time, especially within the last five years, as Fig. 4 shows. A total of 25 of the 43 studies taken into consideration use psycho-social variables to explain public perception of nanotechnology.

Fig. 4: Relevance of psycho-social factors over the course of time



Values in brackets (x-coordinates) indicate the number of published studies in each year which were taken into consideration for the analysis; the y-axis shows the number of studies which surveyed psycho-social factors in each respective year.

The objective measuring of psycho-social factors is fundamentally complicated as they are usually based on subjectively perceived impressions which are therefore more difficult for respondents to convey than sociodemographic or object-related factors. Within the scope of the studies taken into consideration, however, the authors found ways of determining these implicit attitudes by means of suitable indicators. Four areas are condensed here, each of which emphasises different aspects which are explained in more detail below.

A relevant psycho-social factor for explaining public perception of nanotechnology is formed by the **attitude towards science in general**, which is partially conveyed via **trust in science**, and/or the **recognition of scientific authorities**. In this regard, Lee & Scheufele (2006) establish a strong positive influence of trust in science on the acceptance of nanotechnology. This finding is supported by Vandermoere et al. (2009b) with regard to applications in the food sector. Another finding which is shared in many studies (e.g. Lee et al. 2005; Lee & Scheufele 2006; Ho et al. 2011; Retzbach et al. 2011) relates to the perceived benefits of nanotechnology which also correlate positively with trust in science. To complement this, Lee et al. (2005) establish that perceived risks decrease with stronger trust in science but that trust does not correlate with the level of knowledge of the respondents, which means that it is based more on basic emotional attitudes.

These **basic emotional attitudes** (*"affect"*) form another important area within the context of psycho-social factors. In particular when persons are asked about topics for the estimation of which they basically only have a lay person's knowledge, basic emotional attitudes or intuitive perception patterns constitute an important decision-forming reference. This was also verified by many authors for the field of nanotechnology. Emotions such as optimism or scepticism often relate to assessments of the benefits and risks of nanotechnology. Siegrist et al. (2007b and 2008) show, for example, that a negative basic attitude towards nanotechnology correlates with the presumption of low levels of control and also has a decisive effect in this regard on the extent of the perceived risks. If the basic emotional attitude to nanotechnology is positive, this correlation also works in the opposite direction in that the potential benefits of nanotechnology are perceived more strongly. That these affective attitudes towards nanotechnology are also influenced decisively by the **perception of other technologies** is shown by the likes of Bieberstein et al. (2009) when they place risk perception regarding nano-foods in relation to risk assessments in the field of genetically modified foods and establish a link in the perception patterns. Kahan et al. (2007) also detect the influence between the specific risk-benefit perception of nanotechnology and other areas, such as global warming, nuclear energy etc., which is an indication of principle basic attitudes and generalisable cognitive perception patterns in regard to various technology and/or risk areas.[23] Conti et al. (2011) focus their study on the fundamental **feeling of vulnerability** and establish that persons who regard themselves as exposed to external risks to a high degree, thus feeling powerless to a certain extent, also perceive the risks of nanotechnology more strongly.

Another area of psycho-social factors relates to **trust in social institutions** such as the health authorities, consumer protection, politics, industry and commerce. The studies by Siegrist et al. (2007a, 2007b) show here that greater trust in social institutions lowers the level of perceived risks and increases the expected benefits. With regard to the general approval and acceptance of nanotechnology, this estimation is shared in other studies too (Einsiedel 2005; Vandermoere et al. 2009a).

Finally, variables for surveying **general principles** and **political-cultural world views** comprise the most strongly overlapping category of psycho-social factors. In addition to **religiosity**, these establish themselves in the context of the studies under consideration in manifestations of **political affiliation** as well as the generally perceived **relationship between technology and nature**.

In combination with a country comparison, the study by Scheufele & Lewenstein (2005) explains the national differences in the public perception of nanotechnology through the **status of religion in each country**. In this regard, they show that the degree of religiosity in a population appears to have a decisive influence on its moral acceptance of nanotechnology. Other studies (Ho et al. 2011; Brossard et al. 2009) determine this dependence directly by identifying that religiosity correlates positively with the level of perceived risks and that general approval of nanotechnology drops.

Political affiliation in the context of the studies in question is more loosely defined and is not limited exclusively to **party membership**. This could explain, for example, the fact that Smith et al. (2008) ascertain a higher perception of benefits in the group of US Republicans than for Democrats and political independents on the one hand while Cacciatore et al. (2011) determine on the other a higher approval of nanotechnology among respondents who claim to have liberal values. This could also be set in relation to the findings of Gaskell et al. (2005) who assert that **progress-related values** (e.g. in the sense of *"economic growth brings better quality of life"*) have an influence on the assessment of the development perspectives of nanotechnology. Kahan et al. (2007) also identify in their study that depending on which

[23] The perceived proximity of nanotechnology and other areas of technology is addressed in comparative studies (Currall et al. 2006; Berube et al. 2011) which were also part of the individual evaluations (see annex).

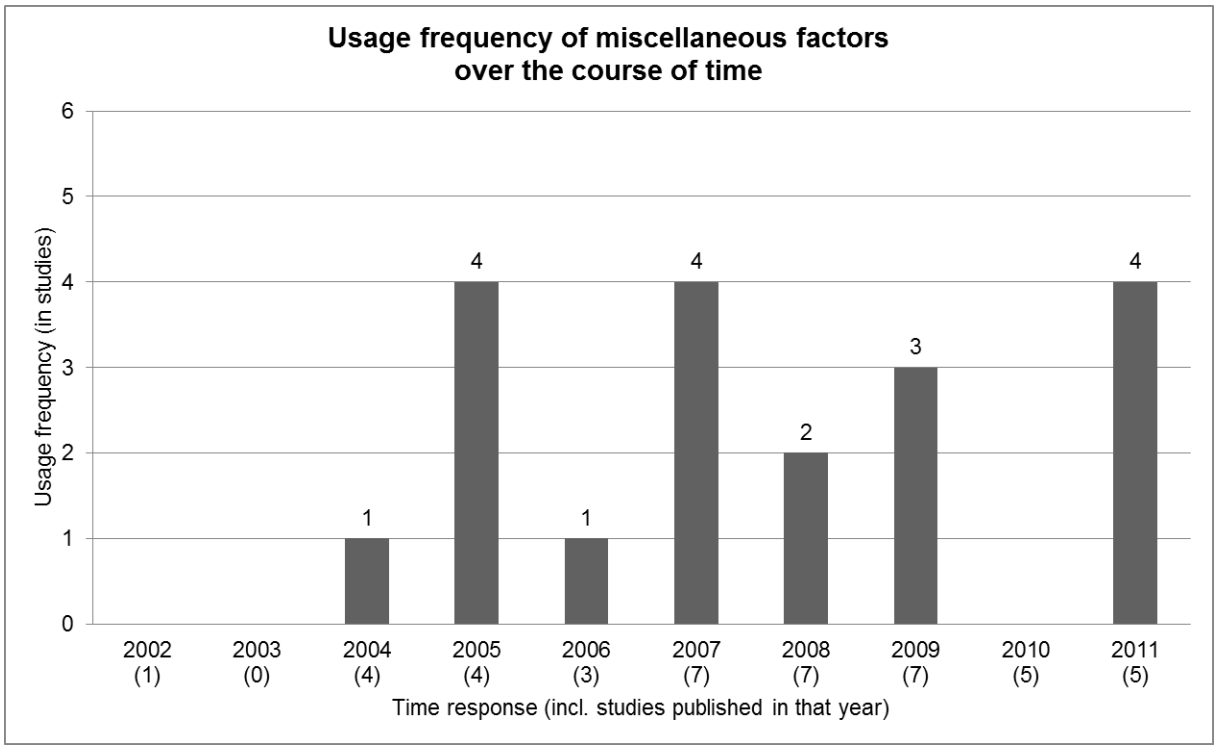
basic attitudes people have, additional information about nanotechnology can tend to have a positive or negative effect on their assessment of it.

In the context of variables for establishing the relation of technology and nature, the study by Kahan et al. (2008) determines that the expected risks of nanotechnology can be partially influenced by a general **fear of environmental risks**. The assessment of **human or technical interference in nature** is also empirically connected to the perception of nanotechnology. Vandermoere et al. (2009a) show that respondents who are critical of interventions of this kind also have a lower level of acceptance for the use of nanotechnology in the food sector. Moreover, Siegrist et al. (2008) also establish not particularly surprisingly that those respondents who prefer organic, healthy foods assess the benefits of nanotechnology as being significantly lower and the risks significantly higher.

3.3.4 Miscellaneous factors

Overall during the analysis of the studies under consideration, indicators were identified in 19 cases which could not be allocated to any of the aforementioned categories and were subsumed under “miscellaneous” for this reason. The graphic presentation of the frequency of use of miscellaneous factors over the course of time is as follows:

Fig. 5: Relevance of “miscellaneous” factors over the course of time



Values in brackets (x-coordinates) indicate the number of published studies in each year which were taken into consideration for the analysis; the y-axis shows the number of studies which surveyed other factors in each respective year.

Analysis of the content of this category shows that in essence, two areas emerge which have been used in various studies to explain public perception of nanotechnology.

One of them involves the **utilisation of scientific media**, which appears to have a relevant influence on both general acceptance as well as the perceived-risk-benefit ratio of the respondents. In this sense, the studies by Lee & Scheufele (2006) and Brossard et al. (2009) show that those respondents who keep up-to-date with science and technology topics

through newspaper articles and TV programmes approve more strongly of nanotechnology than others and that utilisation of the appropriate media also has a moderately positive effect on trust in science (only Lee & Scheufele 2006). The finding of the positive effect is confirmed by Scheufele & Lewenstein (2005), but they point out that this is triggered less by the informative character of the media (because those who take note of nano-reporting are already fairly well informed) and results much more from the opinion-forming effect of the media. That the utilisation of scientific media also influences the perceived risk-benefit ratio and has a positive effect on the evaluation of benefits and a critical effect with regard to the risks (Lee et al. 2005; Ho et al. 2011) supports the hypothesis that nanotechnology probably tends to be conveyed positively in scientific media.

In this regard, the findings of Bieberstein et al. (2009) in particular also appear to be of interest as they show that information on health risks significantly reduces willingness to buy nano-foods and that information on potential ecological or social effects also has a negative effect on this. This permits the assumption that additional information can lead to completely different effects depending on the message it conveys.

On the other hand, the **differentiation between lay persons and experts** is a factor which also has a significant influence on attitudes towards nanotechnology. Findings in this regard show that on average, lay persons assess the risks of nanotechnology in various areas of application higher than experts and also perceive a lower level of trust in state institutions (Siegrist et al. 2007b, 2007c). The study by Scheufele et al. (2007) underscores on the one hand that experts assess the benefits of nanotechnology higher on average while showing on the other that experts tend to be more sceptical than the general public where contamination and health risks are concerned as the general public expects potential risks, especially where the protection of privacy is concerned and with regard to negative economic effects (job losses).

3.3.5 Synopsis

The following table summarises the relevance of the various influencing factors on the perception of nanotechnology.

Tab. 14: Summary of influencing factors

Object-related factors
Object-related factors pick up on attitudes which result from the respondents' concrete engagement with nanotechnology. The following aspects are taken into account here: – In particular self-ascribed familiarity and/or self-estimation of the level of knowledge are factors of significance for many studies in the context of measuring public perception, even though the resultant effects do not produce a clear pattern; several studies confirm though that the acceptance of nanotechnology correlates positively with familiarity of the theme as a whole ("familiarity hypothesis"). – Variables for risk and benefit perception explain in particular the publicly perceived acceptance of nanotechnology. The relation to definite applications and specific benefits and risks results in different findings in the different areas of application of nanotechnologies.
Sociodemographic factors
Sociodemographic factors form an important category to trace difference in attitudes towards nanotechnology back to certain individual or milieu-specific characteristics: – Variables for surveying the gender, education level and age of the respondents are widespread. The first two in particular have been proven to have a significant influence on public attitudes towards nanotechnology. – In the US in particular, ethnicity forms a relevant, independent variable. Comparable findings for Europe only exist for the UK, but no connection was established there between migration background and perception of nanotechnology. In isolated instances, the explanatory content of parenthood, party membership and origin within Germany was examined, but no clearly significant conclusions could be drawn here either.

Tab. 14 (continued): Summary of influencing factors

Psycho-social factors
Psycho-social factors affect associations and ingrained interpretative patterns, which influence the perception of nanotechnology but which have their origin in more fundamental aspects of sociocultural embedding and subjective intuitions: – The gap which results when assessing nanotechnology due to a lack of knowledge of the subject is partly closed by basic emotional attitudes. Instead of knowledge of the technology, it is above all manifestations of affect which shape opinion in this regard. – Attitudes towards or trust in science in general have a decisive influence on perceptions of nanotechnology as it would appear that positive basic attitudes towards science tend to produce positive assessments of the specific technology. If respondents tend to be sceptical towards technical intervention in nature, the acceptance of nanotechnology also drops. – General trust in institutions also constitutes an aspect which has an influence on perception of nanotechnology. If the level of trust is high, the perception of risks diminishes on average while there is a corresponding increase in the perceived benefits. Other psycho-social factors which can have an influence on the perception of nanotechnology are to be found in religiosity, attitudes towards the relation between technology and nature, and political attitudes, although no clear dependencies can be generalised for the latter aspect in particular.
Miscellaneous factors
Two main areas emerge in the category of miscellaneous factors which affect the utilisation of scientific media on the one hand and allocation to expert and lay status on the other. – The reception of scientific media increases acceptance of nanotechnology as well as the level of its perceived benefits. – Examination of the risks associated with nanotechnology shows that they tend to be assessed higher by lay persons than by experts. Furthermore, the specific risks which can occur in concrete areas of application are assessed differently by lay persons and experts.

3.4 Notes on the design of the survey instrument

As already mentioned in the introductory chapter, the international literature study does not only serve the purpose of recording the trends and developments in public perception of nanotechnology and the factors which influence perception. It is also intended to provide tips for the revision of the questionnaire used by the BfR in the first representative survey (Zimmer et al. 2008).

3.4.1 General notes

Against the background that the **areas of application** of nanotechnology have a decisive influence on public perception, it only makes sense up to a point to talk about “the nanotechnology” without differentiation. It has to be assumed that the validity of the measurements will increase if the dependent variables are formulated as specifically as possible. Apart from references to concrete applications, this can be implemented by making reference to specific aspects of perceived acceptance (e.g. “How much sense does the public promotion of research and development make to you in the context of nanotechnology?”).

Einsiedel (2005) develops the hypothesis that public attitudes towards nanotechnology will differentiate with the further development of nanotechnology and the increase in generally accessible information. In the context of independent and in particular object-related factors, this means that variables which reflect the level of knowledge or familiarity will pick up on these trends and will have to adapt themselves to the sociotechnological development level of nanotechnology. Questions regarding familiarity, which only aim at the facts and circumstances concerning if or how much the respondents have heard about nanotechnology up to now may not go far enough in this regard. Here too, therefore, the variables will have to be-

come more specific if the variety of empirical facets are to be recorded with sufficient accuracy.

A few specific examples taken from the evaluation of the literature showing how the survey instrument can be structured are listed below.

3.4.2 Notes on the risk-benefit ratio

As already mentioned in Section 3.2.1, sum indices, which measure the benefit or risk on the basis of different statements, thus making them more nuanced than is possible by asking questions which can only be answered with “great”, “small” or “equal”, are being used more and more to measure the perceived ratio of benefits to risks (cf. Tab. 1).

Tab. 15: Items for the operationalisation of the perceived risk or benefit of nanotechnology

Item	Source(s)
Risk dimensions	
Economic risks	
Because of nanotech we may lose more U.S. jobs	Lee et al. 2005, Ho et al. 2011
Health risks	
Threat to my health	Retzbach et al. 2011
Nanotech may lead to new human health problems	Ho et al. 2011
Environmental risks	
Threat to the environment	Retzbach et al. 2011
Nanotech may lead to the uncontrollable spread of very tiny self-replicating robots	Lee et al. 2005, Ho et al. 2011
Nanotech may lead to more pollution and environmental contamination	Ho et al. 2011
Security risks	
Threat to mankind due to dangerous new weapons	Retzbach et al. 2011
Nanotech may lead to the loss of personal privacy because of tiny new surveillance devices	Lee et al. 2005, Ho et al. 2011
Nanotech may lead to an arms race between the United States and other countries	Lee et al. 2005, Ho et al. 2011
Nanotech may be used by terrorists against the United States	Ho et al. 2011
Benefit dimensions	
Health-related benefits	
Help to cure diseases	Retzbach et al. 2011
Nanotechnology may lead to new and better ways to treat and detect human diseases	Lee et al. 2005
Nanotechnology may give scientists the ability to improve human physical and mental abilities	Lee et al. 2005
Environment-related benefits	
Help to solve environmental problems	Retzbach et al. 2011
Nanotechnology may lead to new and better ways to clean up the environment	Lee et al. 2005
Security-related benefits	
Nanotechnology may help us develop increased national security and defensive capabilities	Lee et al. 2005
Other benefits	
Help to improve everyday products	Retzbach et al. 2011

Siegrist et al. (2007b) and Siegrist et al. (2008) extrapolate the risk dimensions used in their studies by way of contrast to established psychometric scales developed within the scope of measuring attitudes towards technological risks. Perceived risk is subdivided into eight dimensions in the study of 2007:

- Probability of contact with the application (1 never, 5 often)
- Probability of endangering health (1 very unlikely, 5 very likely)
- Concern about the risks (1 not concerned, 5 very concerned)
- Voluntariness of the risk (1 involuntary, 5 voluntary)
- Risk knowledge of those exposed (1 precise knowledge, 5 no knowledge)
- Negative health effects (1 none at all, 5 very severe)
- Control of the risk (1 controllable, 5 uncontrollable)
- Trust in state authorities responsible for risk management (1 no trust, 5 great trust)
- Ethical justification to further develop the application (1 not justified, 5 absolutely justified)

The following five dimensions are used in the study of 2008:

- Feelings in relation to the application (1 positive, 5 negative)
- Concern in relation to the application (1 not concerned at all, 5 very concerned)
- Personal control over contact with the application (1 uncontrollable, 5 controllable)
- Voluntariness posed by the application (1 involuntary, 5 voluntary)
- Negative health effects due to contact with the application (1 none at all, 5 very severe)

3.4.3 Notes on attitudes and other psycho-social factors

Questions were asked in many different ways about attitudes to nanotechnology in the BfR survey of 2007 (Zimmer et al. 2008), e.g with a view towards the acceptance of the areas of application, the perceived ratio of risks to benefits, willingness to buy nanoproducts, trust in certain social institutions and the potential for Germany as a location. Typical behaviour patterns when dealing with nanotechnology were another important means of access. The names of these behaviour patterns as well as the statements used for their operationalisation are listed in Tab. .

Tab. 16: Items for the operationalisation of typical behaviour patterns when dealing with nanotechnology

Statement	Typical behaviour pattern
Nanotechnology should be advanced but there should also be an awareness of possible risks.	Pragmatism
Using the example of nanotechnology it can be seen how many surprisingly new findings are possible.	Open to new ideas
I think it's great to live in a world which keeps on progressing through new advancements like nanotechnology.	Naive optimism
Nanotechnology will open up fantastic opportunities for technical development.	Visions
With my knowledge of science I can just about understand what nanotechnology is all about.	Parallel visualisation
It's really scary if you think how many nanoproducts are supposedly already on the market	Inversion fears
I don't think much of modern technologies like nanotechnology.	Development refusal

(Zimmer et al. 2008)

The overview shows that the attitude characteristics relate in the main to attitudes towards **progress in science and technology**. In addition to this, possible **concern** due to rapid market penetration is addressed ("It's really scary if you think how many nanoproducts are supposedly already on the market") along with the aspect of (cognitive) **control** over the subject of nanotechnology ("With my knowledge of science I can just about understand what nanotechnology is all about"). As is made clear in Section 3.3.3, above, which deals with the influ-

ence of psycho-social factors on the perception of nanotechnology, several attitude aspects are disregarded which could be relevant in a new survey of the German population:[24]

- **Fear of environmental risks** and/or the **assessment of human or technical interference in nature**
- Perception of personal **vulnerability** (Conti et al. 2011)
- **General support for** nanotechnology, e.g. measured by concurrence with a statement such as "Public promotion of nanotechnology" (e.g. Scheufele/Lewenstein 2005, Brossard et al. 2009, Ho et al. 2011)
- Perceived **social benefits** of nanotechnology, e.g. measured by concurrence with a statement such as "Nanotechnology is useful for society" (e.g. Cacciatore et al. 2011)
- **Moral acceptance** of nanotechnology, e.g. measures by concurrence with a statement such as "Nanotechnology is morally acceptable" (e.g. Scheufele et al. 2008)

These attitude-related aspects should be given due consideration when revising Question 19.

Beyond these attitudes, the **affective reactions** to the subject of nanotechnology have been measured in the questionnaire used up to now on the basis of the question "What is your overall feeling about the subject of nanotechnology"? This question can be dispensed with under certain circumstances as the influence of affective variables on opinion formation diminishes the more information that is acquired.[25] Whether the current level of knowledge among the population is sufficient for this remains an open question, however.

3.4.4 Notes on framing

Some studies work with so-called frames, which are different interpretative contexts for nanotechnology relating to the benefits and risks or other factors relevant to perception.

Kahan et al. (2007), for example, use a relatively simple framing concept. The random sample is divided up into two groups, one with and one without advance information. The former is given information on the benefits and possible risks of nanotechnology. This frame is used to measure the influence of additional information on perception. Stampfli et al. (2010) use a similar approach by giving half of their random sample information on the possible risks of nanotechnology which the other half does not get.

The framing approach used by Cobb (2005) differentiates a bit more by testing the influence of ten different frames on public perception of nanotechnology. The frames used either do not touch on the benefits or risks (neutral framing), emphasise the benefits or the risks (one-sided framing) or mention benefit as well as risk aspects (two-sided framing). The random sample is divided up along the different frames. It can be seen here among other things that:

- the overall effects of framing are low, especially with well-balanced frames
- frames on specific risks or benefits of nanotechnology have a greater influence on the perception of nanotechnology than general frames on the value of science
- frames which depict nanotechnology as particularly risky prove to be only marginally more effective where perception of the technology is concerned than those which portray nanotechnology as particularly beneficial.

[24] Aspects such as religiosity and political attitudes appear to be less relevant to the German context, however.
[25] With reference to Kahan (2008), the likes of Satterfield et al. (2009, P.756) write: "*(…) a second study found perceptions to be largely 'affect driven', although more informed persons relied less on affect (…)"*.

In this specific instance, however, and as the author admits, the surprisingly low influence of framing and the high level of consistency of public opinion can be attributed to the attitude of Americans towards nanotechnology - which is very positive overall.

In Conti et al. (2011) on the other hand, so-called “narrative scenarios” are used for framing. In these scenarios, the variables “risk assessment by scientists”, “controllability”, “penetration into the body” and “social justice” are each combined with positive and negative characteristics for selected areas of application (nano-foods, nanopills and nanofuel). Different acceptance values for the application of nanotechnology in the selected areas result, depending on how the characteristics in the narrative scenarios are “set”. Methodologically, this approach goes beyond Cobb (2005) because framing can be differentiated more or less at will, depending on the number of variables taken into consideration and their characteristics.

A limiting factor for the degree of differentiation of framing is, however, the size of the random sample, because an additional sub-random sample has to be formed with each additional differentiation.

3.4.5 Miscellaneous notes

As the evaluation of the international studies shows, public perception of nanotechnology depends among other things on the risks associated with it. The role played here by the **sender of the risk messages**, which means to be more precise the **principles of experts** as perceived by the general public, was examined by Kahan et al. (2008). It transpired here that the connection between perception of the risks of nanotechnology and individual ideological convictions may be reversed. This occurred with particularly great probability when an expert with whose perceived opinion a respondent sympathised was ascribed a statement which deviated from the actual opinion the respondent had previously held. The authors explain this with the assumption that the respondents trust the expert due to socio-cultural affinity. This qualitative aspect of perceived risk information should be taken into account in the updated survey if possible, as this can have implications for the planned development of risk communication concepts.

Whereas the estimation of the risk-benefit ratio with the use of nanotechnology in food packaging is influenced to an equal extent by **cognitive factors** (sociodemographics and knowledge) and psycho-social factors, the influence of **psycho-social variable**s dominates with use in foods. This means on the one hand that the relative influence of these factors should be determined in relation to certain areas of application and on the other that the conveyance of additional information alone will not be sufficient in risk communication to win over more supporters for an application, in this instance in the food sector.

3.5 Synopsis of the international study comparison

The evaluated studies show that there are different ways of measuring perception of nanotechnology in the population. For this reason, it should be made clear in each instance which perception measure is being used as the basis when analysing the factors that influence perception.

The following can be concluded concerning **awareness and knowledge of nanotechnology**:

- In many European countries (e.g. Germany, Switzerland, Scandinavia) and the US, at least roughly two thirds of the population have currently heard of nanotechnology. Up to one third of the population is not familiar with the term.

- In a European comparison and also in comparison with the US, the awareness level in Germany is high. Only in the Scandinavian countries and Switzerland are higher levels of awareness achieved.
- The majority of those in Germany who have already heard of nanotechnology assess their own level of knowledge as low. At the same time though, roughly a third of this section of the population can define nanotechnology fairly exactly. A number of areas of application can also be linked with the term.

The following conclusions regarding **attitudes towards nanotechnology** can be drawn from the analysed empirical findings:

- If the population is asked about its attitude towards nanotechnology without providing any information in advance, answers are mainly positive and only negative to a much lesser extent. At the same time, a considerable proportion of the population is still undecided in this regard.
- It can also be seen that a lower proportion of undecideds in the population does not automatically go hand in hand with a correspondingly high proportion of people with a positive attitude. Fewer undecideds can also mean that there are more people with a critical attitude, which indicates that predictions regarding opinion formation with regard to nanotechnology are difficult.
- If respondents are asked about their attitude towards nanotechnology after they have been provided with information, the assessment of the technology depends on the type of information given, i.e. the frame. The tendency is that the less that framing emphasises the risks, the more positive attitudes tend to be.
- Compared to other technologies, such as GMOs or animal cloning, the population tends to have a positive attitude towards nanotechnology.

The evaluation of the studies also shows that the acceptance of nanotechnology depends on each **area of application**. It also becomes clear that:

- the perceived risk-benefit ratio has a decisive influence on acceptance
- the perceived benefits are not a sufficient predictor for a corresponding willingness to purchase
- the acceptance of applications close to the body (e.g. food) is lower than for areas away from the body (e.g. surface treatment, leisure equipment), with the exception of medical applications as some of these are associated with great benefits,
- use in the food sector is viewed mainly critically and much more critically than in the food packaging sector and
- country-specific differences in the perception of different areas of application can exist.

With regard to the factors which influence public perception of nanotechnology, we arrive at the following results within the scope of the study evaluation:

Object-related factors pick up on attitudes which result from the respondents' concrete engagement with nanotechnology. The following aspects are taken into account here:

- In particular self-ascribed familiarity and/or self-estimation of the level of knowledge are factors of significance for many studies in the context of measuring public perception, even though the resultant effects do not produce a clear pattern; several studies confirm though that the acceptance of nanotechnology correlates positively with familiarity with the theme as a whole ("familiarity hypothesis").
- Variables for risk and benefit perception explain in particular the publicly perceived acceptance of nanotechnology. The relation to definite applications and specific benefits

and risks results in different findings in the different areas of application of nanotechnology.

Sociodemographic factors form an important category to trace differences in attitudes towards nanotechnology back to certain individual or milieu-specific characteristics:

- Variables for surveying the gender, education level and age of the respondents are widespread. The first two in particular have been proven to have a significant influence on public attitudes towards nanotechnology.
- In the US in particular, ethnicity forms a relevant, independent variable. Comparable finding for Europe only exist for the UK, but no connection was established there between migration background and perception of nanotechnology.
- In isolated instances, the explanatory content of parenthood, party membership and origin within Germany was examined, but no clearly significant conclusions could be drawn here either.

Psycho-social factors affect associations and ingrained interpretative patterns, which influence the perception of nanotechnology but which have their origin in more fundamental aspects of sociocultural embedding and subjective intuitions:

- The gap which results when evaluating nanotechnology due to a lack of knowledge of the subject is partly closed by basic emotional attitudes. Instead of knowledge of the technology, it is above all manifestations of affect which shape opinion in this regard.
- Attitudes towards or trust in science in generally have a decisive influence on perceptions of nanotechnology, as it would appear that positive basic attitudes towards science tend to produce positive assessments of the specific technology. If respondents tend to be sceptical towards technical intervention in nature, the acceptance of nanotechnology also drops.
- General trust in institutions also constitutes an aspect which has an influence on perception of nanotechnology. If the level of trust is high, the perception of risks diminishes on average while there is a corresponding increase in the perceived benefits.
- Other psycho-social factors which can have an influence on the perception of nanotechnology are to be found in religiosity, attitudes towards the relation between technology and nature, and political attitudes, although no clear dependencies can be generalised for the latter aspect in particular.

Two main areas emerge in the category of **miscellaneous factors** which affect the utilisation of scientific media on the one hand and allocation to expert and lay status on the other:

- The reception of scientific media increases acceptance of nanotechnology as well as the level of its perceived benefits.
- Examination of the risks associated with nanotechnology shows that they tend to be assessed as higher by lay persons than by experts. Furthermore, the specific risks which can occur in concrete areas of application are assessed differently by lay persons and experts.

3.6 International experts' workshop

The results of the international literature study were put up for discussion within the scope of an international experts' workshop in which eleven scientists from seven European countries participated in addition to the project team. In the course of one day, the results of the literature evaluation were presented and, using this as the basis, the survey instrument for the subsequently conducted representative survey was revised.

In the discussion of the literature study, it was pointed out that the differences between terms such as “attitude”, “opinion” and “perception”, which are used frequently in the studies, should be clearly emphasised. It was also noted that the consideration of qualitative studies (e.g. consumer conferences, citizens’ dialogues, focus groups) can provide additional empirical information on the factors which influence the perception of nanotechnology. It was emphasised in conclusion that where the benefits and in particular the risk aspects of nanotechnology are concerned, the discourse has to be application-specific and not general.

With a view towards the further development of the survey instrument of 2007 (Zimmer et al. 2008), the following suggestions resulted from the discussion in the afternoon:

- The risk-benefit estimation of nanotechnology should be surveyed not only in general but also specifically for each application. When presenting the benefits, for example, the concrete functional effect of a nanotechnology application should be underscored as otherwise it has to be assumed that only the relevance of the area of application will be evaluated (e.g. medical technology always evaluated as more beneficial than cosmetics).
- Consideration of the effect of different interpretative contexts (“framing”) on the perception of nanotechnology in the new survey was welcomed. It is important here to formulate the frame in such a way that the possible risks are also mentioned in addition to the potential benefits.
- Specific questions on consumers’ information needs should be supplemented.

4 Representative Population Survey

4.1 Introduction

4.1.1 Background and objective

While the number of nanoproducts is increasing and the relevance of this basic technology is growing in the everyday life of consumers, the level of knowledge among the population with regard to the potential and possible risks of this technology is still low. This was already the finding of the representative survey conducted by the BfR in 2007 (Zimmer et al. 2008), and this was confirmed by the evaluation of the international empirical studies (cf. Chapter 2). But what about current perceptions of nanotechnology in Germany? How have they changed since the last survey? A further representative survey was conducted to answer these questions. The specific aim was to determine how the population perceives nanotechnology in consumer-related fields of application and which factors influence these perceptions. The new survey was also designed to provide answers to questions such as the following:

- What does the population know about nanotechnology and where do people obtain their knowledge on the issue?
- Does the population perceive nanotechnology more from the point of view of risk or rather from the perspective of potential benefits?
- What hopes and fears do people associate with nanotechnology?
- How does perception of nanotechnology vary in dependence on its fields of application and the context in which it is laced - for example, if the potentials of nanotechnology are outlined without mentioning potential risks?
- Have there been changes in the perception of nanotechnology since the BfR survey on nanotechnology in 2007 (Zimmer et al. 2008)? If so, what is the direction of the trend, and what are possible reasons for these changes?
- Which target groups - for the purpose of risk communication, for example - can be identified based on the empirical data?

In order to find answers to these questions, a survey design was chosen that not only permits comparisons with the findings of the first survey of the BfR but also addresses content-related aspects that reflect the current status of the debate on the perception of nanotechnology. This includes the question of whether the provision of different kinds of information (or interpretative contexts) has an influence on perception ("framing") as well as the question of whether there are groups in society that strongly resemble or differ from each other in terms of their perception patterns ("nano-types") - and how these patterns can be classified in a model of social milieus.

4.1.2 Procedure

4.1.2.1 Questionnaire

A survey instrument was developed that includes major parts of the 2007 questionnaire while adding several new elements. These new elements cover the following aspects:[26]

[26] Also see the full version of the questionnaire in Annex 9.2.1.

Tab. 17: Comparison of 2007 and 2012 survey instruments

Topic	2007 version	2012 version
Introduction	Greeting	Greeting
	Screening (age, gender)	Screening (age, gender)
Unaided survey	Status of nanotechnology	Status of nanotechnology
	Spontaneous knowledge (open question)	Spontaneous knowledge (open question)
Aided survey	Information on nanotechnology (short)	Information on nanotechnology (short, long)
	Assessment of own knowledge	Assessment of own knowledge
	Support for/Rejection of applications	Support for/Rejection of applications (updated)
	Assessment of risk/benefit (general)	Assessment of risk/benefit (general)
		Assessment of risk/benefit (based on applications)
	Willingness to buy	Willingness to buy
Sources of information	Feeling of being informed	Feeling of being informed
	Sources of information	Sources of information
	Trust in institutions	Trust in institutions
	Trust in the government	Trust in the government
		Need for information
		Need for action by official bodies
Attitudes	Feeling about nanotechnology (affect)	Feeling about nanotechnology (affect)
	Attitudes towards nanotechnology	Attitudes towards nanotechnology (updated and extended)
Characteristics of respondents	Sociodemographic characteristics	Sociodemographic characteristics
		Indicator for social milieus

- Two questionnaire versions were compiled: one version that uses only a very short and neutral description of nanotechnology for the aided questions, and one that provides comprehensive information on the potential and risks of nanotechnology alongside this short description. The aim was to examine potential effects of different interpretative contexts on the perception of nanotechnology.
- The list of areas of application was slightly shortened and updated. Four of the applications from 2007 were included and six new or modified applications added.
- Assessment of the risk-benefit ratio was surveyed not only generally with regard to nanotechnology but additionally for the chosen applications.
- An open question on the information needs of consumers and the need for action by official bodies was included in the new questionnaire in order to obtain information that could be used for the drafting of the risk communication concepts (cf. Chapter 0).
- The question on attitudes towards nanotechnology was extensively revised. Only two of the seven original statements were included in the new questionnaire, and were joined by 14 new statements formulated on the basis of the literature evaluation (cf. Chapter 2). The attitude catalogue was also extended as it constitutes an important input for the development of different nano-types (cf. Chapter 4.5).
- Finally, an indicator for the determination of social milieus made up of twelve individual statements was included in the questionnaire in order to permit allocation of respondents to different societal groupings.

4.1.2.2 Milieu approach

The model of "socio milieus", made available for this purpose by the *sociodimensions* company, was used for the operationalisation of the social milieus. The detailed version of the model depicts ten social milieus (see Fig. 6) that differ with regard to the axes "social status" and "sociocultural characteristics" (Schipperges 2010). For reasons of survey economy, the ten segments were condensed into five segments to suit the context of the survey (see Fig. 7 and cf. Chapter 4.5).

Fig. 6: Model of "socio milieus"

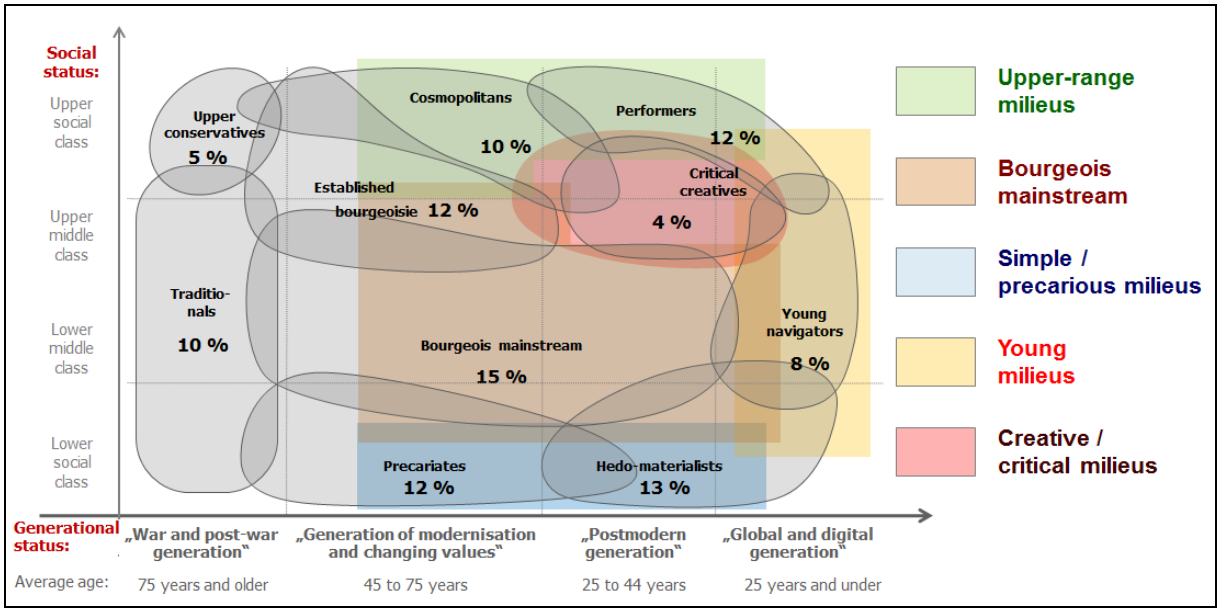
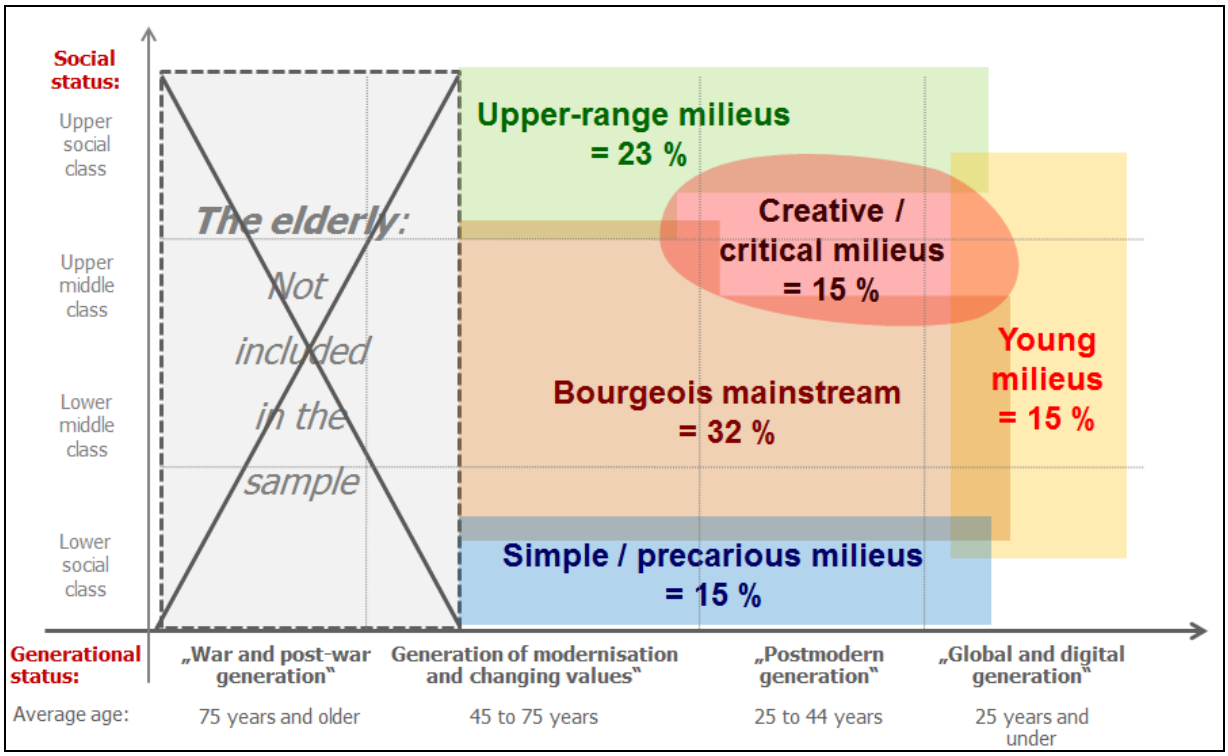


Fig. 7: The "socio milieus" model condensed into five milieus



The five social milieus used in the study are profiled in factfiles in the following tables.

Tab. 18: Factfile "upper-range milieus"

Sociodemographics
- Middle-aged groups and "best agers": 86 % are between the ages of 46 and 60 - Higher educational qualifications are over-represented: 40 % of the sample have a degree from a university (of applied sciences) - Above-average incomes: 67 % of the sample have a net monthly household income of (slightly or well) over 2,500 € - 67 % are in full-time employment - Highest share of respondents without migration background (88 %)
Life-world
- Focused on success and well-off thanks to their own efforts - Performance-oriented and optimistic, pragmatic and focused on achieving what is feasible - Optimistic with regard to the solution of current problems - High standards: "I sometimes consciously treat myself to the very best quality" (applies fully to 76 %) - Life motto: proud of achievements; goal is to maintain and enjoy these achievements

Tab. 19: Factfile "bourgeois mainstream"

Sociodemographics
- Broad age spread with slight over-representation of the middle-aged groups - Average formal education: 42 % of the sample have a mid-level secondary school qualification - Average incomes are over-represented: 41 % have a net monthly household income of roughly or slightly below 2,500 € - People in full-time employment are over-represented (63 %) - 84 % do not have a migration background - more or less in line with the figure for the population overall
Life-world
- Self-image as "centre of society", but increasing fear of loss of social status - Desire for social and job security; willingness to undertake efforts to achieve these goals - but doubts over whether they can achieve them - Consumption and convenience-oriented with high value-for-money awareness - Life motto: be part of the whole, be integrated

Tab. 20: Factfile "simple/precarious milieus"

Sociodemographics
- All age groups; people above the age of 50 are slightly over-represented in the sample (33 %) - Low-level formal education: people with lower or mid-level secondary education are over-represented (74 % in total) - Lowest incomes of all the milieus: 57 % have a net household income of well below 2,500 € - People who are not or are no longer in employment are over-represented (18 %) - People born outside German are also slightly over-represented (10 %)
Life-world
- Getting things sorted out, stick to and keep their job, take care of themselves and the family, master the daily routines - Participation in the affluent and consumer society is severely restricted - Resigned attitude with regard to future prospects: "There's little chance that we'll be able to make something of our lives" (55 % say they agree fully or generally with this statement) - Life motto: to get by

Tab. 21: Factfile "creative/critical milieus"

Sociodemographics
- Predominantly younger and middle age groups from 25 to 45
- People with higher-level educational qualifications are over-represented: 40 % of the sample have a degree from a university (of applied sciences)
- Broad range of different incomes; 55 % of the sample have a net household income of (slightly or well) over 2,500 €
- Employment levels and figures for migration background are in line with those of the population overall
Life-world
- Well informed, liberal, tolerant: "I like to live in an environment that allows me to meet totally different kinds of people" (82 % agree fully with this statement)
- Self-expectation of being mentally agile, forming their own opinion, contributing their own ideas and providing stimuli
- Wide-ranging intellectual and cultural interests; focused on autonomy and self-realisation
- Life motto: viewing things critically, living a responsible and meaningful life

Tab. 22: Factfile "young milieus"

Sociodemographics
- The youngest group: less than 52 % of the sample are below the age of 20
- Mid and high-level formal education (38 % have uni entrance qualification, 11 % do not yet have a secondary school qualification)
- One in two (49 %) are still in education/training
- Highest percentage of people who live in households comprising more than 4 people (parental family)
- Respondents tend to have low to medium incomes – dependent on parents
- Highest percentage of 2nd generation immigrants: 24 % of parents were born outside Germany
Life-world
- Digital natives; they take the globalised world for granted
- The future is full of uncertainty and not really plannable; they want to hold their own in the competitive arena and are aware that they have to be flexible and mobile
- At the same time, they are in search of dependability, roots and orientation; relationships and being part of a family are therefore extremely important to them
- Life motto: to find my place

This questionnaire design allows wide-ranging comparison of the surveys conducted in 2007 and 2012. At the same time, the new survey permits more concrete statements on the perception of nanotechnology in terms of specific applications, different perception types and based on different information levels on the topic of nanotechnology.

4.1.2.3 Sample and field phase

As was the case in the 2007 BfR survey, (Zimmer et al. 2008), the universe for the new survey corresponds to the German-speaking population between the ages of 16 and 60. A representative sample of 1,000 persons (= main sample) was drawn from this universe; the members of the main sample are reachable by phone via the German landline or mobile network.[27]

[27] In order to meet the requirement of representativeness in the best possible way, access to the respondents was via a random sample based on a public telephone directory. Sampling in accordance with the concept developed by the ADM Working Group of German Market Research Institutes was used for this purpose. The ADM telephone selection basis is a pool of phone numbers from the German landline and mobile phone network managed by the ADM and provided in an annually updated form.

The respondents in the main sample were given the brief introductory text on the issue of nanotechnology. A further representative additional sample (n=200) was given not only this brief introduction but also slightly more detailed information on nanotechnology (see Annex 9.2.1). In total, therefore, 1,200 persons were surveyed. As in 2007, the survey was conducted in the form of a computer aided telephone survey.

The initial phase of the main survey was designed as a pre-test phase, supplying a first data set with n=67 cases after three survey days. Viewing and analysis of this data and the experiences of the market research institute in the first round of interviews resulted in minor changes and additions to the questionnaire.[28]

The interviews were conducted by interviewers of the firm "aproxima Gesellschaft für Markt- und Sozialforschung Weimar" in the period from 23 April 2012 to 16 June 2012 with a break from 26 April to 6 May (for the viewing of the pre-test data). The interviewers received in-depth training on the issue of nanotechnology. The interviews lasted an average 22 minutes.[29]

4.1.2.4 Data evaluation

The data analyses were performed using SPSS. After the data set was monitored, checked and weighted, the next task was to compile descriptive analyses. This involved tabulation of the entire question material in order to gain a first overview of findings. The variables used for the table headings were:

- firstly, the sociodemographic characteristics age, gender, education, size of household, net household income, employment and migration background
- secondly, the different interpretative contexts (frames)

Then, the measures of central tendency (means) and measures of dispersion were calculated, as were the bivariate relationships between individual variables (correlations). Inferential statistical methods were used to test for significant differences. These tests were performed for all relevant questions with the focus on the influence of sociodemographic variables and different interpretative contexts (frames).

Category systems were developed for the open questions (spontaneous knowledge, information needs, expectations of government bodies). The open-ended mentions were assigned to the categories and included in the data set as variables.

Factor analysis was performed for statement batteries (attitudes towards nanotechnology, applications) with the aim of dimensionality reduction. The socio-milieus were then added, and the respondents were assigned to the five milieu groups using cluster analysis methods.

The central element of data analysis was the determination of target groups ("nano-types"), also using cluster analysis. Cluster analysis permits the division of a non-uniform set of objects or persons into more uniform groups comprising similar objects or persons. The aim of cluster analysis is therefore to assign the objects (in this study the respondents in the representative survey) to groups in such a way that they are as similar as possible within individual groups, whereas the groups themselves are as heterogeneous as possible (Backhaus et al. 2006). The first step in this process is to determine the characteristics that help to differ-

[28] As only slight modifications were made to the questionnaire, it was possible to include the 67 cases in the evaluation.

[29] According to the aproxima method report (aproxima 2012), 77 people broke off the interview prematurely. This is a very high figure for a population survey. The "dropouts" were mainly people who themselves said they knew nothing at all about nanotechnology (53.2 % of dropouts). The remainder (46,8 %) say they know "something about nanotechnology". It is likely that this low level of knowledge combined with the sometimes extremely detailed assessments of the issue prompted the respondents to break off the interview prematurely.

entiate the groups (in other words active variables such as attitudes towards nanotechnology, acceptance for applications, attitudes towards technology etc.). Following selection of the suitable statistical procedure[30], the groups are formed based on the answers of respondents to the active variables, and the individual cases are assigned to their "type" based on their similarity or distance.

This supplies the "nano-types" for the main sample and additional sample in the 2012 survey. The "nano-types" were tabulated with socio-milieus, sociodemographic characteristics and the remaining question programme in order to arrive at a comprehensive description of the various types.

To the extent they were comparable the data from the current survey was compared with the data from the 2007 BfR survey (Zimmer et al. 2008). Here as well, the data was examined to establish whether the differences are statistically significant.

4.2 Results from the main sample

As mentioned above, the survey is based on a two-part sample. A neutral text explaining nanotechnology was read to the respondents in the main sample (n=1,000) by way of introduction to the aided questions. This text is the same as the one used in the 2007 BfR survey (Zimmer et al. 2008). The respondents in a further sample (n=200) were given additional information on the potential and risks of nanotechnology. The findings outlined below refer to the main sample. The findings from the additional sample are shown in the next Chapter.

4.2.1 Status of nanotechnology

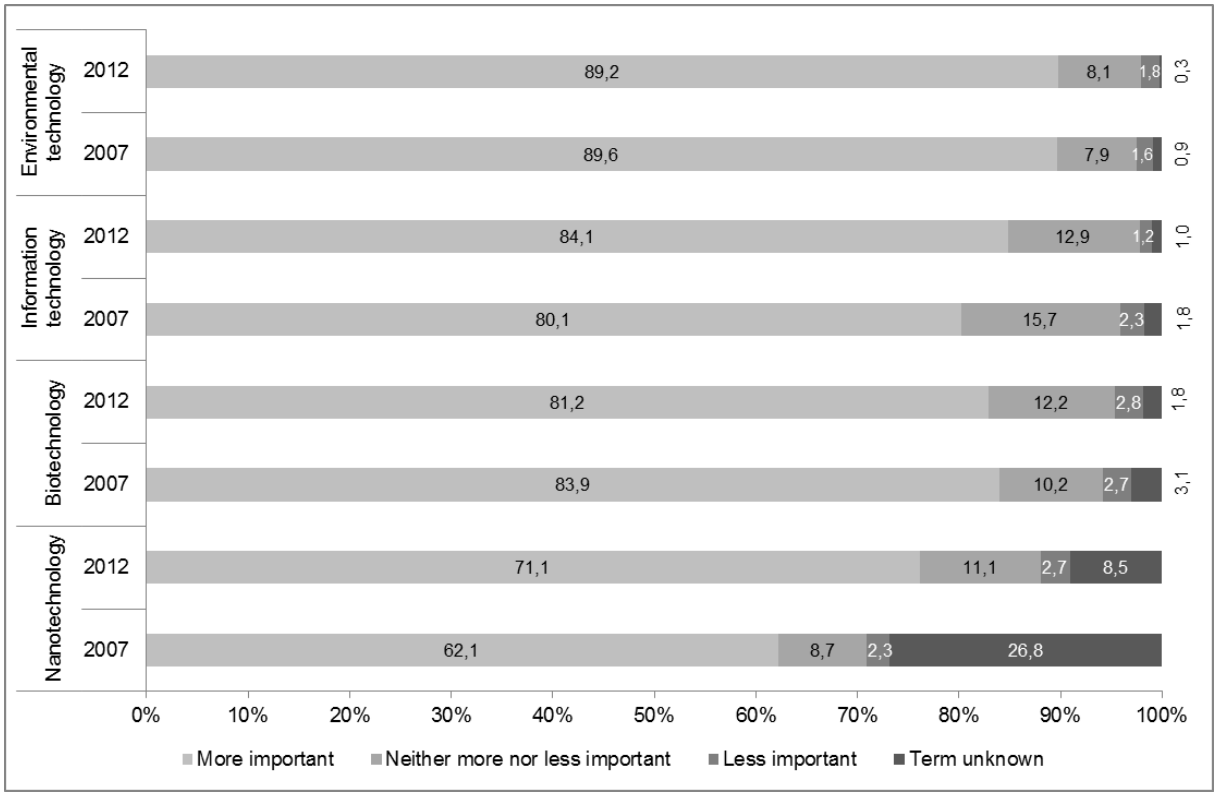
The question as to the assessment of the status of various technologies for daily life was unaided - in other words, without any prior information being provided on nanotechnology. The answers show that an overwhelming majority of respondents believe that nanotechnology will become increasingly important (cf. Fig. 8).

This belief is even more pronounced in 2012 than five years previously, not least due to the fact that the percentage of respondents who are not familiar with the term is far lower than in 2007. Some of these 18.3 % of respondents predict that nanotechnology will become increasingly important (+9.0 %), while others say they are unable to give a clear assessment (+6.6 % "Don't know/No answer").

[30] The two-step cluster analysis of SPSS was used in the first phase. This method was used to determine the types in the main sample (n=1,000). These types were then transferred to the additional sample (n=200) with the help of the cluster centre analysis of SPSS.

Fig. 8: Status of nanotechnology

"Please say which of the following technologies will in your opinion become more or less important for our daily life or will become neither more nor less important: nanotechnology, biotechnology, environmental technology, information technology" (n=1,000)



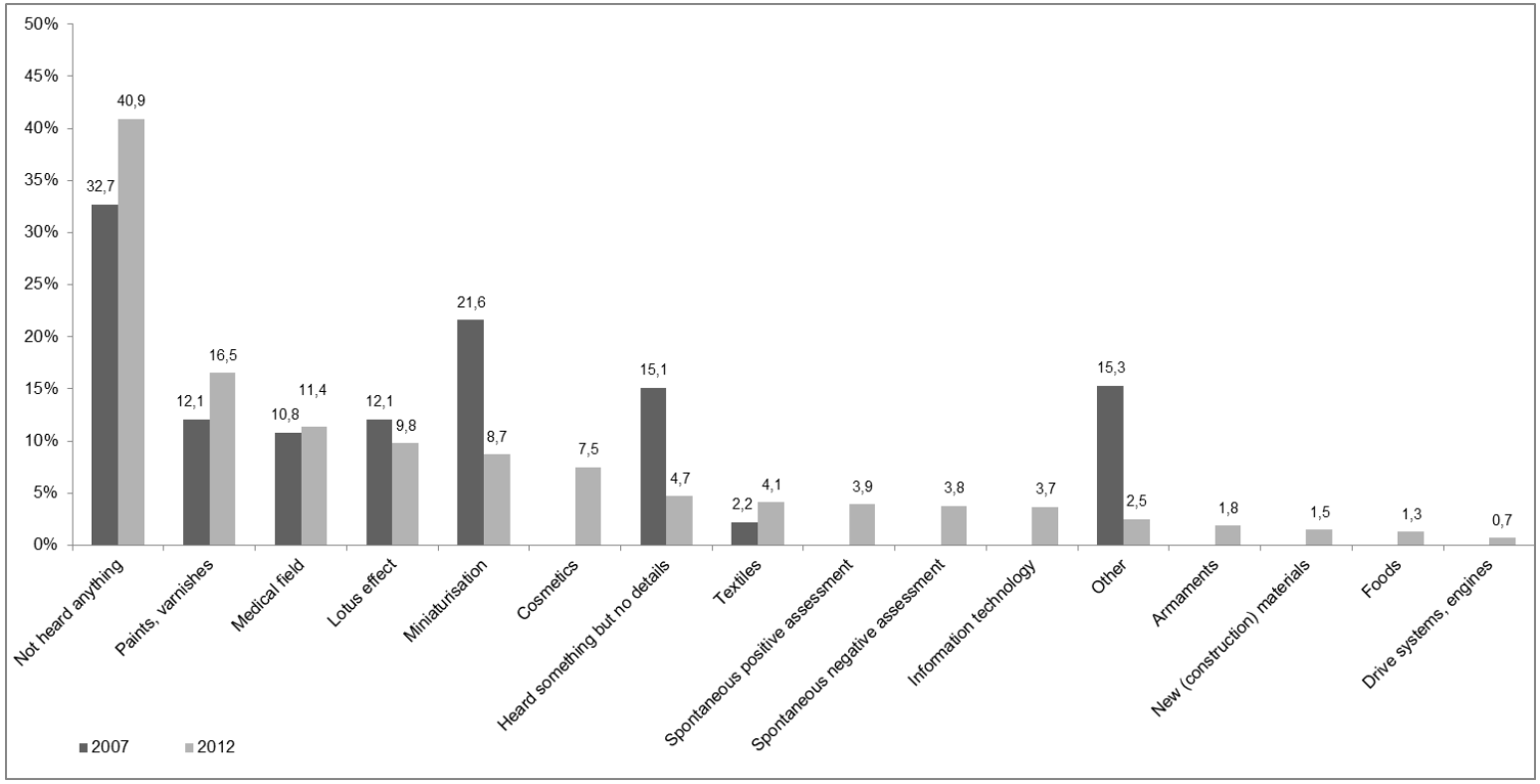
4.2.2 Spread of knowledge about nanotechnology

When asked about nanotechnology compared to other technologies, therefore, far fewer respondents in the 2012 survey say they are not familiar with the term "nanotechnology" than was the case in 2007. This does not, however, automatically mean that knowledge levels among the population with regard to nanotechnology have increased. Many respondents have still not heard of nanotechnology. The answers to the open question "What have you heard or read about nanotechnology or nanomaterials?" (cf. Fig. 9) show that the percentage of uninformed people has increased - from 32.7 % in 2007 to 40.9 % in 2012. If we include the respondents who "have heard something about it but cannot provide any further information" (15.1 % in 2007 and 4.7 % in 2012), however, then this puts the increase in perspective (47.8 % who know nothing or little about nanotechnology in 2007 against 45.6 % in 2012). This means that no clear pattern is discernible. The percentage of female respondents in 2012 who know nothing or little about nanotechnology (53.0 % + 4.7 % = 57.7 %) is far higher than the figure for the male respondents (29.3 % + 4.8 % = 34.1 %).

At the same time, Fig. 9 shows more highly differentiated knowledge levels among respondents who say that they possess a certain amount of knowledge about nanotechnology. The awareness scores for individual nanotechnology applications, such as paints and varnishes or textiles, have even increased.

Fig. 9: Unaided mentions in connection with the terms "nanotechnology" and "nanomaterials"

"What have you already heard or read about?", open question (n=1,000)[31]

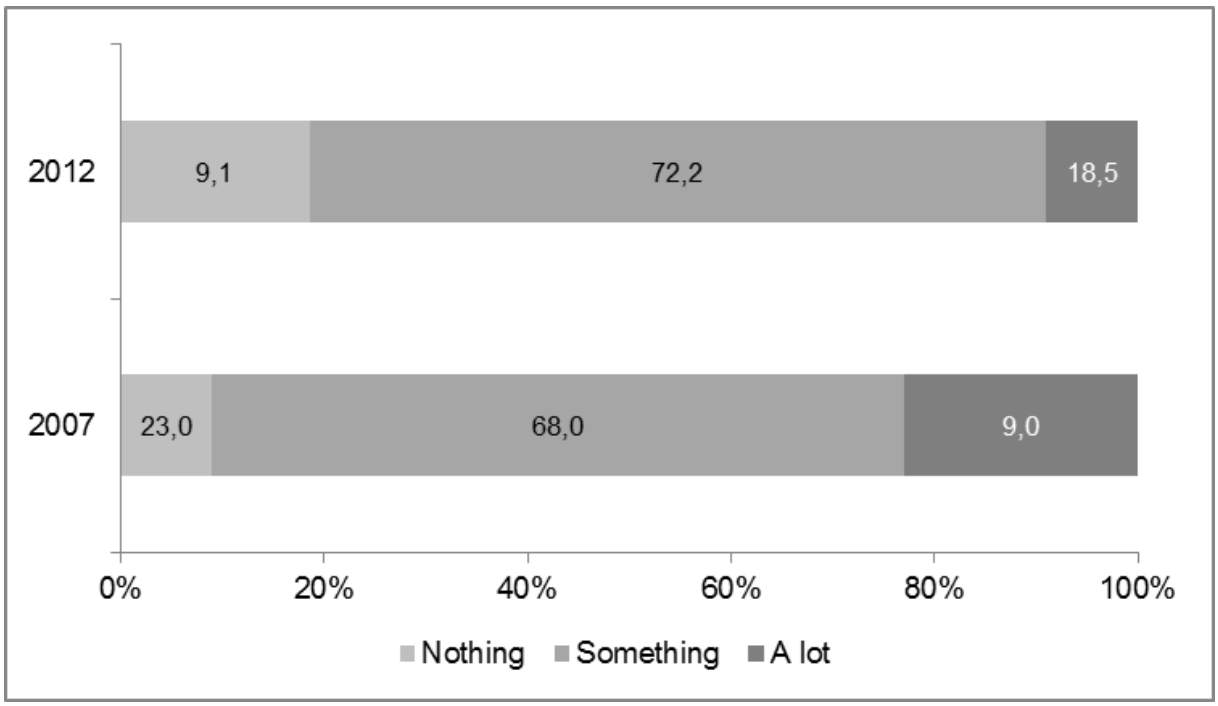


[31] The full answer categories are: "Not heard anything/Unknown/No answer", Area of paints, varnishes, surface treatment", "Medical field", "lotus effect", "Miniaturisation", "Cosmetics", "Heard something, but no further details", "Field of textiles", "Spontaneous positive assessment/Benefits (for environment, health)", "Spontaneous negative assessment/Risks (to environment, health)", "Field of IT (chips, computers, robots)", "Other", "Armaments/Aerospace technology", "New (construction) materials", "Foods", "Drive systems, engines, machines, automotive construction".

If respondents are given a brief explanation of nanotechnology, then awareness levels are slightly higher, and the percentage of uninformed respondents falls to 18.5 % (Fig. 10). This aided knowledge level has changed only slightly between 2007 and 2012.[32]

Fig. 10: Aided awareness of nanotechnology

"How much have you heard about nanotechnology to date?" (n=1,000)



Men also record significantly higher scores than women for aided awareness of nanotechnology: 74.1 % of male respondents say they have heard "something" and 12.7 % "a lot". The corresponding figures for the female respondents are 70.3 % and 5.3 %.

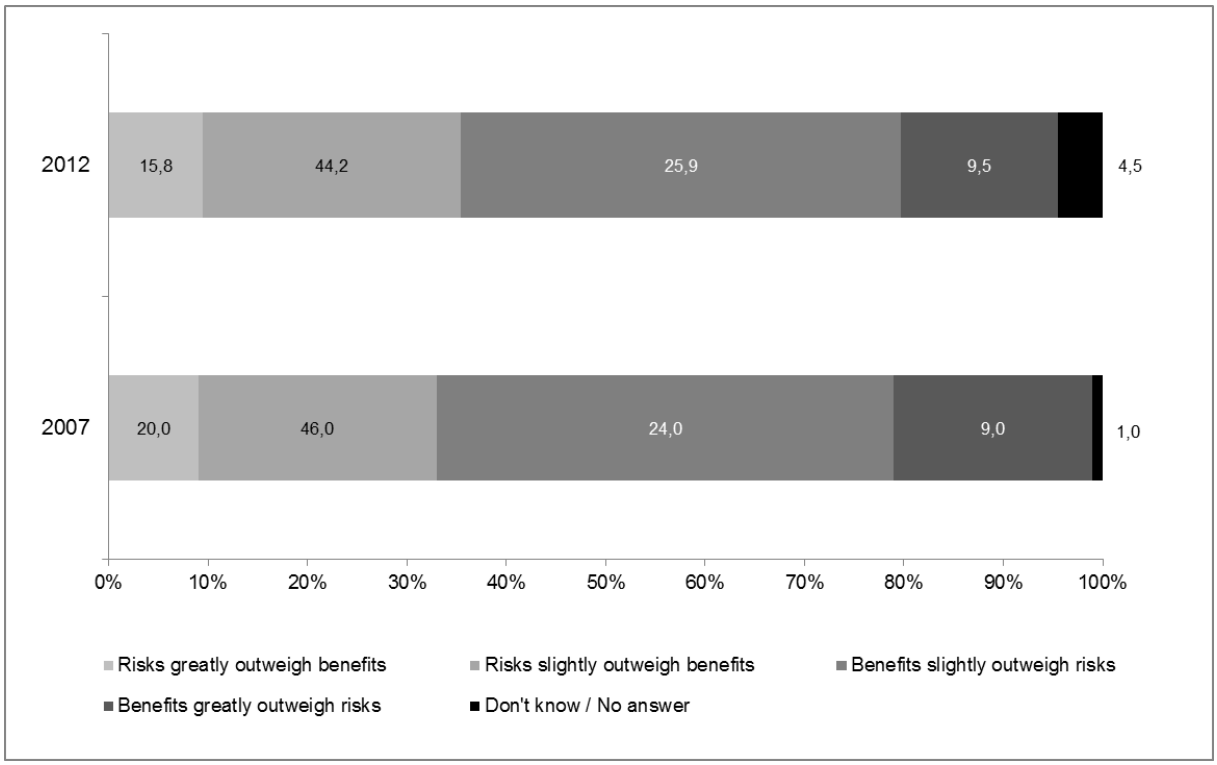
4.2.3 Risk-benefit ratio

The risk-benefit ratio of nanotechnology is seen slightly more critically in 2012 than five years earlier (cf. Fig. 11). Men take a more positive view of the ratio than women. The same applies to young respondents (16 to 30 years of age) relative to older respondents (31 to 60 years of age).

[32] As the differences are not statistically significant, it is not possible to make any statements on tendenices.

Fig. 11: Assessment of the risk-benefit ratio

"What is your assessment of the risk-benefit ratio of nanotechnology?" (n=1,000)



4.2.4 Acceptance for nano-applications

Respondents were asked for their assessment of various applications of nanotechnology and nanomaterials in a total of ten areas that can be grouped into three categories[33]:

- Applications in medicine and environmental protection
- Applications outside the human body
- Applications in foods and cosmetics

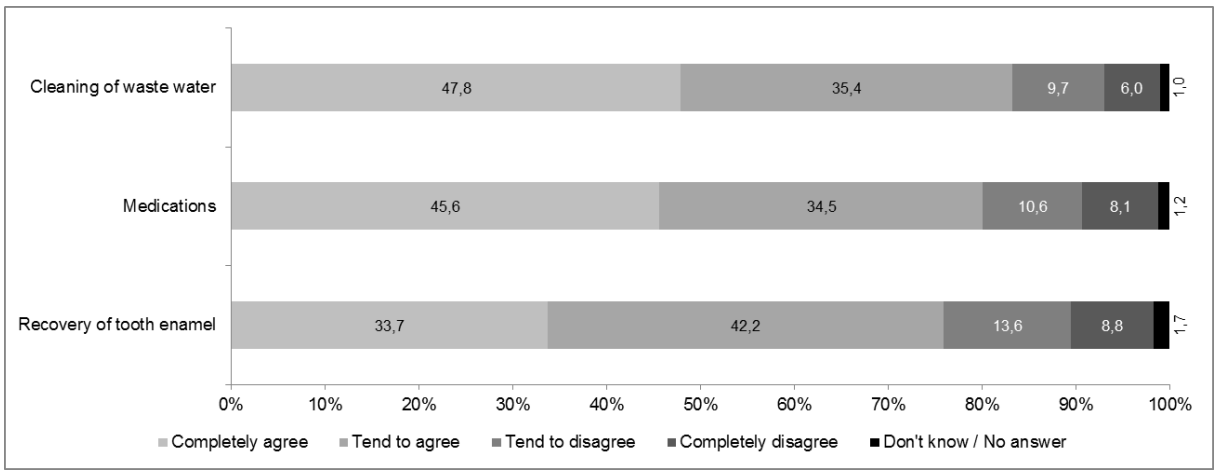
4.2.4.1 Applications in medicine and environmental protection

Acceptance levels for medical applications are high (cf. Fig. 12).[34] At least three quarters of the population fully or generally support the listed applications. Acceptance levels for the specified environmental application (cleaning of waste water) are even higher.

[33] A principal components analysis with varimax rotation was performed. The three factors explain 62 % of total variance (see Annex 9.2.2).
[34] The basically positive assessment of the application "Recovery of damaged tooth enamel" is slightly weaker than in the 2007 survey, falling from 80.0 % ("fully support" and "generally support") to 75.9 %.

Fig. 12: Support for medical applications

"Which of the following applications of nanomaterials do you support or disapprove of?" (n=1,000)[35]



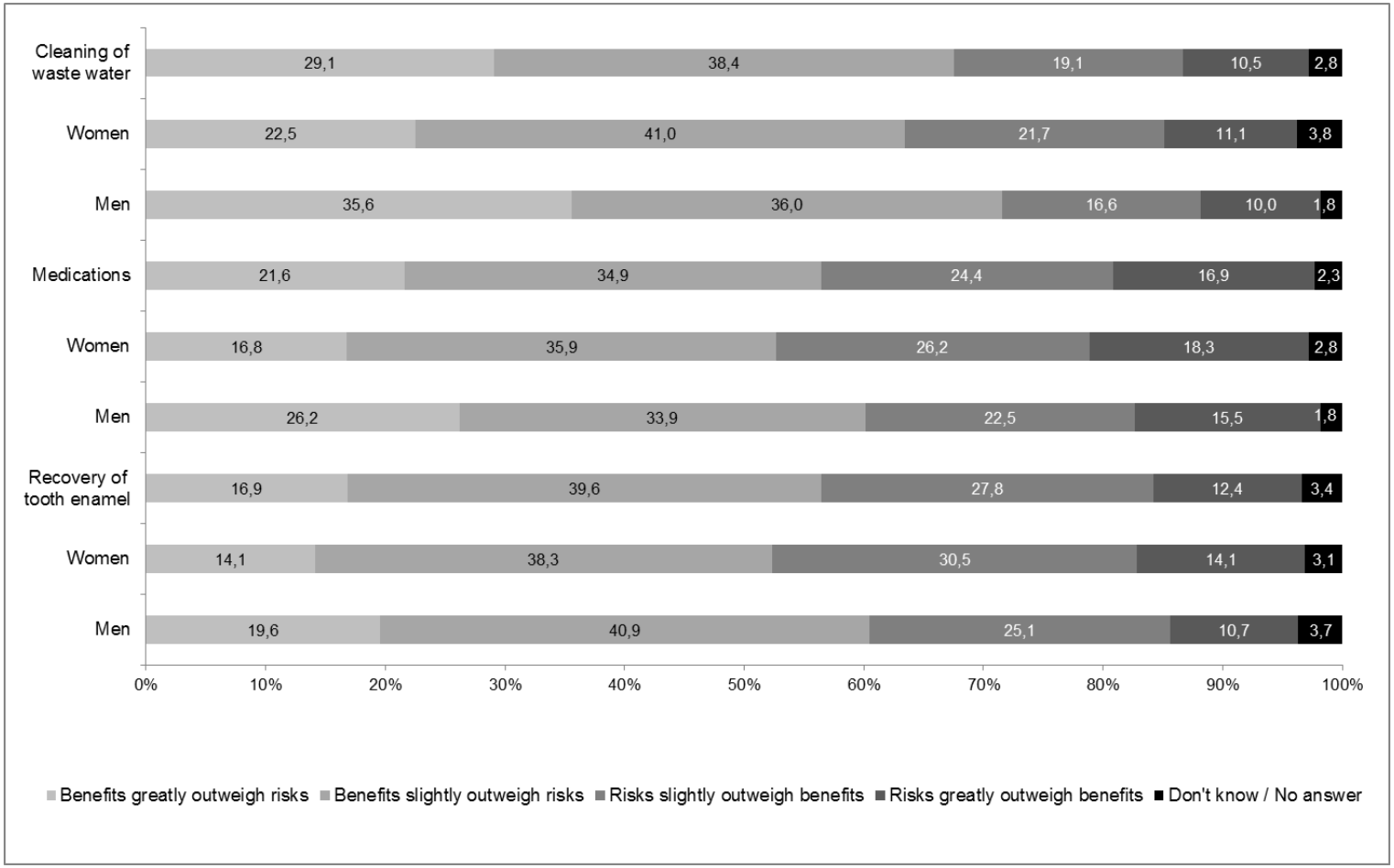
The high level of acceptance for these kinds of nano-application is probably due to, among other things, the fact that their benefit is seen as being greater than the associated risks. In the case of the environmental application, two thirds of the population say that the benefits greatly or slightly outweigh the risks, while this applies to around half of respondents in the case of medical applications.

There are only minor differences between men and women when it comes to approval for the listed applications. The differences are more marked, however, with regard to the perceived ratio of risk to benefit (cf. Fig. 13). These differences are statistically highly significant and confirm the more critical assessments of the female respondents.

[35] The full answer categories are: "Recovery of damaged tooth enamel", "Medications that can release their active substances in concentrated form in the desired target location", "More efficient cleaning of waste water".

Fig. 13: Risk-benefit ratio in medical and environmental protection applications

"What is your assessment of the risk-benefit ratio of each of the following applications of nanomaterials?" (n=1,000)[36]



[36] The full answer categories are: "Recovery of damaged tooth enamel", "Medications that can release their active substances in concentrated form in the desired target location", "More efficient cleaning of waste water".

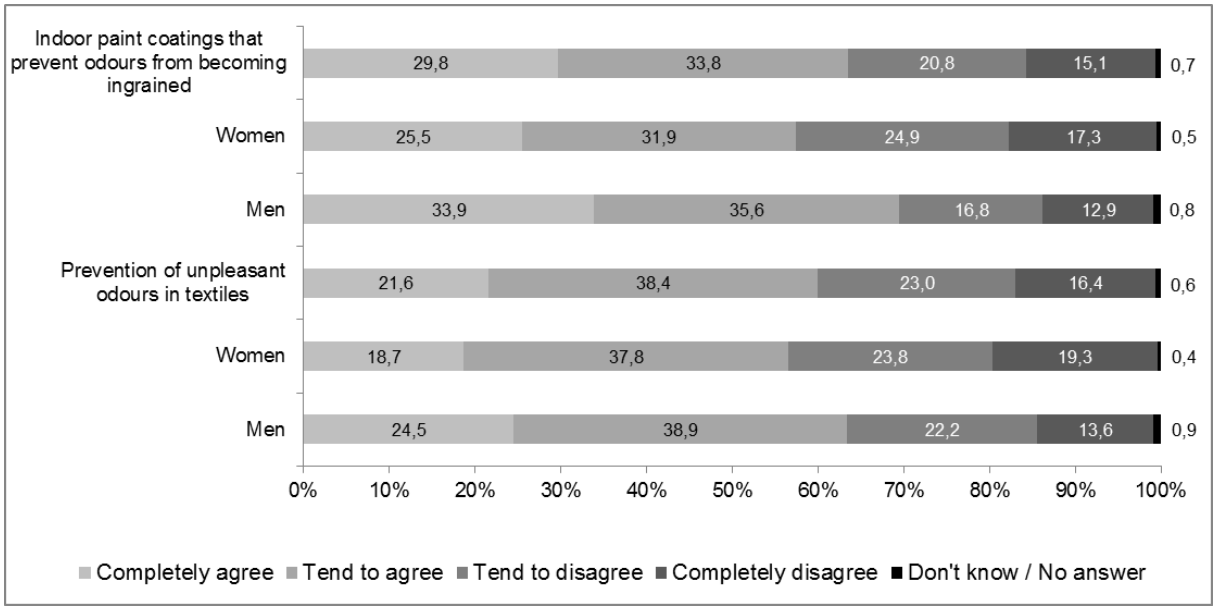
4.2.4.2 Applications outside the human body

The use of nanotechnology and nanomaterials in products outside the human body is not viewed quite as positively as medical or environmental applications but is still fully or generally supported by (over) 60 % of the population (cf. Fig. 14). This is due not least to the fact that the benefit of the applications in question is seen as being greater than the risks (cf. Fig. 15).

The level of support among the men for these applications is also far higher than among women. Moreover, men take a less critical view of the risk-benefit ratio than women. The use of nanotechnology in textiles marks the first reversal in the acceptance scores among the women: a small majority of women say that the risks far (20.1 %) or slightly (30.3 %) outweigh the benefits.

Fig. 14: Support for applications outside the human body

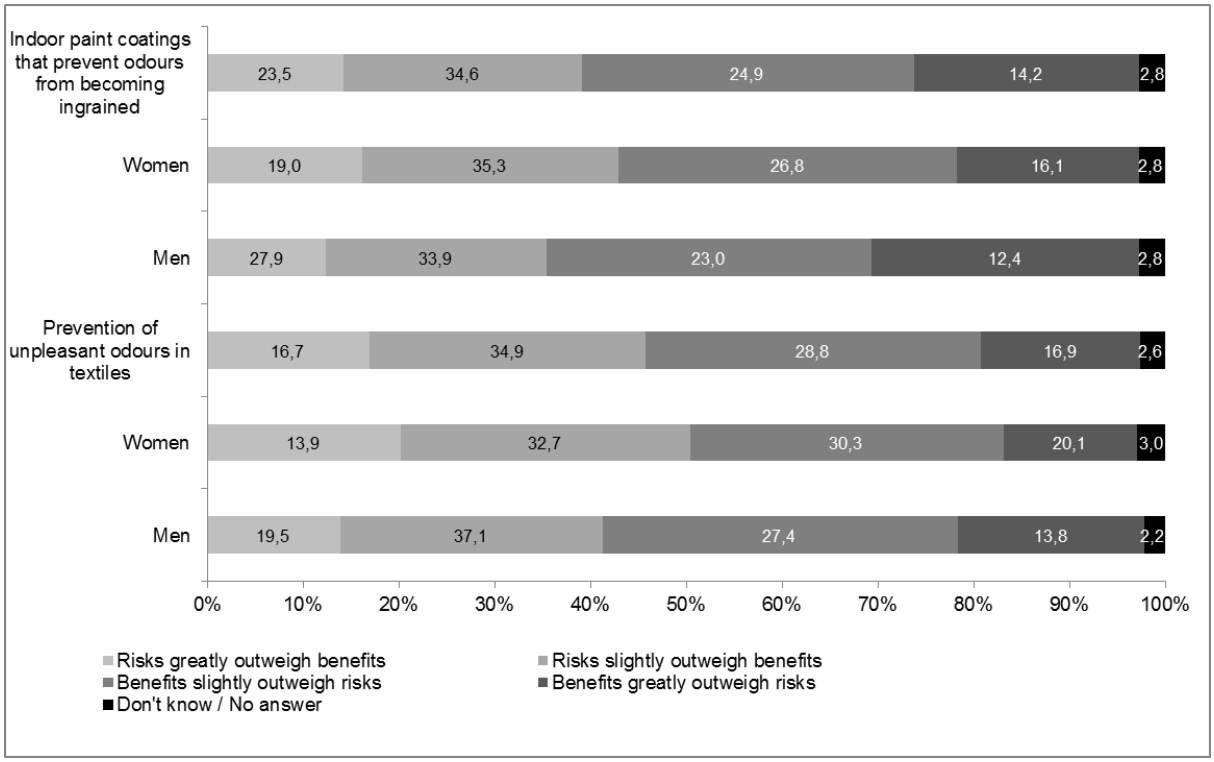
"Which of the following applications of nanomaterials do you support or disapprove of?" (n=1,000)[37]



[37] The full answer categories are: "Indoor paint coatings that prevent odours (e.g. cigarette smoke) from becoming ingrained" and "Prevention of unpleasant odours in textiles".

Fig. 15: Risk-benefit ratio of applications outside the human body

"What is your assessment of the risk-benefit ratio of each of the following applications of nanomaterials?" (n=1,000)[38]



4.2.4.3 Applications in foods and cosmetics

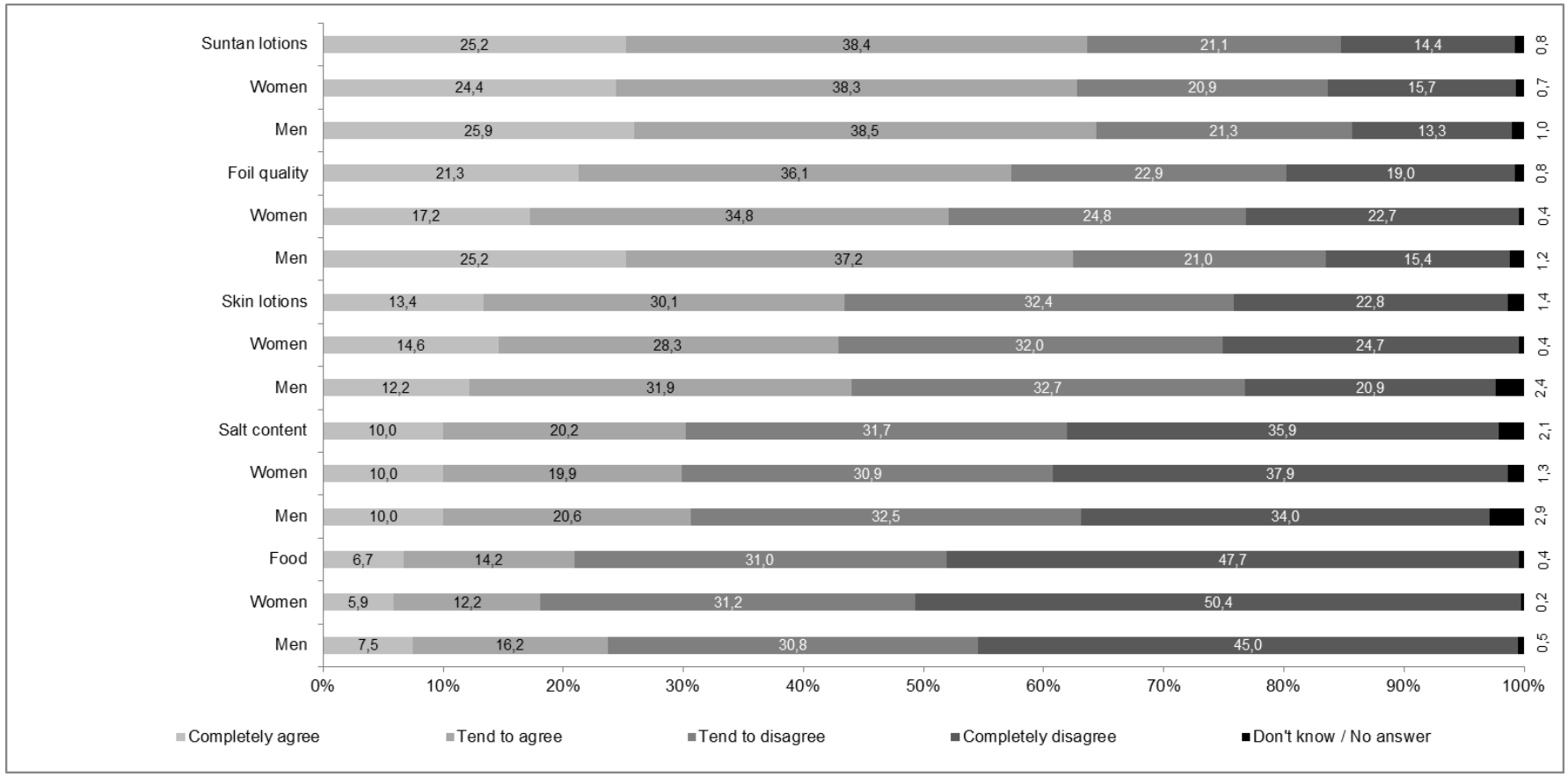
The respondents tend to take a critical view of the use of nanotechnology and nanomaterials in foods and cosmetics (cf. Fig. 16). The exceptions are their use in sun lotions to increase efficacy and in food packagings when nanomaterials prolong the shelf life of foods. The acceptance levels of around 60 % are probably due to the fact that these kinds of use create a clear benefit (improved protection against skin cancer and longer shelf life of foods). Almost one in two respondents say that these benefits outweigh the potential risks (cf. Fig. 17).

Acceptance levels are far lower (between 43.5 % and 20.9 %) for the other listed applications – creams that penetrate deep into the skin and manipulated foods, and the perceived risk-benefit ratio is negative: in some cases, a clear majority (between 61.2 % and 73.5 %) believe that the risks outweigh the benefits.

[38] The full answer categories are: "Indoor paint coatings that prevent odours (e.g. cigarette smoke) from becoming ingrained" and "Prevention of unpleasant odours in textiles".

Fig. 16: Support for applications in foods and cosmetics

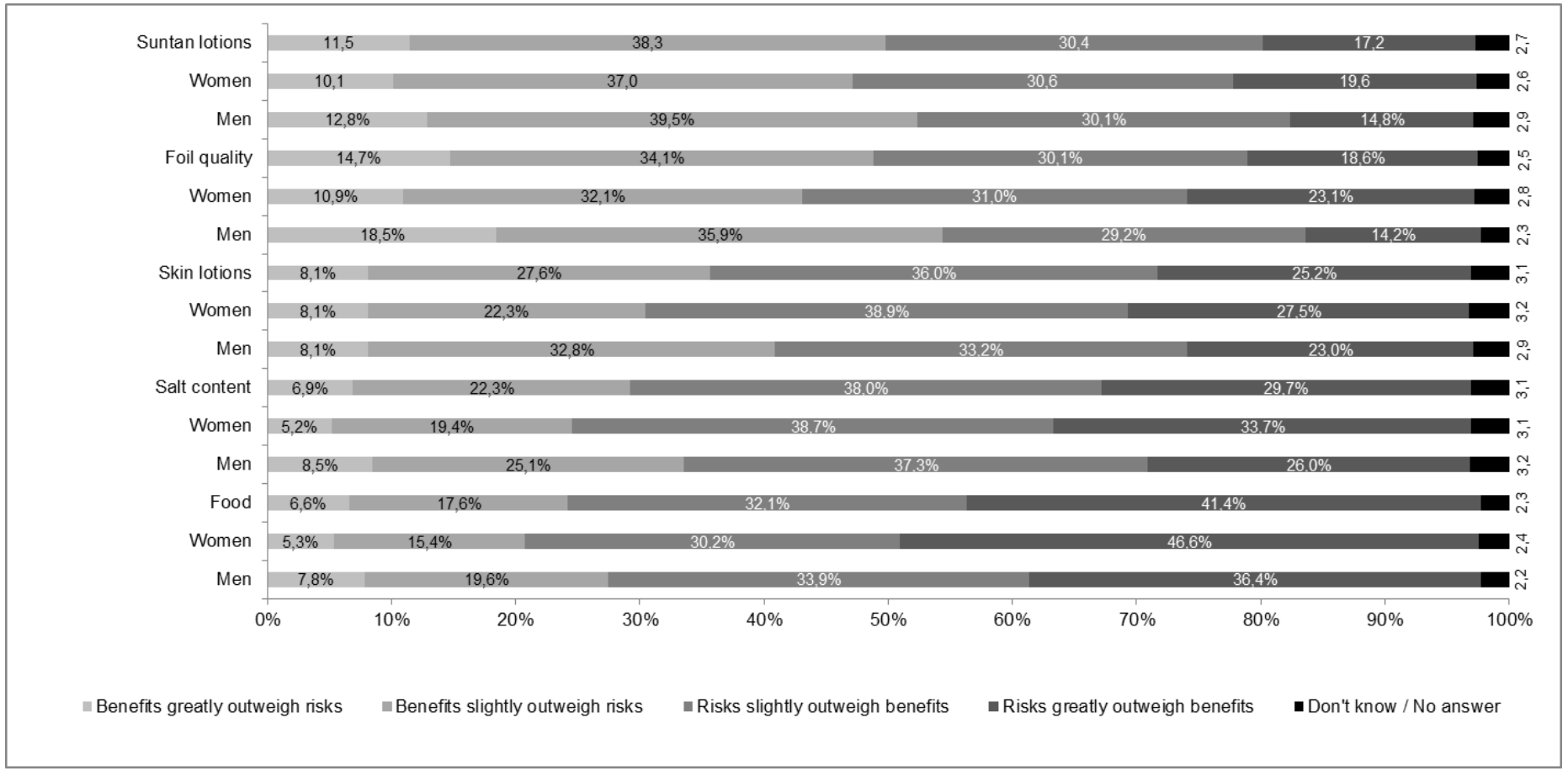
"Which of the following applications of nanomaterials do you support or disapprove of?" (n=1,000)[39]



[39] The full answer categories are: "Increased efficacy of suntan lotions", "Improved foil quality to increase the shelf life of foods", "Support for applications of nanomaterials in active substances of skin lotions that reach deeper layers of the skin", "Reduction in the salt content in foods without affecting the taste", "Enrichment of foods with vitamins and other nutrients".

Fig. 17: Risk-benefit ratio of applications in foods and cosmetics

"What is your assessment of the risk-benefit ratio of each of the following applications of nanomaterials?" (n=1,000)[40]



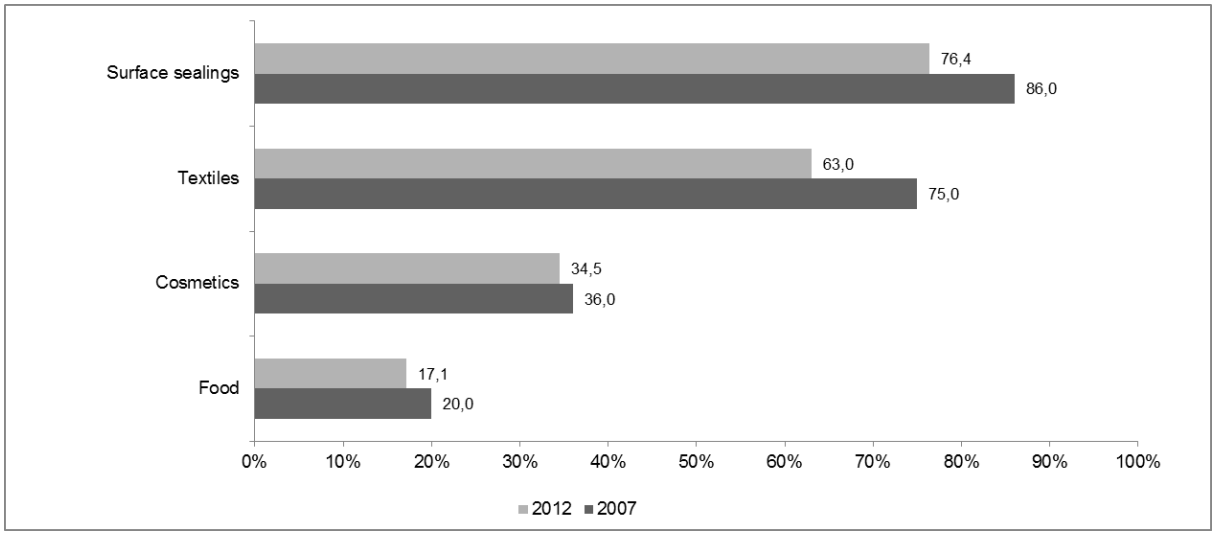
[40] The full answer categories are: "Increased efficacy of suntan lotions", "Improved foil quality to increase the shelf life of foods", "Support for applications of nanomaterials in active substances of skin lotions that reach deeper layers of the skin", "Reduction in the salt content in foods without affecting the taste", "Enrichment of foods with vitamins and other nutrients".

4.2.5 Willingness to buy nanoproducts

The willingness to buy nanoproducts also varied widely in 2012 depending on the application in question. Scores are relatively high when it comes to products for surface sealing and care or in clothes but on the low side for nano-cosmetics and nano-foods. Overall, the willingness to buy nanoproducts has decreased, however, above all in the two first-named categories (cf. Fig. 18).

Fig. 18: Willingness to buy nanoproducts

"Would you buy products in the following groups if they contain nanomaterials?" (n=1,000)



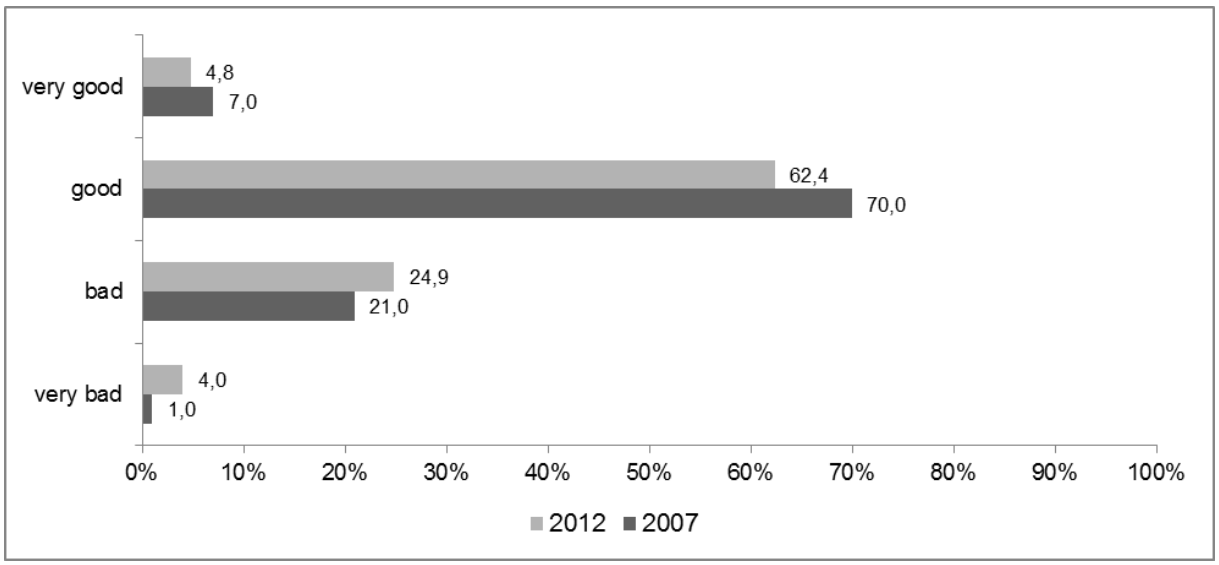
In 2012, men showed a significantly higher willingness than women to buy nanoproducts (with the exception of cosmetics). With regard to the variables of age, education and income, there are only sporadic (weakly) significant differences, the level of which does not permit any general statement on tendency.

4.2.6 Affect

Although the majority of respondents (62.4 %) have a good (62.4 %) to very good (4.8 %) feeling about the issue of nanotechnology, these figures are significantly lower than in the 2007 survey. Men have a far better (though not significantly better) feeling about nanotechnology than women (76.7 % versus 57.4 % good or very good).

Fig. 19: Feeling about nanotechnology

"What is your general feeling about the issue of nanotechnology?“ (n=1,000)

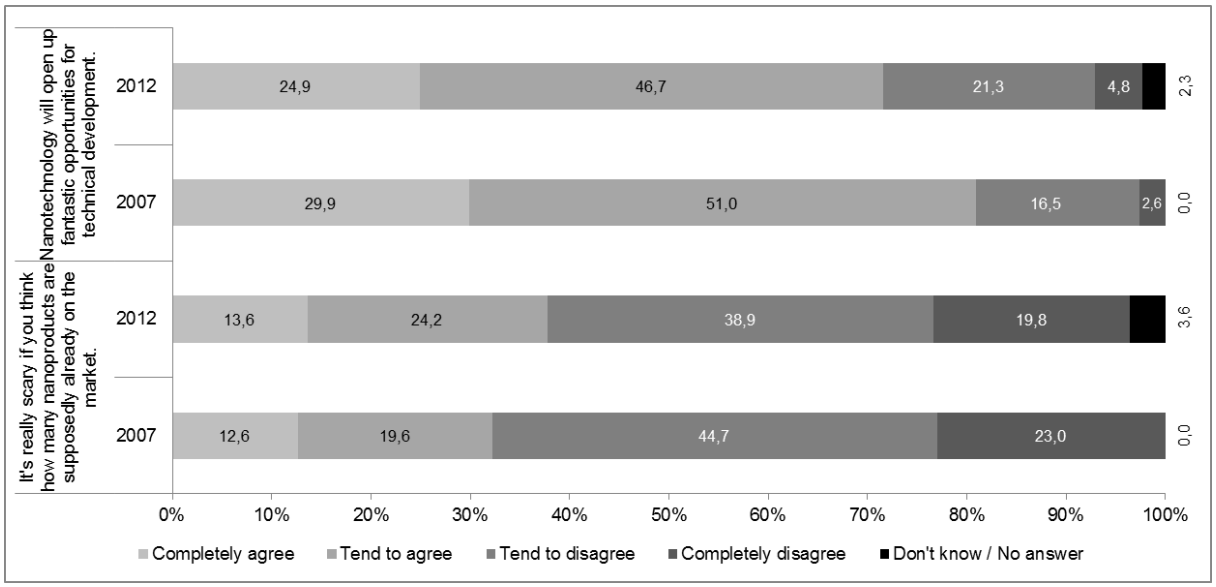


4.2.7 Attitudes towards nanotechnology

As mentioned above, extensive changes were made to the attitude battery compared to the 2007 survey, and only two statements were retained. The findings for both statements show a slight downtrend in positive attitudes towards nanotechnology. Only 71.6 % of respondents agree with the statement "Nanotechnology will open up fantastic opportunities for technical development" (compared to 80.9 % in 2007), and only 58.7 % reject the statement "It's really scary if you think how many nanoproducts are supposedly already on the market" (compared to 67.8 %). The differences are statistically significant in both cases.

Fig. 20: Attitudes towards nanotechnology (comparison 2007/2012)

"To what extent do you personally agree with the following statements and attitudes of consumers?" (n=1,000)



The findings for the attitude aspects surveyed in 2012 for the first time are outlined below. They are grouped according to the four factors determined using factor analyses:[41]

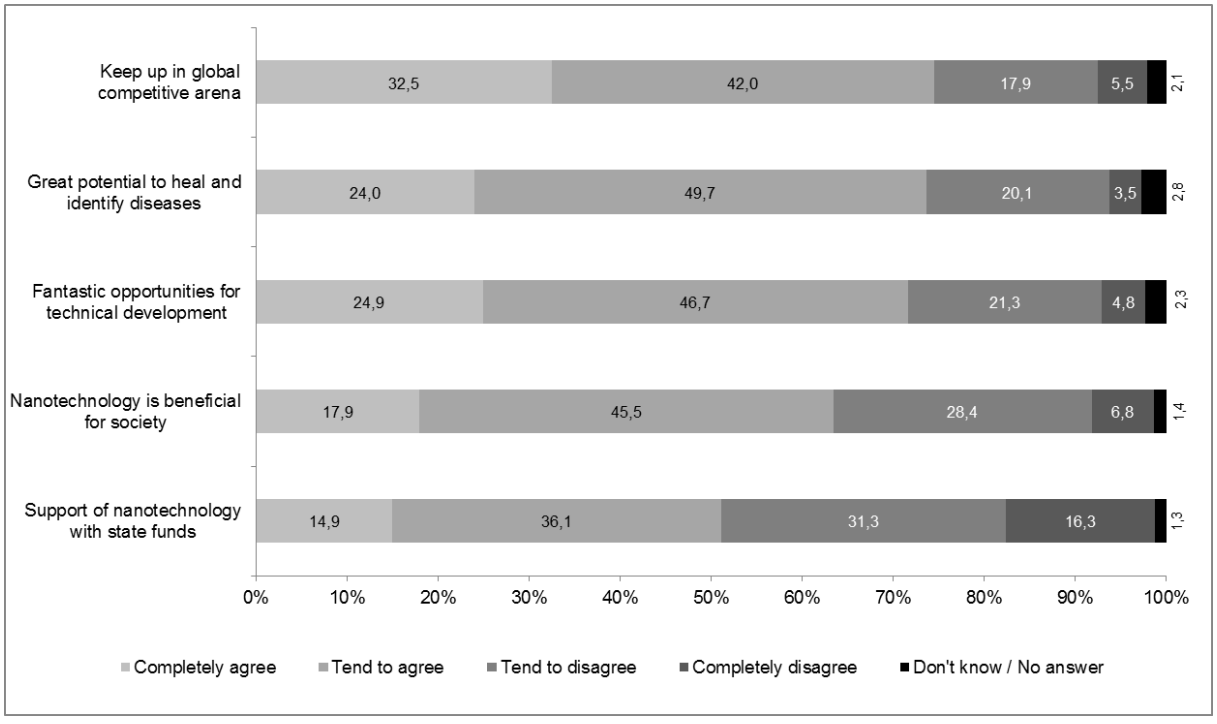
- Potential of nanotechnology
- Health and ecological risks
- Fascination of nanoproducts
- Risks of nanotechnology for society

4.2.7.1 Potential of nanotechnology

People also associate a wide range of possibilities with the emergence of nanotechnology. Nanotechnology is seen as making an important contribution to strengthening Germany as an industrial location in the global competitive arena (74.5 % agree fully or generally with this assessment) and as an instrument that helps to identify and cure disease (73.7 %). It is assumed that this basic technology will significantly promote technical development (71.6 %) and that nanotechnology will benefit society (63.4 %). Just over one in two respondents support state funding for nanotechnology. This opportunity-focused attitude is found more commonly among men and younger respondents (16–30 years of age) than among women and older people (31–60 years of age).[42]

Fig. 21: Potential of nanotechnology

"To what extent do you personally agree with the following statements and attitudes of consumers?" (n=1,000)[43]



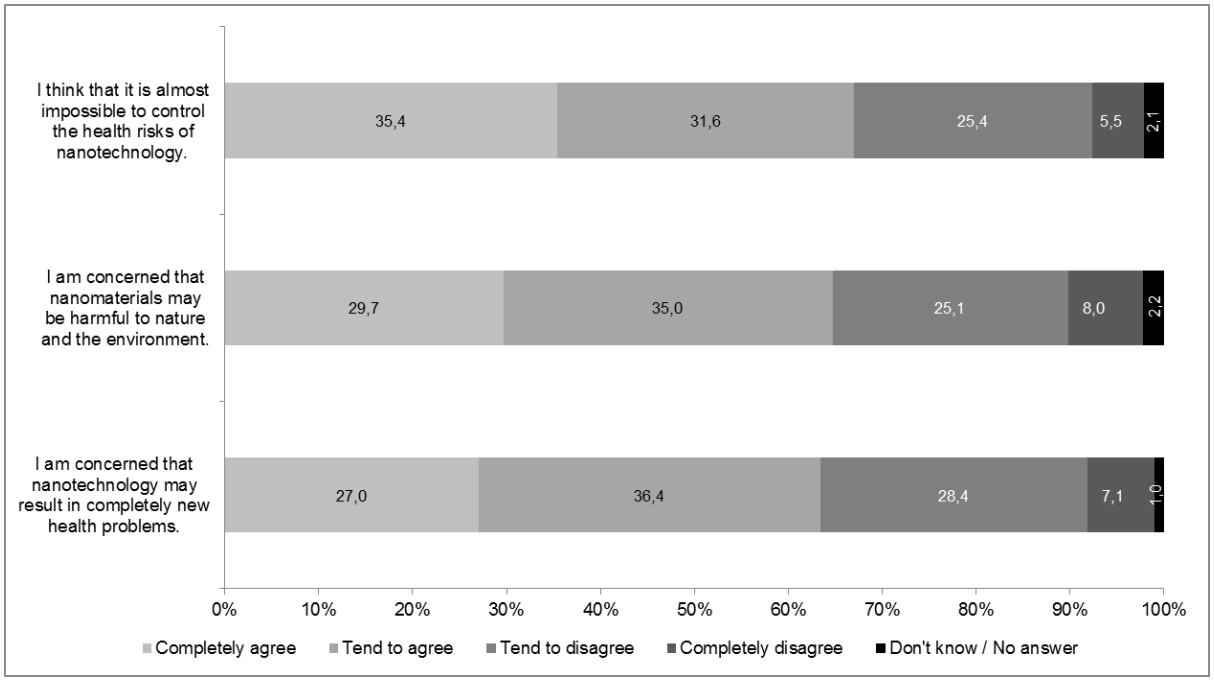
[41] A principal components analysis with varimax rotation was performed. The three factors explain 59 % of total variance. Annex 9.2.2 contains an overview of the factors and the assigned attitude statements (incl. the factor loadings).
[42] With regard to the two statements "I am convinced that nanotechnology is beneficial to society" and "I am in favour of nanotechnology being supported with state funding", there are statistically highly significant differences in terms of gender (18.4 and 13.5 %) and age (cohort of 16–30 year-olds compared to the cohort of 46-60 years-olds; 23.9 and 19.3 %).
[43] The full categories are: "In order to hold its own in the global competitive arena, Germany has to rely on technologies like nanotechnology", "I believe that nanotechnology has great potential to heal and identify diseases", "Nanotechnology will open up fantastic opportunities for technical development", "I am convinced that nanotechnology is beneficial for society", "I am in favour of nanotechnology being supported with state funds".

4.2.7.2 Health and ecological risks

Around two thirds of the population agree with statements that emphasise the health and ecological risks of nanotechnology. Women voice greater concern than men in response to all three statements.[44] Age differences play little or no role in this respect.[45]

Fig. 22: Health and ecological risks

"To what extent do you personally agree with the following statements and attitudes of consumers?" (n=1,000)



4.2.7.3 Fascination of nanoproducts

That nanoproducts can also hold a certain fascination, however, is reflected by the high scores for the two statements "If nanotechnology makes everyday products better, I will be happy to use them" and "I hope nanotechnology will help to protect the environment and repair environmental damage". Attitudes are therefore positive if a concrete benefit is associated with nanoproducts. Where the benefit is vague, on the other hand, as in the wording "I am looking forward to the many new nanoproducts that will soon be available", then approval levels fall markedly.

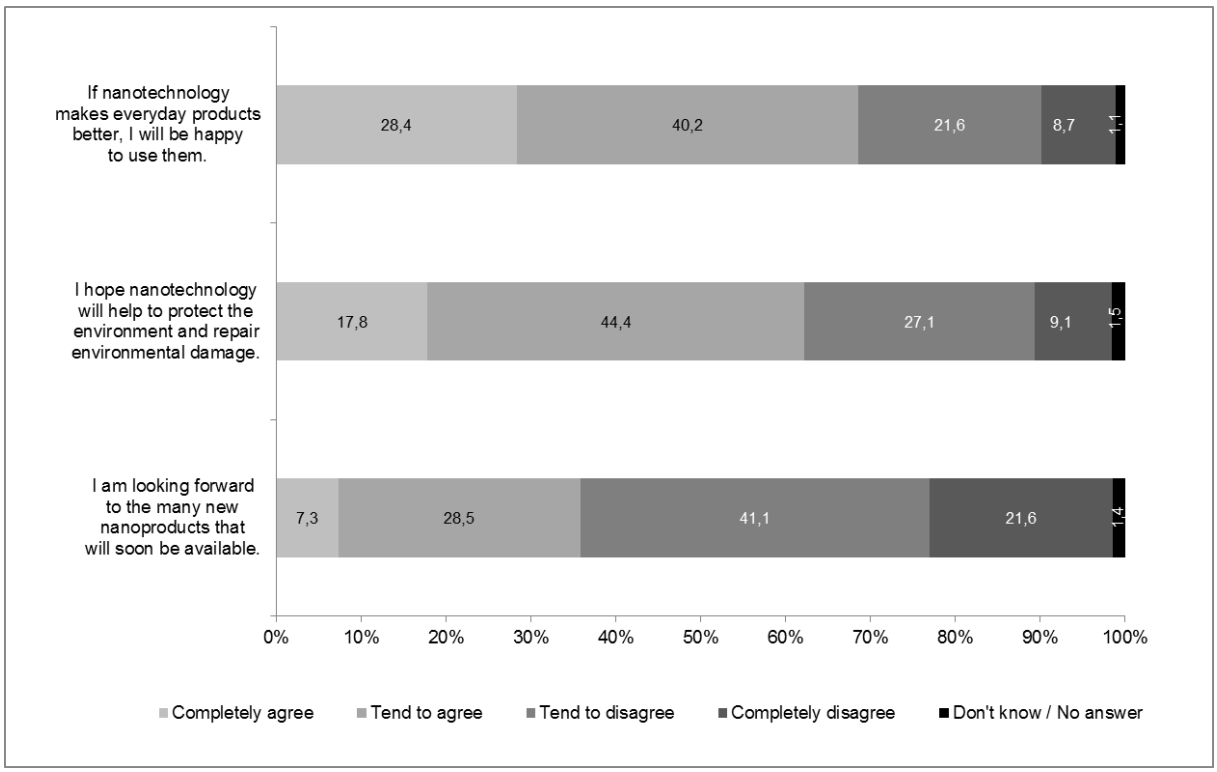
There were no significant differences for this factor between either men and women or between younger and older respondents.

[44] The statistically highly significant differences are at 11.1 % for the statement "I think that it is almost impossible to control the health risks of nanotechnology", 14.4 % for the statement "I am concerned that nanotechnology may result in completely new health problems" and 14.6 % for the statement "I am concerned that nanomaterials may be harmful to nature and the environment".

[45] With regard to the variable of age, the only highly significant difference is for the statement "I think that it is almost impossible to control the health risks of nanotechnology". The agreement scores for the youngest cohort (58.9 %) are far lower than those for the oldest cohort (71.0 %).

Fig. 23: Fascination of nanoproducts

"To what extent do you personally agree with the following statements and attitudes of consumers?" (n=1,000)

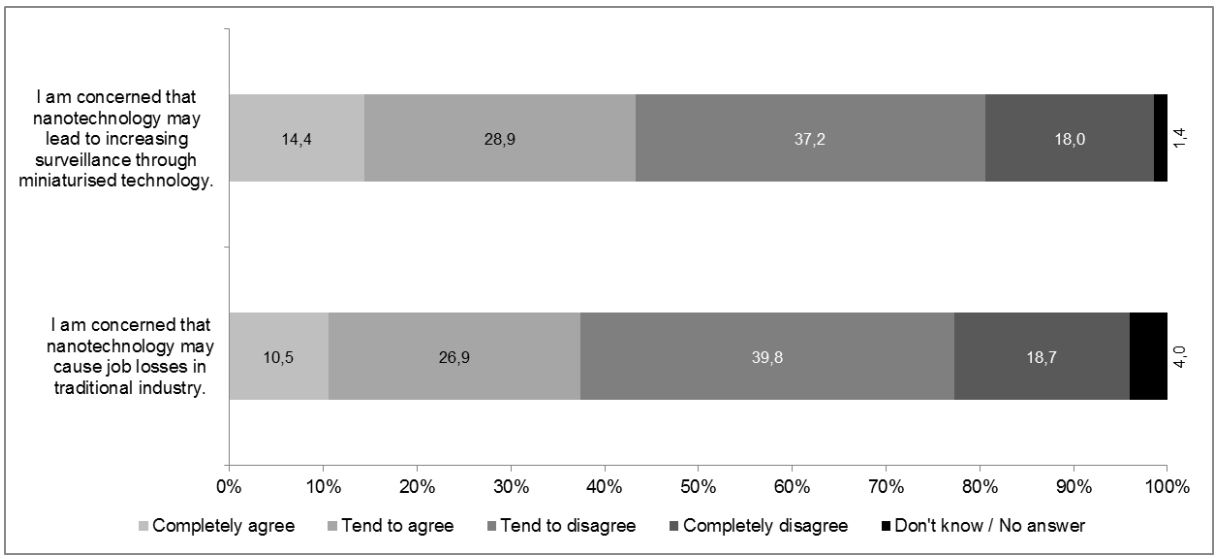


4.2.7.4 Risks of nanotechnology for society

The attitude statements focusing on the potential dangers of nanotechnology for society (job losses, increasing surveillance) recorded the lowest agreement scores. A majority of respondents do not share these fears, possibly because they see them as being very abstract. Nevertheless, over one in three (40 %) of the population agree with these statements, indicating that some sections of society are indeed extremely concerned in this respect. This standpoint is not significantly influenced by sociodemographic variables.

Fig. 24: Risks of nanotechnology for society

"To what extent do you personally agree with the following statements and attitudes of consumers?" (n=1,000)

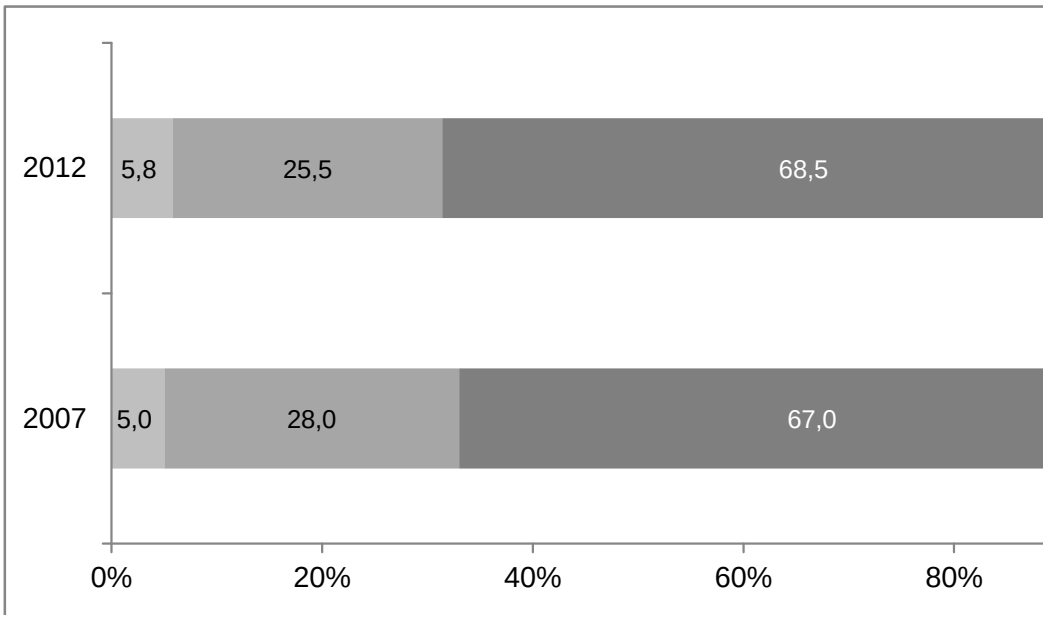


4.2.8 Information behaviour

The majority of consumers still feel less well-informed about nanotechnology compared to other modern technologies (cf. Fig. 25). The differences with regard to subjective information levels between the two surveys are not significant.

Fig. 25: Subjective level of information about nanotechnology compared to other technologies

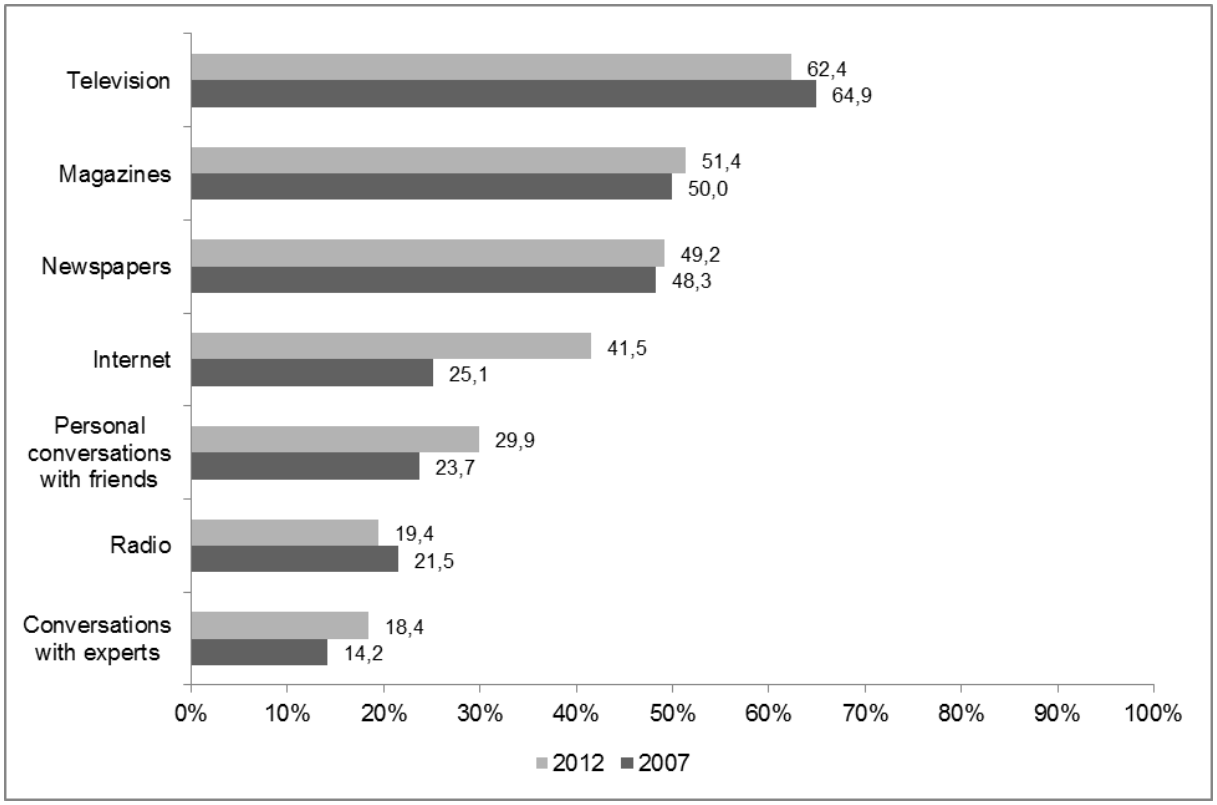
"How well do you feel informed about nanotechnology compared to other modern technologies such as biotechnology or information technology?" (n=1,000)



As was the case in 2007, the most important sources of information today ("Where have you heard, read or seen something about nanotechnology?") are seen as being television as well as magazines and newspapers (cf. Fig. 26), followed in fourth place by the Internet, which has gained considerably in importance since the 2007 survey, when 25.1 % of respondents said they had read something about nanotechnology (compared to a far higher figure of 41.5 % in 2012). This is due to the generally increased importance of the Internet as an information medium but also suggests that there are more frequent reports on nanotechnology on the Internet than there used to be. For just under a third of respondents, personal conversations with friends and acquaintances are a further important source of information. Only just under one fifth of respondents cite radio programmes and conversations with experts.

Fig. 26: Importance of sources of information

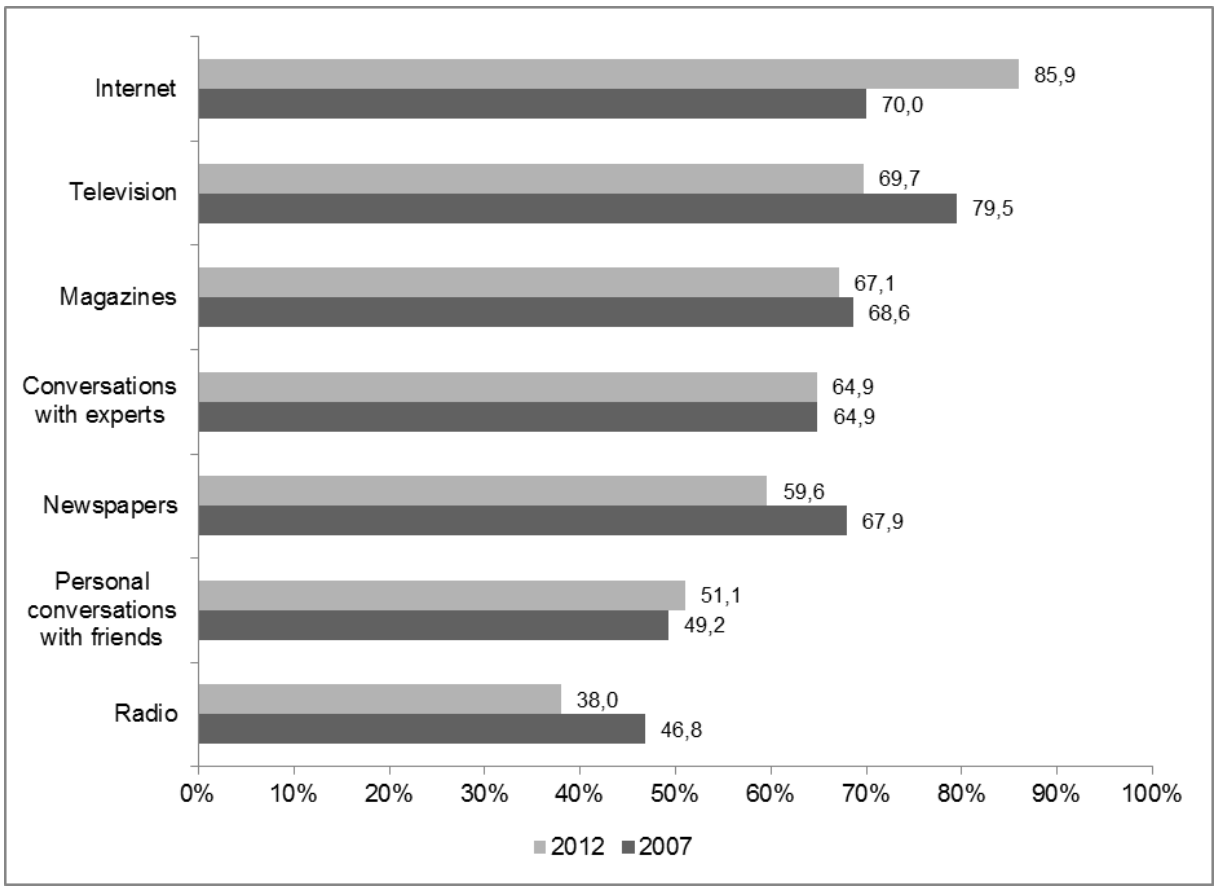
"In which of the following media have you heard, read or seen something about nanotechnology?" (n=1,000)



When asked about their preferred **information channels** today ("Which of the following media would you use to obtain information on issue of nanotechnology?"), respondents name the Internet in first place by a long way. In contrast, television, radio and newspapers have lost ground when it comes to the active search for information (cf. Fig. 27).

Fig. 27: Preferred sources of information

"Which of the following media would you use to obtain information on issues of nanotechnology?" (n=1,000)



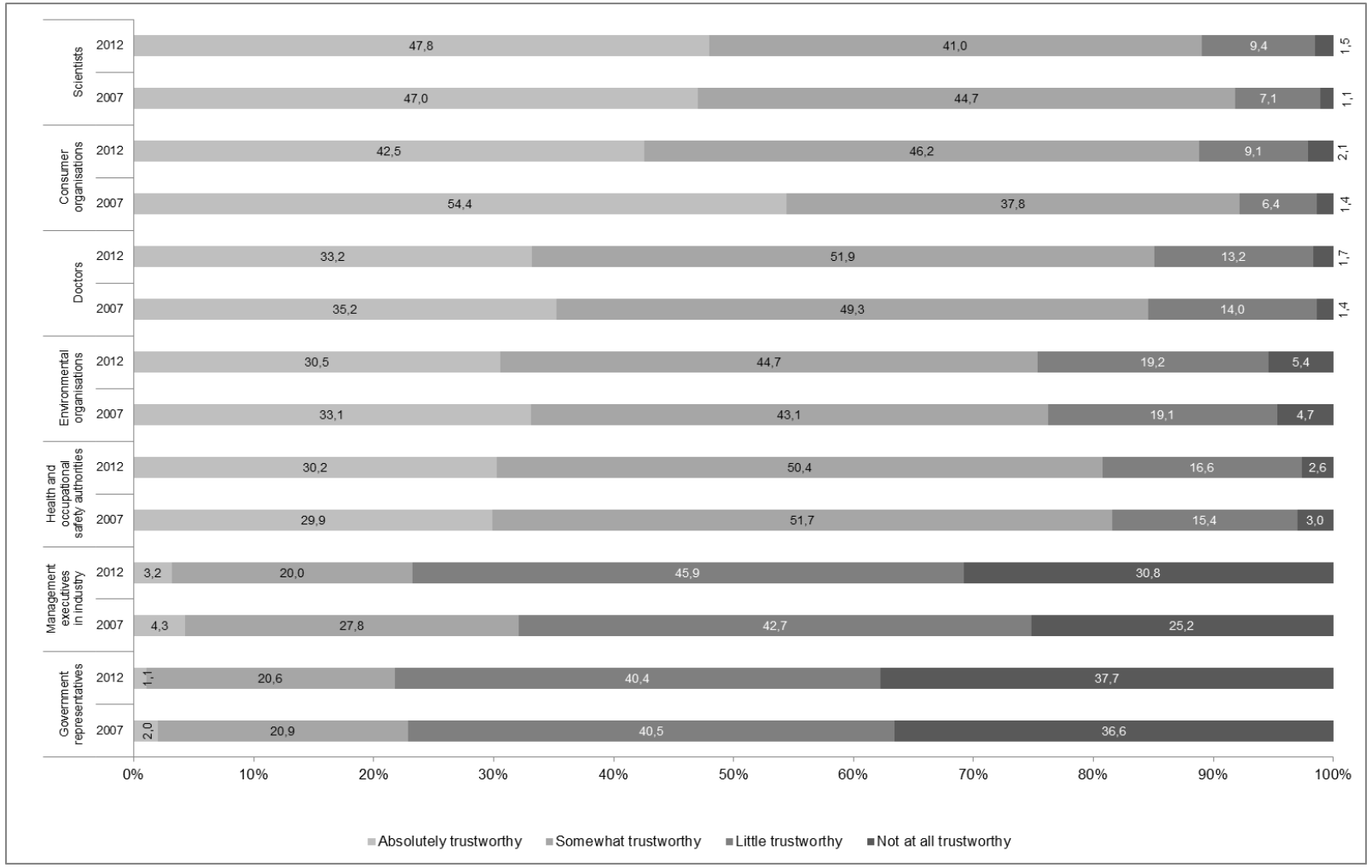
4.2.9 Trust in institutions

Scientists, doctors, health authorities, occupational safety authorities and environmental organisations are considered the most trustworthy sources of information on the issue of nanotechnology, with women placing their faith in the last two more frequently than men.[46] Consumer organisations are some way behind in this respect, with management executives in industry and government representatives even further behind. Only just over 20 % of the population see the latter as being absolutely or somewhat trustworthy.[47]

[46] The scores for "absolute" and "some" trust in health and occupational safety authorities are 84.0 % (women) and 77.4 % (men), with figures of 82.1 % and 68.6 % for environmental organisations.
[47] There has been no change in the ranking of the institutions and persons since the 2007 survey. The differences between the results in 2007 and 2012 are not statistically significant.

Fig. 28: Trust in institutions

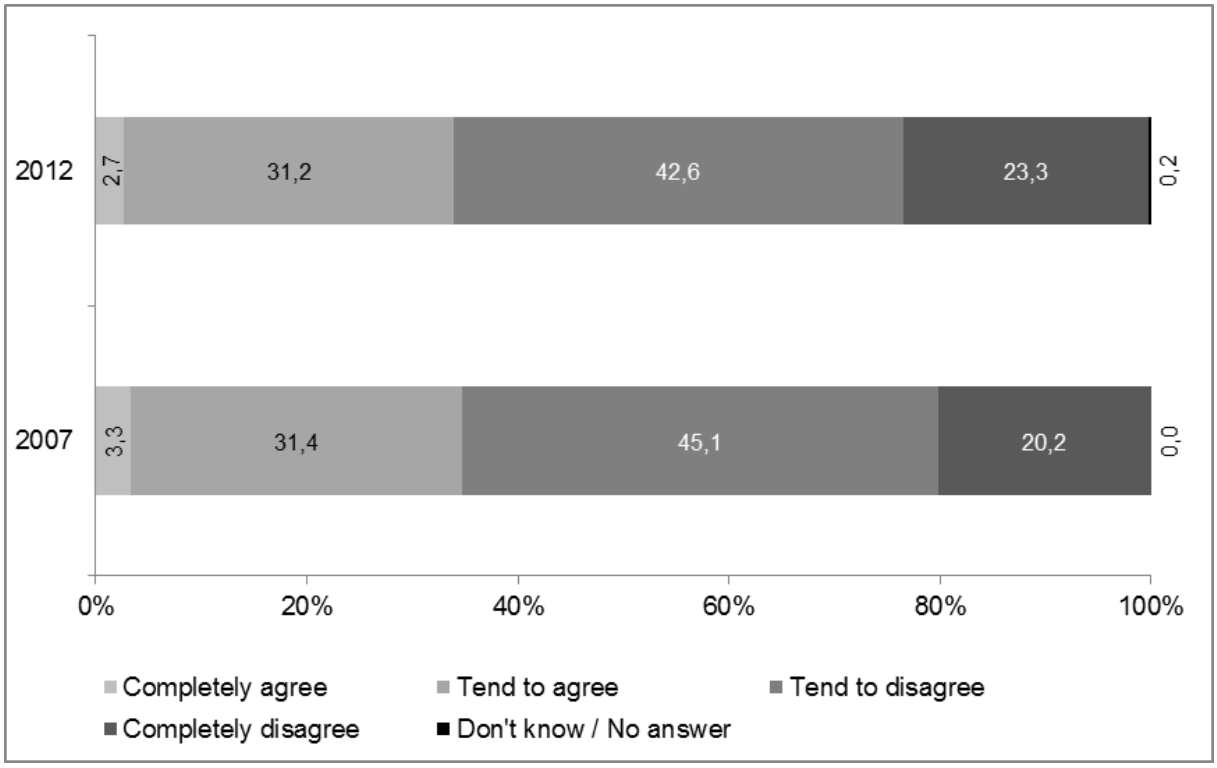
"How much faith would you have in the following persons or institutions if they were to inform you about nanotechnology?" (n=1,000)



This finding is in line with fact that only one in three respondents fully or generally agree with the statement "You can trust the government to protect the public from environmental risks and technical risks" (cf. Fig. 29). In the new survey, however, there are major (significant) differences in this respect based on gender: whereas 40.5 % of men agree with this statement, this applies to only 27.1 % of women.

Fig. 29: Trust in the government

"To what extent do you agree with the following statement: You can trust the government to protect the public from environmental risks and technical risks?" (n=1,000)

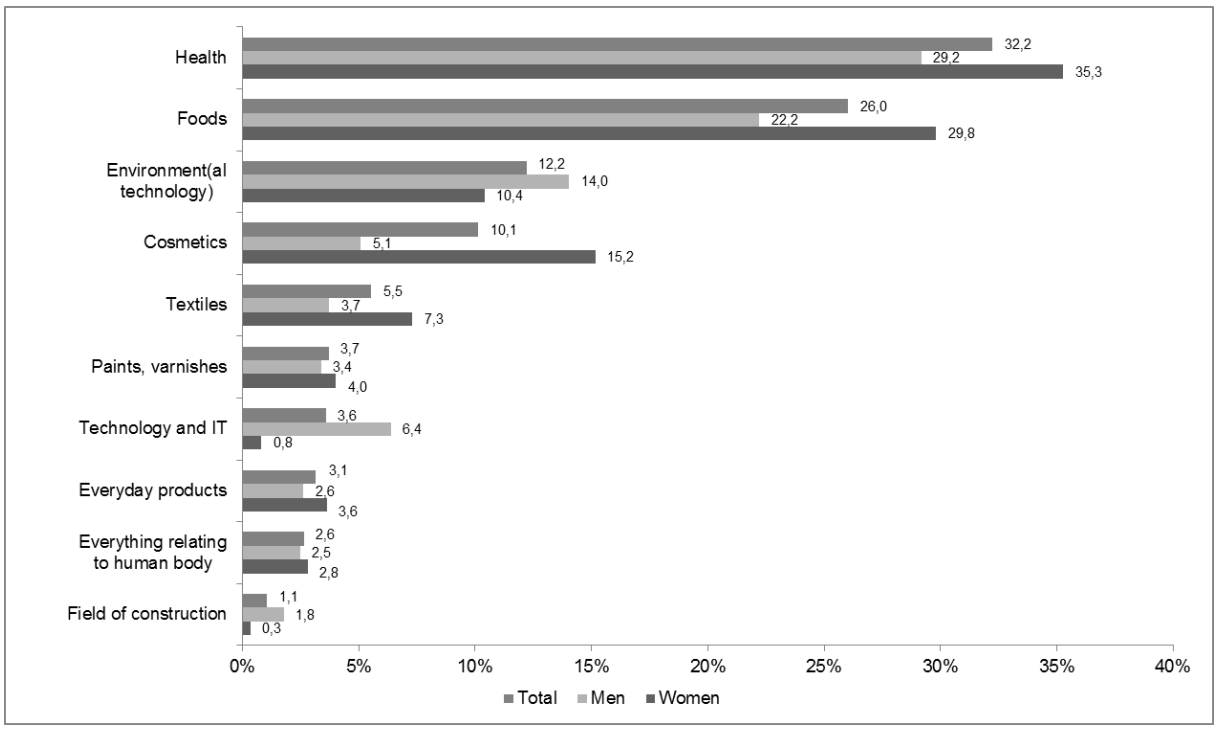


4.2.10 Need for information and action

Consumers want concrete information on applications of nanotechnology and nanomaterials (cf. Fig. 30). Women are primarily interested in applications in the fields of health, food, cosmetics and textiles. For men, the main applications are health and food, as well as environment(al technology), water, energy and (information) technology.

Fig. 30: Application-related information desires

"In which areas would you like more information about nanotechnology?“ (n=1,000)[48]

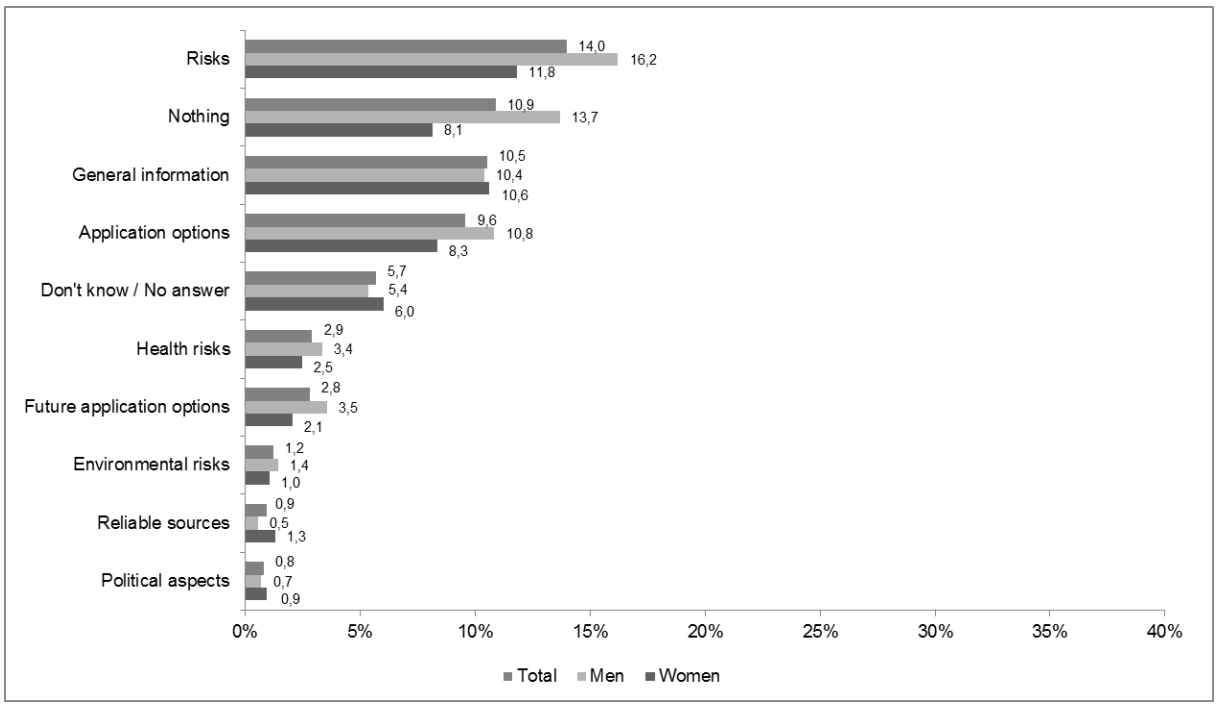


Compared to information on specific applications, which is in some cases desired by up to just under one third of respondents (health: 32.2 %), there is less demand for general information on nanotechnology, which was only named by around one in five respondents (21.6 %). When it comes to general information, the focus is on information on potential risks (cf. Fig. 31). In response to this question, it was also found that only few respondents (10.9 %) have no information needs at all - something that applies to a higher percentage of men (13.7 %) than women (8.1 %).

[48] The full answer categories are: "Area of health (medications, medical technology)"; "Foods", "Environment(al technology), water and energy"; "Cosmetics"; "Textiles"; "Paints, varnishes, surfaces"; "Technology and IT (computers, mobile phones, chips)"; "Household applications, consumer products, everyday products", "Information on everything relating to the human body", "Field of construction".

Fig. 31: General information desires

"In which areas would you like more information about nanotechnology?“ (n=1,000)[49]

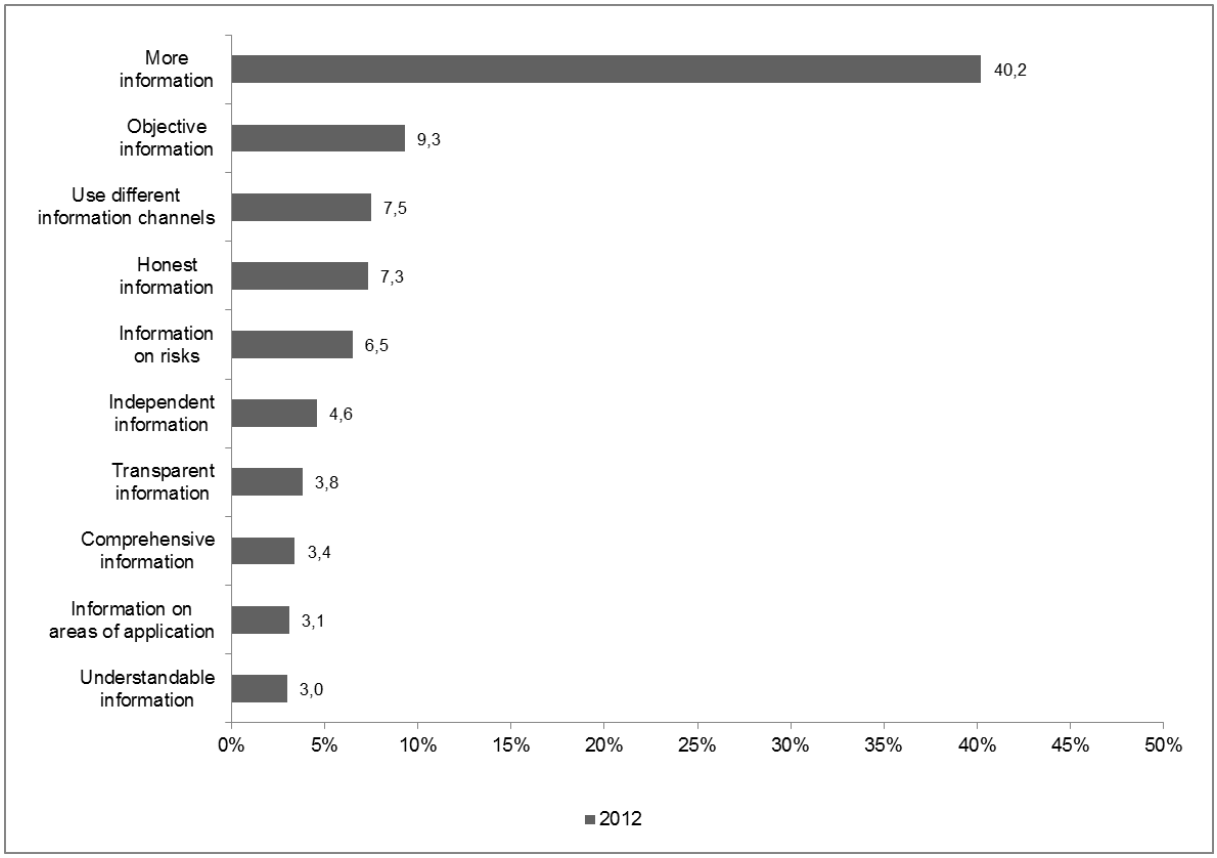


According to the following diagram, the most important expectation of official bodies by far is that they provide more in-depth information on nanotechnology (cf. Fig. 32).

[49] The full answer categories are: "Risks (general/long-term)", "On no topic area/Nothing", "General information on nanotechnology/on everything", "Information on application options and locations", "Don't know/No answer", "Risks to health", "Information on potential and future application options", "Risks for the environment", "Reliable, trustworthy sources", "Political aspects (e.g. control, labelling)".

Fig. 32: Expectations of official bodies - information

"In your opinion, what should official bodies (e.g. government or authorities) do with regard to nanotechnology?“ (n=1,000)[50]

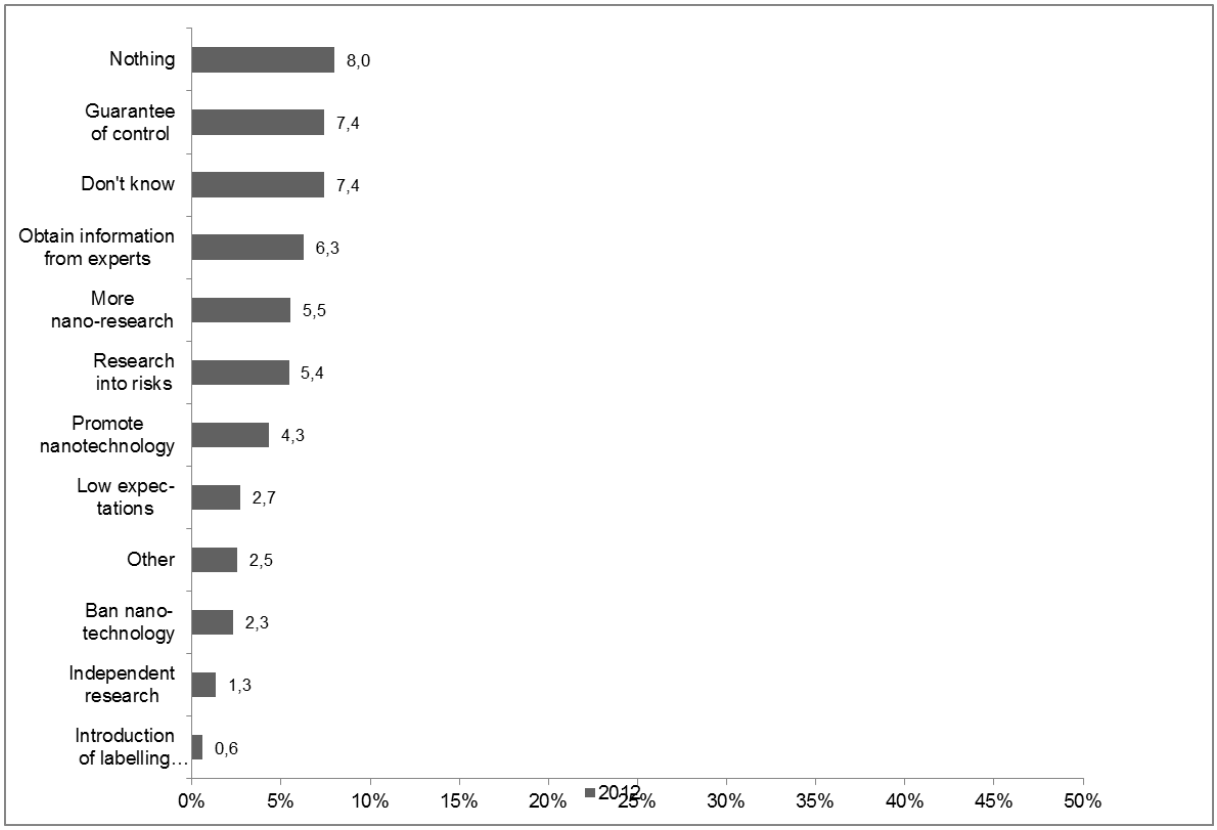


What consumers want is a balanced, objective, honest, independent and understandable information policy, while far less importance or no importance at all is attached to control and safety or the introduction of mandatory labelling by official bodies (cf. Fig. 33).

[50] The full answer categories are: "More information", "Balanced/Objective information", "Information via different information channels (media, Internet)", "Honest information", "Information on risks", "Independent information", "Transparent information", "Comprehensive information", "Information on areas of application", "Understandable information".

Fig. 33: Expectations of official bodies – control and promotion

"In your opinion, what should official bodies (e.g. government or authorities) do with regard to nanotechnology?" (n=1,000)[51]



4.3 Findings from the additional sample: evaluation by interpretative context

As outlined above, an additional sample (n=200) was asked the same questions as the main sample. At the beginning of the survey, however, the additional sample was given not only a brief description of the topic but also slightly more detailed and non-application-specific information on the potential and risks of nanotechnology.[52]

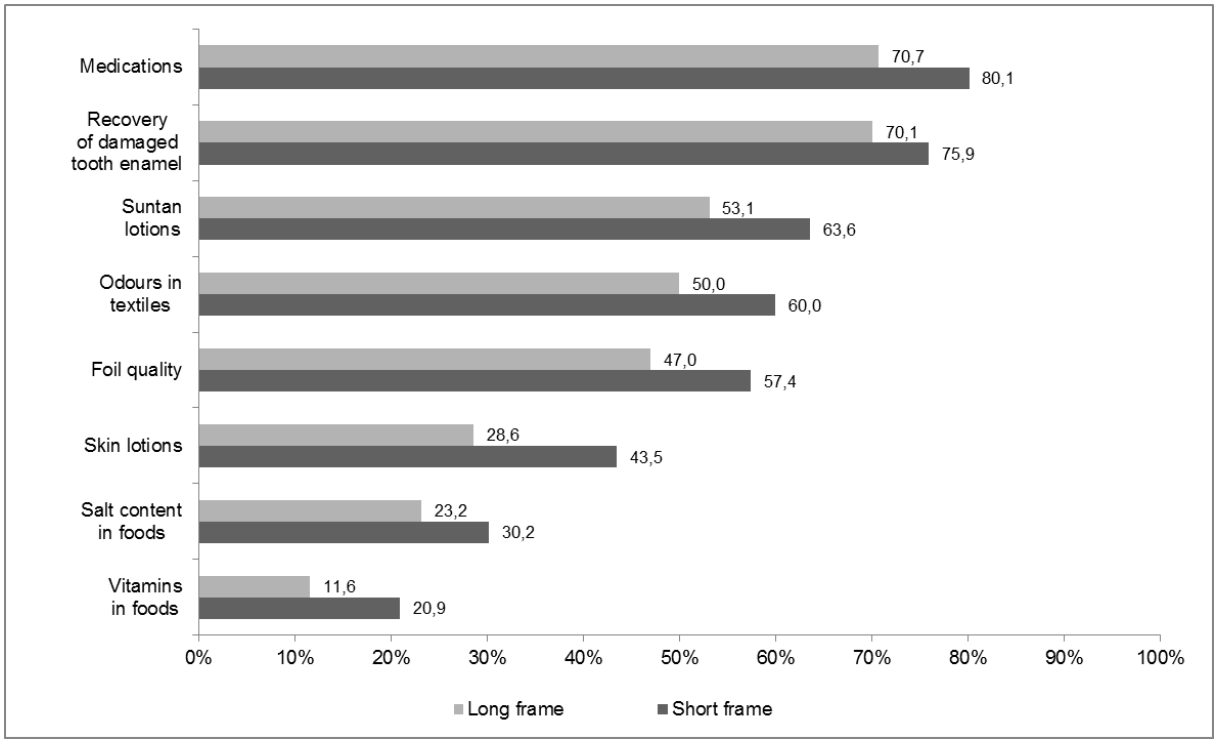
Other empirical studies have also used these or similar interpretative contexts (frames; cf. Chapter 3.4.4). It was found that two-sided framing, which addresses both potential and risks, leads to a slightly more critical attitude towards nanotechnology than a neutral portrayal that does not mention these aspects (e.g. Cobb 2005, Vandermoere et al. 2009a).

This finding is confirmed by the new survey. Support for various nano-applications is significantly lower when the respondents are provided with more comprehensive information on the potential and risks of nanotechnology (cf. Fig. 34).

[51] The full answer categories are: "Nothing", "Guarantee of control and safety", “Don't know/No answer", "Official bodies should obtain information from experts (also critical ones)", "More nano-research", "Research into risks", "Promote nanotechnology (ongoing development, investment)", "Low expectations of official bodies/Other actors should provide information", "Other", "Restrict/Ban nanotechnology", "Independent research", "Introduction of labelling regulations".
[52] See questionnaire in Annex 9.2.1.

Fig. 34: Support for nano-applications in dependence on interpretative context

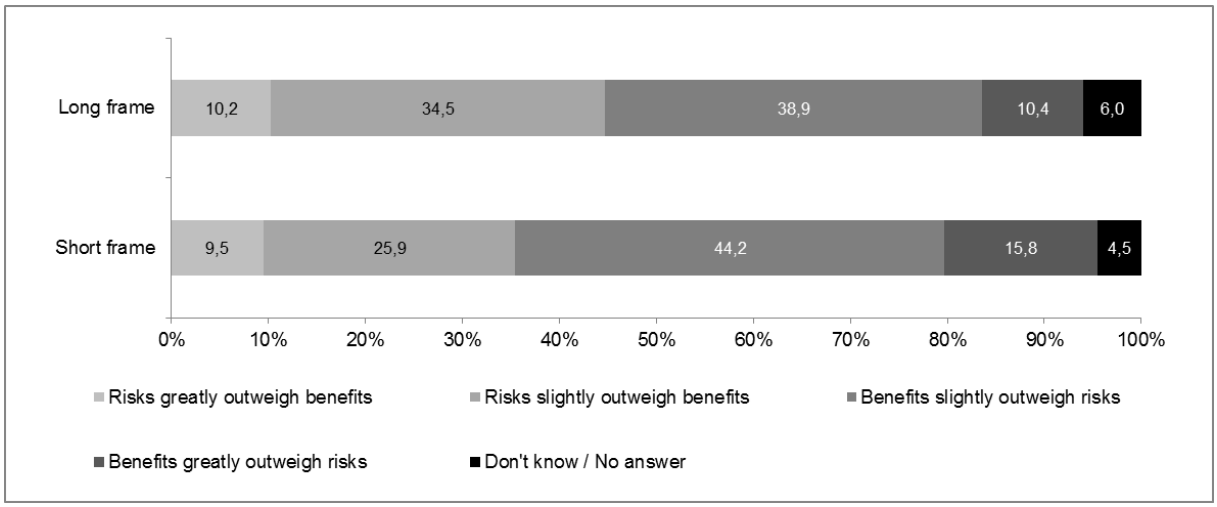
"Which of the following applications for nanomaterials do you support or disapprove of?"
(This is the same question as in Fig. 16, but the two answer categories "fully support" and "generally support" have been grouped together.)



The full descriptions of the applications are: "Medications that can release their active substances in concentrated form in the desired target location", "Recovery of damaged tooth enamel", "Increased efficacy of suntan lotions", “Prevention of unpleasant odours in textiles", "Improved foil quality to increase the shelf life of foods", "Active substances of skin lotions that reach deeper layers of the skin", "Reduction in the salt content in foods without affecting the taste" and "Enrichment of foods with vitamins and other nutrients".

Fig. 35: Risk-benefit ratio in dependence on interpretative context

"What is your assessment of the risk-benefit ratio of nanotechnology?“ (n=200)



This finding also applies to a slightly lesser extent to the perception of the risk-benefit ratio. If the respondents are given not only neutral information but also information on the potential and risks, nanotechnology is assessed more critically on the general level (cf. Fig. 35).

With regard to the application level of nanotechnology and nanomaterials, more information means that the ratio of risk to benefit is also seen more critically for specific applications but not for all applications: with respect to its use in sun lotions, the share of those who say that the risk will be "far" or "somewhat" greater than the benefit increases significantly, from 47.6 % to 60.3 %; in the case of skin creams, the figure rises from 61.2 % to 75.7 %.

The effect of different interpretative contexts is hardly noticeable on the level of attitudes. A significant difference was only found for one attitude statement: agreement ("fully" or "generally") with the statement "I am concerned that nanomaterials might harm the environment and nature" increased slightly, from 64.7 % to 71.6 %.

By way of conclusion, the following can be said with regard to two-sided framing:

- Two-sided framing has significant effects on the perception of different areas of application. It tends to lead to lower acceptance for nano-applications.
- It has the same scepticism-promoting effect on the assessment of the general risk-benefit ratio. This effect is weaker with regard to the application-related risk-benefit ratio, and this kind of interpretative context has only little or hardly any effect on the attitude level.

This finding confirms the finding of Cobb (2005) that balanced information on potential and risks only has a limited effect on the perception of nanotechnology. The data from the new survey additionally shows that the firmer the opinion of respondents, the lower the effect of this balanced information. This applies less to the various applications of nanotechnology - which are new to most respondents - than to the attitudes towards nanotechnology.

4.4 Summary of the descriptive evaluation of the main and secondary samples

The representative survey conducted in 2012 comprised a main sample (n=1,000) and an additional sample (n=200). The latter was given a slightly more detailed description of nanotechnology in order to permit analysis of the possible effects of different interpretative contexts on the perception of nanotechnology.

The figures for the main sample show that over 71 % of the population – almost ten percentage points more than in 2007 – believe that the **importance** of nanotechnology will increase.

However, a majority of the respondents have still not heard anything about nanotechnology. The answers to the open question "What have you heard or read about nanotechnology or nanomaterials?" show that the share of uninformed people has increased - from 32.7 % in 2007 to 40.9 % in 2012. If we also include the respondents who "have heard something about it but cannot provide any more details" (15.1 % in 2007 and 4.7 % in 2012), however, then this puts the increase in perspective (47.8 % who know nothing or little about nanotechnology in 2007 against 45.6 % in 2012). It is not therefore possible to make any clear statements on **awareness**.

If the respondents are provided with a brief explanation of nanotechnology, then the **awareness level** increases slightly, and the percentage of uninformed respondents falls to just 18.5 %. There was little change in this "aided knowledge level" between the surveys in 2007 and 2012.

The **risk-benefit ratio** of nanotechnology is seen slightly more critically in 2012 than five years previously: in 2012, 35.4 % of respondents believe the risks are greater than the benefit (compared to a figure of 33.0 % in 2007). The majority of respondents (60.0 % in 2012 and 66.0 % in 2007) take a more positive view of the risk-benefit relationship.

What is also apparent is that **acceptance** for nanotechnology depends on the area of application. Acceptance levels are high for medical and environmental applications. In contrast, the use of nanotechnology and nanomaterials in products outside the human body (e.g. paint, textiles) is not viewed quite as positively, although it is still supported fully or generally by (over) 60 % of the population. The use of nanotechnology and nanomaterials in foods and cosmetics tends to be seen critically. The exception is the use of nanotechnology in sun lotions to increase their efficacy, and in food packagings, provided that this can prolong the shelf life of food products.

We find similar attitude relationships for the willingness to buy nanoproducts. **Willingness to buy** is relatively high for surface sealing and care products but tends to be low when it comes to nanocosmetics and nano-foods.

Although the majority of respondents have a good (62.4 %) to very good (4.8 %) **feeling** about the issue of nanotechnology, these figures are significantly lower than in the 2007 survey.

Based on two attitude items surveyed both in 2007 and 2012 ("Nanotechnology will open up fantastic opportunities for technical development", "It's really scary if you think how many nanoproducts are supposedly already on the market"), the positive **attitude** towards nanotechnology is slightly weaker. That nanoproducts can also hold a certain fascination, however, is reflected by the high scores for the two statements "If nanotechnology makes everyday products better, I will be happy to use them" and "I hope nanotechnology will help to protect the environment and repair environmental damage". This means that people also associate a wide range of possibilities with the emergence of nanotechnology. Nanotechnology is seen as making an important contribution to strengthening Germany as an industrial location in the global competitive arena (74.5 % agree fully or generally with this assessment) and as an instrument that helps to identify and cure disease (73.7 %). It is assumed that this basic technology will significantly promote technical development (71.6 %) and that nanotechnology will benefit society (63.4 %). Just over one in two respondents therefore support state funding for nanotechnology. The recorded attitudes also reflect a certain amount of scepticism, however: around two thirds of the population agree with statements that emphasise the health and ecological risks of nanotechnology.

The majority of consumers still feel less well-informed about nanotechnology compared to other modern technologies. The differences with regard to **subjective information levels** between the two surveys are not significant. As was the case in 2007, the most important **sources of information** today are seen as being television as well as magazines and newspapers, followed in fourth place by the Internet, which has gained considerably in importance since 2007. When asked about their preferred **information channels** today, respondents even name the Internet in first place.

Scientists, doctors, health authorities, occupational safety authorities and environmental organisations are considered the most **trustworthy** sources of information on the issue of nanotechnology. Consumer organisations are some way behind in this respect, with management executives in industry and government representatives even further behind. Only just over 20 % of the population see the latter as being absolutely or somewhat trustworthy.

Consumers want concrete **information** on applications of nanotechnology and nanomaterials, whereas there is far lower demand for general information on nanotechnology. The focus is on information on risks. By far the most important expectation of **official bodies**, therefore, is that they provide more in-depth information on nanotechnology. What consumers want is a balanced, objective, honest, independent and understandable information policy, while far less importance or no importance at all is attached to control and safety or the introduction of mandatory labelling by official bodies.

For the following findings, there were numerous significant differences for the variables **gender** and **age**:

- Women are on the whole more sceptical towards nanotechnology than men; i.e.
  - men tend to be more in favour of nano-applications than women
  - men take a more positive view than women of the risk-benefit ratio in general and in connection with specific applications
  - men have a far better feeling about nanotechnology than women
  - when it comes to information about nanotechnology, men have more faith in the government than women; women have more faith than men in environmental organisations as well as health and work safety authorities
  - in some areas, men have a far more positive attitude towards nanotechnology than women
- Younger people are on the whole more open-minded about nanotechnology than older people; i.e.
  - younger people tend to be more in favour of nano-applications than older people. The cohort of 16 to 30-year-olds is in some cases far more open-minded than the population overall
  - younger people take a (slightly) more positive view than older people of the risk-benefit ratio in general and in connection with specific applications
  - in some areas, younger people have a far more positive attitude towards nanotechnology than older people

In contrast, there are few to hardly any significant differences for the variables "education", "size of household", "income" and "migration background".

Comparison of the main and additional samples tells us the following about the effect of different **interpretative contexts (framing)**:

- Two-sided framing (risks and benefit) has significant effects on the perception of different areas of application. It tends to result in lower acceptance levels for nano-applications.
- It also boosts scepticism when it comes to assessment of the overall risk-benefit ratio. This effect is weaker with regard to the application-specific risk-benefit ratio, and this kind of interpretative context has little or almost no effect on the attitude level.

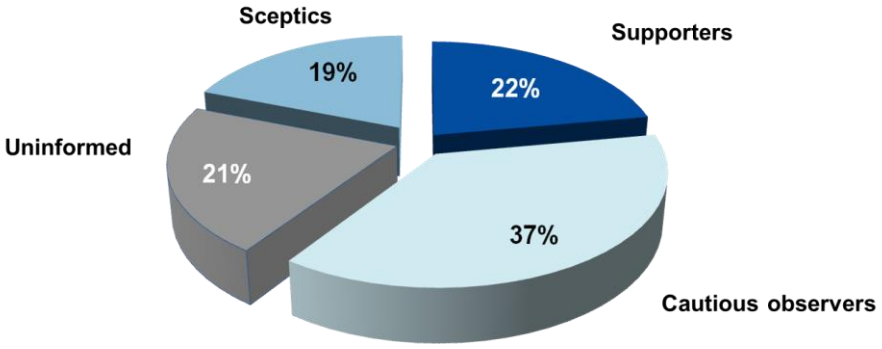
4.5 Nano-types and social milieus

As mentioned in Chapter 4.1.2.4, one of the goals of the data analysis was to determine "types" who perceive nanotechnology differently. These "nano-types" help us to identify potential target groups for risk communication.

Cluster analysis methods (two-step method, SPSS) were used to define four types. The "active variables" used for type formation are: attitudes towards nanotechnology, the acceptance of applications and other characteristics (including aided knowledge, affect, assessment of the general risk-benefit relationship).

It is possible to distinguish four nano-types: supporters (22 %), sceptics (19 %), cautious observers (37 %) and uninformed (21 %) (cf. Fig. 36).

Fig. 36: Distribution of nano-types in the main sample (n=1,000)



4.5.1 Differences with regard to nanotechnology

The supporters say far more frequently than the population overall that they have already heard "something" about nanotechnology (cf. Tab. 22). The scores for the uninformed are naturally significantly lower than for the population overall. Almost four in five respondents conforming to this type say they have heard nothing at all about nanotechnology. Alongside the supporters, the cautious observers also possess above-average knowledge levels.

The willingness to purchase products in the segments of surface sealing and care, clothing, cosmetics or food that contain nanomaterials is in some cases far greater among supporters than among the population overall. The sceptics are the most reserved group in this respect.

Another characteristic feature of the supporters is that their feeling towards the issue of nanotechnology is good or very good far more frequently than is the case among the population in general. The feeling of the "cautious" type is similarly positive, while the opposite is true of the sceptics, almost all of whom have a bad to very bad feeling about nanotechnology.

Tab. 23: Differences between the nano-types with regard to nanotechnology (n=1,000)

		Total sample	Supporters	Cautious observers	Sceptics	Uninformed
Knowledge	None at all	19 %	0 %	0 %	9 %	79 %
	Some	72 %	90 %	85 %	83 %	21 %
	Quite a lot	9 %	10 %	15 %	8 %	0 %
Willingness to buy	Surface sealing and care	76 %	93 %	86 %	49 %	68 %
	Clothing	63 %	87 %	69 %	23 %	63 %
	Cosmetics	35 %	61 %	35 %	6 %	32 %
	Food	17 %	36 %	11 %	1 %	23 %
Affect	Very positive/Positive feeling	70 %	99 %	94 %	10 %	51 %
	Very negative/Negative feeling	30 %	1 %	6 %	90 %	49 %

4.5.2 Sociodemographic characteristics

The four types also differ in terms of sociodemogarphic characteristics (cf. Tab. 24). The supporters tend to be young and male. The sceptics on the other hand tend to female and older. The group of "uninformed" also comprises an above-average percentage of women.

Tab. 24: Differences between the nano-types with regard to sociodemographic variables

		Total sample	Supporters	Cautious observers	Sceptics	Uninformed
Gender	Men	51 %	68 %	56 %	35 %	37 %
	Women	49 %	32 %	44 %	65 %	63 %
Age	16–30	28 %	45 %	24 %	15 %	32 %
	31–45	33 %	25 %	37 %	34 %	33 %
	46–60	39 %	30 %	39 %	51 %	36 %

4.5.3 Milieu affiliation

The four nano-types were also analysed to determine which milieu they belong to (cf. Tab. 25). The initial finding is that each type is represented in each social milieu. However, the distribution of types across the social milieus differs from the distribution found in the overall sample (n=1,000), in some cases significantly:

- The supporters are found with above-average frequency in the young milieus: while only 15 % of the total sample belong to this milieu, the figure for supporters is 27 %. The index value of 1.75 indicates that the share of young milieus among supporters is 75 % higher than among the overall sample.
- The sceptics tend to be found in the upper-range and creative/critical milieus and to a far below-average degree – 53 % more seldom than in the overall sample – in the young milieus.
- The uninformed are found more frequently than the population overall in the young milieus as well as in the simple and precarious milieus.
- The cautious observers are inconspicuous in this respect, and their milieu distribution is more or less in line with that of the overall sample. In other words, the index values are almost all nearly 1.

Tab. 25: Differences between the nano-types with regard to milieu affiliation

	Total	Supporters *(Index)*	Cautious observers *(Index)*	Sceptics *(Index)*	Uninformed *(Index)*
Upper-range milieus	23 %	24 % (1.07)	22 % (0.96)	29 % (1.27)	17 % (0.75)
Bourgeois mainstream	32 %	28 % (0.88)	35 % (1.11)	31 % (0.97)	31 % (0.96)
Simple/Precarious milieus	15 %	9 % (0.60)	15 % (0.99)	14 % (0.90)	24 % (1.53)
Young milieus	15 %	27 % (1.75)	10 % (0.65)	7 % (0.47)	20 % (1.31)
Creative/Critical milieus	15 %	12 % (0.79)	18 % (1.20)	19 % (1.30)	9 % (0.60)
Total	100 %	100 %	100 %	100 %	101 %

* Index value: expectation value = 1.00 (frequency of occurrence in "total")

If we further differentiate the various milieus by gender, we see that major differences between men and women can occur within the same milieus. The upper-range milieu contains an above-average number of male supporters, for example, but also an above-average number of female sceptics. This finding once again underlines the major importance of gender with regard to the perception of nanotechnology.

Tab. 26: Differences between the nano-types with regard to milieu affiliation and gender

		Total	Supporters *(Index)*	Cautious observers *(Index)*	Sceptics *(Index)*	Uninformed *(Index)*
Upper-range milieus	Men	12 %	17 % (1.44)	12 % (1.07)	11 % (0.92)	6 % (0.49)
	Women	11 %	8 % (0.68)	10 % (0.86)	18 % (1.62)	12 % (1.02)
Bourgeois mainstream	Men	17 %	19 % (1.13)	21 % (1.27)	12 % (0.72)	11 % (0.64)
	Women	15 %	9 % (0.62)	14 % (0.94)	19 % (1.23)	20 % (1.31)
Simple/Precarious milieus	Men	8 %	6 % (0.86)	10 % (1.33)	4 % (0.56)	7 % (0.97)
	Women	8 %	3 % (0.35)	5 % (0.65)	10 % (1.24)	16 % (2.08)
Young milieus	Men	8 %	19 % (2.31)	4 % (0.53)	1 % (0.15)	10 % (1.22)
	Women	7 %	8 % (1.09)	5 % (0.78)	6 % (0.85)	10 % (1.42)
Critical/Creative milieus	Men	7 %	8 % (1.12)	8 % (1.23)	7 % (0.99)	3 % (0.49)
	Women	8 %	4 % (0.51)	9 % (1.17)	12 % (1.57)	6 % (0.70)
Total		100 %	101 %	98 %	100 %	101 %

4.5.4 Influence of different interpretative contexts

If the respondents are not only given the neutral short description of nanotechnology but also a description of potentials and possible risks (interpretative context, long), then, as is to be expected, the percentage of "uninformed" falls, in this case by around one third. Also not surprisingly, the percentage of sceptics also shows a major increase, rising by over half. At the same time, the percentage of supporters falls by almost one third.

Tab. 27: Influence of different interpretative contexts

	Interpretative context, short (main sample n=1,000)	Interpretative context, long (additional sample n=200)	Difference
Supporters	22 %	16 %	- 6 %
Cautious observers	37 %	41 %	+ 4 %
Sceptics	19 %	29 %	+ 10 %
Uninformed	21 %	14 %	- 7 %

Framing therefore has a quite pronounced effect on the frequency distribution of the various types. This is above all due to the fact that the interpretative context has a strong influence on the perceived acceptance of nano-applications (see Chapter 4.3) and that this variable was also included in the definition of the types.

4.6 Summary of nano-types and social milieus

Based on the empirical data, it is also possible to differentiate four **nano-types**: supporters (22 %), sceptics (19 %), cautious observers (37 %) and uninformed (21 %). The supporters say far more frequently than the population overall that they have already heard "something" about nanotechnology. The scores for the uninformed are naturally significantly lower than for the population overall. Almost four in five respondents conforming to this type say they have heard nothing at all about nanotechnology. Alongside the supporters, the cautious observers also possess above-average knowledge levels. The supporters tend to be young and male. The sceptics on the other hand tend to female and older. The group of "uninformed" also comprises an above-average percentage of women.

The **nano-types** are also in part differently distributed among the various social **milieus**: the supporters are found with above-average frequency in the young milieus. The sceptics tend to be found in the upper-range and creative/critical milieus and to a far below-average degree in the young milieus. The uninformed are found more frequently than the population overall in the young milieus as well as in the simple and precarious milieus. In contrast, the cautious observers are inconspicuous in this respect, and their milieu distribution is more or less in line with that of the overall sample.

If we further differentiate the various **milieus** by **gender**, we see that major differences between men and women can occur within the same milieus. The upper-range milieu contains an above-average number of male supporters, for example, but also an above-average number of female sceptics. This finding once again underlines the major importance of gender with regard to the perception of nanotechnology.

5 Risk Communication Concepts

5.1 Introduction

5.1.1 Background and objective

In recent years, there has been little or no change in awareness levels among the general population with regard to nanotechnology. This is shown by a comparison of the representative Germany-wide surveys on the risk perception of nanotechnology among the population conducted in 2007 and 2012 (cf. Chapter 0). In response to the open question regarding nanotechnology, around 40 % of respondents in the 2012 survey say they had not previously heard of nanotechnology or nanomaterials (cf. Chapter 4.2.2). At the same time, however, those respondents who did know about the topic were able to make fairly differentiated statements on individual issues and applications. The risk-benefit ratio of nanotechnology is seen slightly more critically than five years previously, and the general attitude towards nanotechnology has become less favourable. The subjective feeling of being informed about the issue is also still less pronounced than is the case with other innovative technologies. From the point of view of consumers, therefore, this means that an information deficit still exists when it comes to nanotechnology.

Against this backdrop, the **task** in Work Package 6 (WP 6) is to develop two alternative concepts for target group-appropriate risk communication with regard to nanotechnology in consumer-oriented areas. These concepts should represent evidence-based recommendations for action by decision-makers and multipliers and serve as a basis for future communication strategies of the BfR.

5.1.2 Procedure

Two alternative risk communication concepts were developed in a two-stage process, which took account not only of the previous work from the research project but also of the insights gained in two group discussions with consumers.

First, the conceptual framework of the risk communication concepts was developed based on the results of the international study comparison (WP2) and the findings of the representative survey of consumers (WP3–5) as well as research on national and international examples of nano-related risk communication. The concept proposals comprise the following elements of a communication strategy (more detailed information in Chapter 5.2.2):

- Initial situation
- Positioning
- Copy strategy (communication objectives, value proposition, factors supporting the value proposition and communication style)
- Communication measures

Due to the significantly different perceptions of nanotechnology among men and women that were apparent in the representative survey (cf. Chapter 3.6), the concept proposals were differentiated by gender. The conceptual derivation is shown in Chapter 5.2.

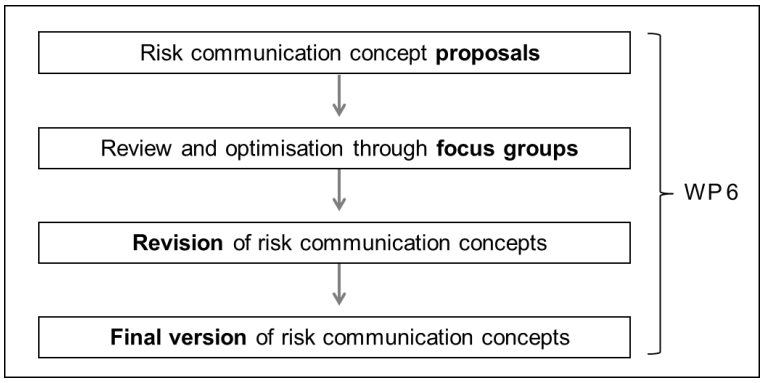
The concept proposals were then reviewed and optimised in two focus groups with consumers - one male, one female. The first part of the group discussion polled spontaneous associations with and general knowledge of nanotechnology, and looked at examples of nano-applications in terms of acceptance as well as potential and risks. The second part focused on the information and communication needs of participants with regard to nanotechnology. The aided discussion of examples for different concepts and discussions in small groups

pinpointed important ideas for subsequent revision of the two communication concepts. The results of this qualitative survey are outlined in Chapter 5.3.

The final concepts are outlined in sections 5.4 and 5.5.

Fig. 37 below provides an overview of the procedure

Fig. 37: Procedure in Work Package 6



This sub-section on the communication concepts concludes with a recommendation and a summary in Chapter 5.6.

5.2 Derivation of target group-specific risk communication concepts

5.2.1 Effective risk communication

The focus of risk communication is on the interactive exchange of information and opinions between the public at large, non-governmental organisations, authorities and industry on the potential and risks of technologies (Ulbig et al. 2010: p. 40). The primary function is to make the public "risk-mature" through information and education. "Risk-mature" means the ability to assess risks independently and then to assess the appropriateness of options for action (Hertel und Henseler 2005: p. 83). Accordingly, the job of risk-regulating institutions is to create and maintain a suitable communication and exchange platform that promotes risk-mature attitudes among consumers. In order to achieve this goal, effective risk communication takes account of criteria like understandability, transparency and usability (Kurzenhäuser et al. 2010).

Risk communication can be prepared and presented to consumers in a variety of ways. The literature distinguishes between three types of communication (Hertel und Henseler 2005: p. 11):

- Risk communication as an offer of information (one-way communication)
- Risk communication as an offer of dialogue (two-way communication)
- Risk communication in the form of participation (with options for involvement in the preparation and making of decisions)

Findings from recent empirical consumer studies and the representative survey conducted as part of the project (cf. Chapter 3.3.8) indicate a need to create multi-dimensional offers for the communication of the potential and risks of nanotechnology. Firstly, the provision of information via classic channels such as the mass media is absolutely essential in order to combat the knowledge deficits in the field of nanotechnology. If this raises awareness and

makes consumers more conscious of the issues, it paves the way for more in-depth offers of dialogue and participation. The latter put consumers in a position to judge and evaluate the information, and to understand complex information contexts and constellations of players in the process of risk assessment. Discursive forms of dialogue include such things as public meetings, panel discussions and Internet forums. Their characteristic feature is a built-in feedback option for the target group of communication, thereby permitting members of the target group to outline their own points of view on certain issues, for example. Communicative participation processes go a step further and offer participants the opportunity to be involved in the preparation and making of decisions. Examples of such processes include consensus conferences, future workshops, citizens' forums, citizens' commissions etc.; in other words, forms of participation in which people work together to seek a common solution (Hertel and Henseler 2005: p. 18).

Risk communication often fails due to misinterpretations or a lack of clarity among the addressees (Ulbig et al. 2010: p. 112). When drawing up information content, therefore, and choosing the form of address and the medium, it is important to take the influence of life-world and target group-specific determinants into consideration. This is why all forms of communication must also always take account of needs and circumstances shaped by socio-cultural and societal factors. Among other things, this includes differences in perception between men and women.

5.2.2 Blueprints for target group-specific risk communication concepts

Against the backdrop of the considerations outlined above, the drafted risk communication concepts attached central importance to the gender-specific findings of the representative survey with regard to nanotechnology (see below) and developed an ideal-typical male and an ideal-typical female concept.

With regard to gender-specific differences in the perception of nanotechnology, the representative survey showed that women are on the whole more sceptical towards nanotechnology than men (cf. Chapter 0). This means that:

- Men are more often in favour of nano-applications than women
- Men take a more positive view than women of the risk-benefit ratio in general and with regard to specific applications
- Men have a far better feeling about nanotechnology than women
- When it comes to information about nanotechnology, men have more faith in the government than women. Women have more confidence than men in environmental organisations and health and occupational safety authorities
- In some cases, men's attitudes towards nanotechnology are far more positive than those of women

The realisation that there are gender-specific differences in the perception of nanotechnology is the primary differentiating characteristic between the two alternative communication concepts, and this permits clear differentiation of the two concepts. Nevertheless, the implementation of individual measures to address the different target groups is not always meaningful. The conceptual considerations are therefore to be seen as ideal-typical and, in some cases, simplified.

First of all, both concepts were drawn up based on the following content of the blueprint. The initial situation outlines the problems and challenges of risk communication. The positioning statement describes the specific benefit of the subject of communication from the perspective of a specific target group and acts as a structuring factor for the objectives and themes of communication. The so-called copy strategy serves to lend concrete form to the positioning

strategy. It defines how the positioning strategy can be implemented in terms of arguments and communicative aspects and can be seen as a thread running through the communication process. It comprises, among other elements, the following (Meffert et al. 2008; Fuchs und Unger 2007; Baumgarth 2008):

- Communication objectives: what is the goal of communication?
- Value proposition: what are the benefits for consumers?
- Reasons for the value proposition: what evidence supports the proposed benefits?
- Communication style: what is the nature of the language and visual concept?

Alongside these conceptual considerations, ideas were also developed for possible operational communication measures for both concepts. These measures are not designed to target exclusively men or women but, given the conceptual thoughts outlined above, are particularly suitable for addressing the target group in question.

In the **ideal-typical male concept** based on the assumption of a positive basic attitude towards nanotechnology through to a fascination with this technology, the planned communication measures were as follows:

- Experiment kit for schools containing different experiments from the world of nanotechnology and demonstrating simple nanotech phenomena ("SimplyNano 1")
- Open nano-lab in scientific institutions where scientists conduct live experiments ("Gläsernes Forschungslabor" (Transparent Research Lab))
- Smartphone app showing examples of nanotechnology applications ("nanotörn")
- Germany-wide roadshow of an "exhibition centre on wheels" providing information on the potential and risks of nanotechnology using information panels, brochures and films, and also giving the public an opportunity to talk to scientists

Four types of communication measure were also discussed to cater to the **ideal-typical female concept**:

- Interactive and educational online "search game" to promote playful involvement with nanotechnology in an everyday environment ("NanoramaLoft")
- Exhibition in a museum designed to appeal to families and providing an overview of the different fields of application for nanotechnology
- Print brochure featuring useful information on nanotechnology in an everyday context today and in the future
- Online information platform with information on research projects, applications and materials, safety and legal issues ("Nanoportal Baden-Württemberg")

5.3 Review and further development of the draft concepts in focus groups

The conceptual considerations outlined in the preceding chapter formed the basis for group discussions, where they were presented in simplified form together with the proposed measures. The goal of the group discussions was to gain more in-depth insights into the information needs of selected target groups by addressing the following key questions:

- How is nanotechnology perceived by the target groups, and what are the resulting information and communication needs?
- How do the target groups view the developed communication concepts, and how relevant, acceptable, credible etc. are the concepts?
- Which information media and measures can be used to reach the target groups?

In line with the gender-specific communication concepts, the groups of participants were also put together based on gender.

5.3.1 Methodology

The focus group method was chosen to review the communication approaches. Focus groups or group discussions are a commonly used and proven survey instrument in qualitative market and social research (see, for example, Kühn and Koschel 2011; Lamnek 2005; Bohnsack et al. 2010).

The advantage of group discussions is that they document opinions in the context of social communication. The mutual stimuli provided by group participants promote the diversity of opinion and rapidly pinpoint central argumentation patterns and controversies. A wide range of media and techniques can be used during the course of a group discussion (films, discussions in small groups, compilation of collages etc.), providing a forum not only for rational and verbal insights but also for creative and emotional stimuli. Last but not least, this is also a "vibrant" process, as it permits the observer to experience the reactions of the target groups live and unfiltered through a one-way mirror.

There were two focus groups lasting three hours, each with nine participants. The groups met on 7 and 8 November 2012 in a centrally located test studio in Berlin.

The make-up of the groups was based on the results of the representative survey. It was decided to put together two single-gender groups, each comprising different "nano-types" and age groups:

- Group 1: Men
  - "Nano-types": equally divided between "supporters" and "cautious observers". According to the representative survey, these two types account for 71 % of men. "Sceptical" and "uninformed" men were not invited to take part.
  - Level of knowledge: average *("have heard about it")*
- Group 2: Women
  - "Nano types": equally divided between "sceptics" and "cautious observers". According to the representative survey, these two types account for 59 % of women. "Supporters" and "uninformed" women were not invited to take part.
  - Level of knowledge: average *("have heard about it")*

The nano-type of the "uninformed" was not included in the focus groups, as their participation was not expected to make any substantial contribution to the development of target group-specific risk communication concepts. In order to make the focus groups as representative as possible of the key target groups, neither were the "minority types" among the men and women included. In other words, the nano-type "sceptics" were excluded from the male group and the nano-type "supporters" from the female group. When interpreting the results, therefore, it should be taken into account that the participating men and women partly come from different attitude spectrums. This disparity was deemed to be acceptable, given that the aim was to allow targeted discussion of the ideal-typical male and female communication concepts with the participants.

Half of the participants in each group were between the ages of 20 and 35, the other half between 35 and 60 years old. The recruitment criteria also ensured a relevant mix in terms of educational background and size of household. People employed in the fields of nanotechnology, journalism and marketing/market research were not invited to take part, and a screening questionnaire was developed for the recruitment of quota-compliant participants.

The focus groups were moderated[53] using a detailed topic catalogue, which served as a framework for the moderators but was used flexibly to provide sufficient time and space for the core issues identified by the group participants. The group sessions were structured as follows:

- Greeting and introduction:
  - Information on the topic, the schedule and data protection
  - Introduction round
- Unaided discussion:
  - Nanotechnology: associations, experiences, opinions
  - Information needs
- Aided discussion:
  - Presentation of information films[54] on nanotechnology
  - Discussion: spontaneous reactions, potential and risks of nanotechnology, relevance of and willingness to use products, supplementary information needs
    Review of communication concepts:
  - Presentation of communication concepts A and B (alternating sequence in the focus groups)
  - Discussion: spontaneous reactions, acceptance and relevance, credibility of approach and sender, assessment of measures and media, suggestions for improvement
- Development of communication approaches by the participants:
  - Work in two small groups (younger participants below the age of 35 versus older participants over 35)
  - Preferred communication content, media, visualisations (collages)
- Conclusion, closing:
  - Presentation of the results of small work groups
  - Final session: recommendations

The collages were put together on flip charts with the help of topical magazines from which the participant were able to cut out images. Each team had an identical set of magazines (*Stern, Brigitte, Chip, PM* and *Bahn Mobil*).

The focus group discussions were recorded on DVD, transcribed and their content then analysed and evaluated[55].

5.3.2 Perception and information needs

Spontaneous associations

When asked what springs to mind when they think about nanotechnology, the participants above all name various everyday products:

- Above all: coatings, particularly on cars but also on glass surfaces (windows/windscreens etc.), roof tiles, kitchenware (pots, pans), furniture, furnishings or bathroom fittings. Participants have heard of the "Lotus effect").
- Detergents/Cosmetics/Textiles/Leather impregnation sprays
- Semiconductors in computers

[53] The moderator was Dr. Brigitte Holzhauer, and the co-moderators were Dr. Gerd Scholl and Maike Gossen.
[54] Two information films were shown (in a different sequence in the two groups):
1. "Nanotechnologie", film produced by the Deutscher Museum, 4 minutes (correct as of 7 Nov 2012): http://www.youtube.com/watch?v=7Ng3wrQZMR8&feature=related
2. "Nanopartikel auf dem Vormarsch" (Nanoparticles on the Advance)", produced by the Hessischer Rundfunk broadcasting company, aired on the "eins plus" channel on 15 April 2012, 6 minutes (correct as of 7 Nov 2012):

[55] The focus groups were evaluated by Dr. Brigitte Holzhauer.

Objects from the scientific sphere were named less frequently, such as:

- Micro machines/Nanobots, mini-robots
- Nanotubes/Transport of medications
- Space research/New materials
- Also: learning from nature (e.g. water roll-off from lotus leaves, the adhesive pads of geckos)

The term "nano" translates as "small", "extremely tiny", "dwarf", "10 to the power of minus 6" and the first impression is that it is associated with a very modern context of meaning: nano signifies new, scientific and forward-looking; nano suggests quality and exclusivity, and is associated with expensive products.

Critical associations are found only sporadically, in the sense that nanoparticles diffuse in the body, for example, or can cross physiological barriers.

Experiences

Nanotechnology is associated with various everyday products, but concrete (and conscious) experiences with nano-products are still not very common. People assume that they have already come into contact with nano at home or at work without noticing or being aware of it.

Opinions on and attitudes towards nanotechnology

Unaided opinions on nanaotechnologies (in other words, opinions that are formed without the participants having been given any information on the topic) are very vague and non-specific. Firm and well-founded attitudes do not yet exist. The most common spontaneous association is with genetic technologies. It is possible to identify the following types of opinions:

- Fascination with technology (men, above all in the group of "supporters")
- Weighing of positive and negative potential (men/women)
- Concern (women, "sceptics" among the female participants)

Aided opinions were surveyed following the presentation of two different films on nanotechnology (cf. Chapter 5.3.1).

It is above all the critical aspects that stay in the mind of consumers; in other words, information regarding the fact that nanotechnology is already used in many everyday products, or that medical trials have determined that this technology may have negative effects on the hearts of rats and that nanomaterials are not always detectable in products or listed in product information. How do consumers react to this? It gives them all cause for reflection, and it is possible to distinguish three typical reactions:

- A call for supervision and rules (men/women)
- Indignation and rejection (women, "sceptics" among the female participants)
- Relativisation of risks (men, most commonly among the "supporters")

With regard to the fields of application, it is above all the applications of nanotechnology that are associated with the human body that give rise to fear and criticism: nano in foods, in cosmetics, in clothing (above all children's clothing). Applications in which nanoparticles do not enter the body by a direct route are seen as being less problematic. With these applica-

tions, however, some participants raise the question of disposal and the impact on the environment. Positive effects are seen above all in medicine and the computer industry.

The future expectations for nanotechnology are extremely positive in the field of science: researchers predict that nanotechnology will continue to make advances and will open up unimagined possibilities, opportunities and perspectives. In contrast, the future developments in the consumer segment give rise to ambivalence. On the one hand, there will probably be more products in future that contain nanomaterials and that may lead to improvements (more innovative, more practical, faster, more environment-friendly etc.), while on the other hand participants fear that they as consumers will not be properly informed. There is an assumption that industry will play its cards close to its chest, particularly if it transpires that there are risks.

From their discussion of nanotechnology, most focus group participants conclude that they need to find out more about nanotechnology and be better informed. But this doesn't apply to all of them: in view of all the pressing issues that face society, some ask themselves why they should engage with this issue. They say they will only look for information when the issue affects them directly.

Information needs

On which issues and aspects relating to nanotechnology do consumers want or need more information? What do they need to know in order to make informed purchase decisions when it comes to products that contain nanomaterials?

The discussion of nanotechnology in the focus groups shows that an issue that is initially perceived (in the unaided discussion) as being part of everyday life, unproblematic and interesting can quickly be perceived differently by consumers. When people become aware of potential risks and the lack of options to influence and steer their own purchase decisions - due to non-existent labelling of products - this gives rise to concern and uncertainty.

Information needs concern not only more scientific, technical questions (such as information on basics and research findings) but also consumer-related issues like applications, benefits and risks of nanotechnology for health and the environment. In addition, consumers ask themselves what action they can take and how they can identify nanoproducts when making purchase decisions.

5.3.3 Feedback on the communication concepts

5.3.3.1 Acceptance and relevance of the ideal-typical male communication concept

The first communication concept is designed as an "ideal-typical male" approach to appeal to the nano-types of "supporters" and cautious observers" that are dominant among men. The concept was shown as the first concept in the focus group with men and as the second concept in the female group. The concept is outlined in full in Annex 9.3.2.1.

Initial situation and objective

In the initial situation, the ideal-typical male concept targets less-informed but fascinated consumers of both genders with positive attitudes who see above all the benefit of nanoproducts. The objective is to increase the level of knowledge among consumers, to portray

innovative and technical fields of application, and to outline potential risks and (official) measures to avoid and mitigate risk.

The men (nano-types "supporters" and "cautious observers") spontaneously recognise themselves in the initial situation and as addressees.

In contrast, the women (nano-types "sceptics" and "cautious observers") identify with this concept to a far lesser degree. They feel that the concept is aimed not at them but at others, namely:

- Consumers with more positive attitudes who see above all advantages in nanotechnology
- Uncritical consumers who are curious about the possibilities and products, and who don't think any further than this
- Consumers who are better-off (as nanoproducts are seen as being more expensive)

The objective of the ideal-typical male concept is widely accepted. The most important factors for the communication goals are:

- that consumers are given specific information as to which products contain nano
- that they are also told which product improvements are enabled by nano and which harmful effects of other processes (e.g. chemicals in textiles or detergents) it might be possible to avoid through the use of nano
- that people are informed about scientifically validated risks (men)
- that people are informed about both potentials and risks (women).

All in all, the concept addresses the needs and concerns of the target group of "supporters". The "cautious observers" tend to fall in line with the group atmosphere, but this approach is foreign to the "female sceptics".

Senders

In the ideal-typical male concept, the plan is that the sender of the information offers is an official body working in cooperation with independent experts, technicians and scientists.

Some men (among the ranks of "supporters") suggest that industry should also be a sender, as they believe that this would help to make industry accountable but also because they feel that the companies who make the products are the most likely source of product-specific information. There are, however, also strong reservations regarding this suggestion, as more critical consumers assume that objective risk information would no longer be assured.

Above all the women feel it is important that the senders of the information also include consumer protection organisations. They suggest that state authorities, independent experts and consumer protection organisations should be equally represented among the senders.

Measures

The planned communication measures for the ideal-typical male concept are experiment kit, smartphone app, nanotruck roadshow and an open nanolab.

The measures do not meet expectations, above all from the point of view of the men (who are supposed to be core target group for this concept. The main criticisms are:

- that, apart from an "educational benefit", the measures would not have any concrete advantages for consumers or help them to deal more competently with nanoproducts on a daily basis
- that the measures would only reach a low number of consumers
- that all the measures provide insufficient information on the risks and dangers of nanotechnology

The experiment kit is seen as a great information service for schools and as an idea that would help to illustrate the issue of nanotechnology in physics and chemistry lessons or during project weeks. The drawbacks of the experiment kit are seen as being that if does not provide sufficient information on the everyday and product-related risks of nanotechnology, and that information would be limited to a kind of superficial fascination with technology. Moreover, quite a few people said the idea did not appeal to them personally.

A smartphone app arouses interest, and not only among younger people. It is modern and in keeping with the times. One drawback is that not everyone has a smartphone and can be reached by the app. If products were labelled, the smartphone idea is an attractive proposition and could generate real benefits. It would then be possible to use a QR code or barcode scanner on the product to determine whether it contains nanomaterials. This would be of considerable practical benefit for consumers. Until this is possible, however, the support for a smartphone app is limited.

The nanotruck is highly controversial. Some see it as an interesting idea, and believe that it would make waves and raise awareness levels for the issue of nanotechnology. The fact that the truck could also go to smaller towns and park in front of buildings like supermarkets means it might be able to reach new target groups. On the other hand, the truck idea is seen as requiring a lot of effort and being expensive. The feeling is that a truck would only reach a small number of consumers. It would resemble a kind of funfair event, and many people can't imagine it could provide the kind of in-depth information they need about nanotechnology.

The idea of a freely accessible nanolab is not popular in the discussion. Very few would go to an open day at the university; others admit they don't really go to museums. This measure is not expected to reach any significant number of consumers.

5.3.3.2 Acceptance and relevance of the ideal-typical female communication concept

The second communication concept is designed as an "ideal-typical female" approach to appeal above all to the nano-types of "female sceptics" and "cautious observers" that are dominant among women. The concept was shown as the first concept in the focus group with women and as the second concept in the male group. The concept is outlined in full in Annex 9.3.2.2.

Initial situation and objective

In the initial situation, the ideal-typical female concept targets less-informed but uncertain and sceptical consumers who see above all the risks of nanoproducts. The objective is to increase the level of knowledge among consumers, to portray everyday fields of application, and to outline potential risks and (official) measures to avoid and mitigate risk.

The women (nano-types "sceptics" and "cautious observers") recognised themselves in the initial situation and as addressees. Women also accepted the objective, but they also see a further goal: they want concrete product information to help them make appropriate purchase

decisions on a daily basis. The precondition for this is the labelling of nanoproducts - as well as detection options for nanoparticles.

Some of the men (nano-type "cautious observers") can also identify with the initial situation and the objective of the female concept. The target groups for the ideal-typical female concept are seen as being people:

- who tend to be anxious and who want to be protected
- who are less interested in the scientific aspects of nanotechnology and not as fascinated with technology in general.

Unsurprisingly. some of the other men (nano-type "supporters") criticise the objective of the concept as being too unscientific, imprecise or uncritical.

To this extent, the ideal-typical female concept adequately addresses the needs and concerns of the target group of "sceptics". However, participants who are classified as "cautious observers" also show an affinity for the concept, particularly after they were made aware of the potential risks. In contrast, the "supporters" say some of the aspects that are important to them are missing.

Senders

In the ideal-typical female concept, the planned sender of the information offers is an official body in cooperation with consumer organisations.

Consumer protection organisations (above all the "Stiftung Warentest" and "Ökotest" magazines) enjoy a high level of credibility, even if they are not always of the same opinion. The women therefore believe that it is better if there are several organisations acting as senders of the information, particularly as there is a certain mistrust of information that comes from official bodies (cf. the ideal-typical male concept). Independent scientists can also underpin the credibility of the sender, especially if they represent a broad spectrum of opinions.

Consumer protection organisations are also accepted by the men, as they are closer to consumers and their concerns.

Measures

The communication measures planned for the ideal-typical female concept are: online game, online information platform, brochure and museum exhibition.

From the point of view of the women (who are earmarked as the core target group for the concept), these measures complement each other well, and they are suitable for addressing widely differing consumer groups (with the exception of older people).

The online platform is seen as the central information medium (also by the men). People can access this platform to obtain targeted information. It is basically available to all consumers practically everywhere. At the same time, however, it is generally only consumers who are aware of the issue and already know something about it who will find the online platform. This raises the question of how to make people aware of the online platform. The respondents suggest the flanking use of conventional media, such as references to the platform in magazines, on posters, in the subway, or on radio and TV (e.g. in science programmes).

Like the online platform, the brochure is seen as being a good and important idea, above all for consumers for whom the Internet represents an obstacle. A brochure, particularly one from a serious sender, is a highly credible source of information. This poses the question, however, of how to make consumers aware of the brochure and how they are to obtain it. The suggestions of the respondents range from mailing of a flyer via the postal system through to availability in medical practices, civic offices or shops.

The idea of an online game is not considered to be a convincing concept as a standalone communication measure, but it could act as a source of everyday and surprising information on nanoproducts in the context of the online platform. Moreover, it is seen as being suitable above all for young people and schoolchildren, for whom it might be of even more interest than the experiment kit (from the ideal-typical male concept).

The museum exhibition only appeals to individual respondents, who suggest that this kind of exhibition should also act as a forum for exchange with scientists who can provide answers to their questions. However, this measure is not expected to reach any notable number of consumers.

5.3.4 Communication approaches proposed by the respondents

The participants in the focus groups were asked to work in small groups with the aim of thinking of ways to inform consumers in their respective age groups about nanotechnology (the small groups were put together based on age - younger or older than 35).

Media and information channels

All groups agree that the Internet plays a central role in communication, and a wide range of well-researched information on nanotechnology should be available on an Internet portal/website.

Above all the younger respondents (younger men and younger women) envisage a website providing a modern and varied media mix complete with texts, short films, downloads, apps, animations or games (such as the online game planned for "Concept B"). This website should also publicise ongoing events (e.g. in museums) and offer the option of ordering (younger women) information materials (such as the experiment kit). Moreover, the website should also make use of the social networks (Facebook, Twitter etc.) to ensure that it reaches younger consumers in particular.

As a flanking measure alongside the website, the respondents suggest a wide range of media and activities to raise awareness levels for nanotechnology and publicise the website, such as a "promotional week", project weeks in schools, a high-profile campaign, features on radio or TV (in science programmes, for example) or articles in print media (daily newspapers or special-interest media).

The sender should be recognisably objective and respected. The respondents suggest a multi-player sender made up of leading official bodies (e.g. ministries), consumer protection organisations and independent experts.

Content and topics

The respondents agree that the following themes play a central role when it comes to information on nanotechnology:

- Basic scientific information: what is nanotechnology about?
- Areas of application: what are the various applications? Today and in the future? In the scientific and consumer fields?
- Potentials: what are the opportunities and options offered by nano? What are the real benefits of nanoproducts?
- Risks: what are the dangers? Which potential risks have already been investigated and which risks have not yet been researched?

There are differences between the target groups with regard to the status and importance of the various themes:

For the older women (above the age of 35) the concrete everyday applications are the key issue. They want specific information on the areas in which nanotechnology is used, about the benefits and above all about the risks. They express little interest in scientific background information.

For the young women (below the age of 35), the important issues are the scientific and technical potentials, consumer-related aspects, product information and the risks to health and the environment.

The young men (below the age of 35) are interested in information that enables them to assess the possibilities, applications and risks of nanotechnology. They attach particular importance to distinguishing between current and future, actual and potential aspects. The nanotechnology applications of most interest are technology, nutrition and health. These topics are also reflected in the collages - the depiction of a sports car, for example, a medication package and various foods (meat, vegetables, cabbages and a pink sheep).

The older men (above the age of 35) also lay great store by differentiated information that enables them to distinguish fact from fiction. They want information on the vested interests of the various players so that they can form their own impressions

5.3.5 Conclusions

Nanotechnology is not a topic that is of pressing importance for consumers. It is therefore unlikely that an information campaign would generate any major degree of interest at the current point in time. In view of the many issues that are competing for the attention of consumers, they would probably take only little notice of this kind of information. This view is also supported by the extremely low awareness levels among consumers with regard to the information services that already exist.

At the same time, however, nanotechnology is an issue that causes uncertainty and gives pause for thought when people actually engage with it. In this more aware condition, consumers are open for information and attach great value to well-founded, honest, neutral and independent information. This is why it is advisable - based on the findings of the focus groups - to develop and maintain these kinds of information services. In view of the information and dialogue options it provides, the Internet is well-suited to this purpose and is a medium that broad sections of the population actively use to obtain information (cf. Chapter 4 and Fig. 27). In the event of uncertainty among consumers or even a nanotechnology scandal, there would then be an authoritative information platform that helps consumers to find their bearings while also paving the way for acute and case-specific risk communication.

At a time when nanotechnology is not really "on the radar" of the population, this type of Internet platform will probably perform a kind of "standby" function. It can, however, also serve

as the centrepiece of an information concept and the basis for targeted activities designed to once again raise awareness for the issue.

5.4 Ideal-typical male risk communication concept

The ideal-typical male concept for risk communication on the issue of nanotechnology described in Chapter 5.2.2 and Annex 8.3.21 was adapted and optimised based on the outcomes of the male focus group[56]. The following section outlines the modified definitions of the initial situation and copy strategy[57] as well as the communication media and measures.

5.4.1 Initial situation

The initial situation was essentially extended to include two new aspects. The finding that a high percentage of men have a positive basic attitude towards nanotechnology was underpinned by the fascinating scientific and technical opportunities that it opens up for the future. The call for supervision and rules for consumer protection as well as the desire for participation and information also emerged from the focus groups and were added to the definition of the initial situation.

> *Men have an overwhelmingly positive attitude towards nanotechnology, and are particularly fascinated by the scientific and technical potentials in terms of future technologies. Even though they tend to see the benefits of product applications rather than the risks, they call for supervision and rules to protect the consumer. Experience with nanoapplications to date is non-specific and knowledge of specific benefits is often vague. As a result, they want participation options as well as neutral and independent information from official sources - on the basis of which they can then form their own opinion of nanotechnology.*

5.4.2 Positioning statement and copy strategy

The original **positioning** statement was also reviewed and slightly modified. Environmental protection and human health aspects proved to be of secondary relevance in the focus groups. Instead, men are primarily interested in technical and scientific aspects, and these aspects now play a more important role in the revised positioning statement.

> *Nanotechnology provides innovative solutions in numerous everyday application fields and product categories as well as promising future prospects in the areas of science and technology. In order to exploit these potentials, the potential risks must be avoided or mitigated.*

The individual elements of the **copy strategy** were also revised and supplemented with important findings from the focus groups.

[56] The distinction made between younger and older men in the description of the focus group findings is no longer made in the following.

[57] A copy strategy defines how the positioning statement can be implemented in terms of argumentation and communication – as the phase prior to verbalisation and visualisation of market communication, so to speak (Kotler und Bliemel 2001, p. 120f.). It therefore contains all the key specifications for the development of creative solution approaches and can be seen as a "thread running through the whole process". It usually comprises the following elements: communication objectives, description of the value proposition, factors supporting the credibility of the value proposition, communication style.

Communication objectives

1. *Improve knowledge regarding the benefits of nanoapplications*
2. *Provide information on potential risks*
3. *Supply differentiated information as the basis for (purchase) decisions*

Value proposition

Better informed:

- *on the benefits of nanoapplications in various product segments*
- *on both the scientifically validated and as yet unresearched risks of nanotechnology*
- *on expert contacts for information and questions about nanotechnology*
- *on regulatory measures in the field of nanotechnology*
- *on reliable recommendations for action in the event of a crisis*

Factors supporting the value proposition

- *Because information comes from an institution which is independent (vis-à-vis industry and other interests)*
- *Because the information is scientifically validated and reliable*
- *(Because the information is jointly issued by official bodies, consumer protection organisations and independent experts)*

Communication style

- *Factual, clear-cut*

5.4.3 Communication media and measures

Both the analysed examples of international risk communication in the area of nanotechnology and the focus groups provide pointers to possible communication media and measures that appear suitable for the ideal-typical male concept.

The focal point of activities should be the creation of an **information portal on the Internet**. This website should be the focal point of all information measures and should be designed to serve as a reliable and independent point of contact for information in the event of a crisis. In terms of content, the best strategy would be a combination of everyday and consumer-focused information alongside scientific and technical content.

An Internet portal also provides a suitable platform for interactive, Internet-based dialogue formats such as discussion forums, knowledge tests, expert chats etc.

The portals can be publicised online and offline by target group-specific **flanking measures**. These measures can also raise awareness for the scientific and application-related aspects of nanotechnology, provide information on concrete applications and make people aware of the potential and risks of this technology.

The following measures are conceivable as flanking measures:

- Regular and differentiated reporting in daily and weekly newspapers
- Journalist blog with comprehensive reports and articles
- Smartphone apps
- Social media profiles (e.g. Facebook and Twitter)
- etc.

On the level of information interests, the requirements in terms of **communication content** range from differentiated information and knowledge concerning the vested interests of different players all the way through to the potential, applications and dangers of nanotechnology.

5.5 Ideal-typical female risk communication concept

The process for revision of the ideal-typical female concept is identical with that used for the development of the first concept.

5.5.1 Initial situation

The initial situation for the ideal-typical female concept was primarily supplemented by taking account of the evidently lower level of knowledge and the negative attitude towards nanotechnology among some of the women. This translates into a demand for information as well as a call for concrete options that enable them to make informed purchase decisions when it comes to nanoproducts.

> *Although women also see benefits in nanotechnology, they often tend to focus more on the risks of specific applications, and they are extremely concerned about potential health or environmental risks. In addition, many women know little about nanotechnology. This results in a call for official supervision and rules as well as (in some cases) a negative attitude towards nanotechnology. Women therefore want descriptive basic information and above all reliable and practical information from official sources that helps them to find their bearings. They also call for concrete steps that enable them to make informed purchase decisions.*

5.5.2 Positioning statement and copy strategy

Based on the findings of the focus groups, the original **positioning** statement was supplemented by adding the call for information that helps consumers to find their bearings in an everyday context.

> *Nanotechnology provides innovative solutions in numerous everyday application fields and product categories as well as promising future prospects in the areas of science and technology. The risks that may be associated with the technology are systematically researched. Official bodies take measures to avoid or mitigate these risks and provide reliable and practical information that helps consumers to find their bearings.*

The revised **copy strategy** is as follows.

> *Communication objectives*
> 1. *Improve knowledge regarding the benefits of nanoapplications*
> 2. *Provide information on potential risks*
> 3. *Provide specific information that helps consumers to make informed everyday (purchase) decisions*
>
> *Value proposition*
> *Better informed:*
> - *on potential risks of nanotechnology and the avoidance of these risks*
> - *on the benefits of nanoapplications in various product segments*

- *on expert contacts for information and questions about nanotechnology*
- *on reliable recommendations for action in the event of a conflict or scandal*

Factors supporting the value proposition

- *Because information comes from an institution which is independent (vis-à-vis industry and other interests)*
- *Because the information is scientifically validated and reliable*
- *(Because the information is jointly issued by official bodies, consumer protection organisations and independent experts)*

Communication style

- *Practical, useful, pragmatic*

5.5.3 Communication media and measures

The **online information portal** and integrated dialogue formats are also seen as being the preferred central information measures for the ideal-typical female concept.

Flanking measures to publicise the portal and raise awareness should focus above all on information content that is relevant to everyday life and relates to specific applications.

The following measures are conceivable as flanking measures:

- Product segment-specific information in retail outlets
- Regular reporting in newspapers and magazines and on TV
- Consumer information hotline
- Flyers and brochures in public institutions and facilities
- Product labelling
- Smartphone app (in future, ideally with QR code to permit identification of nanoproducts)

5.6 Recommendations on the alternative risk communication concepts

The primary objective of both risk communication concepts for nanotechnology presented in this report is to increase the risk maturity of consumers. The form of address, the communication messages and the concrete measures should, however, be target group-specific. The concepts were differentiated by gender to take account of the empirical findings showing that men and women perceive nanotechnology and the associated potential and risks differently. The review of the draft concepts in two gender-specific focus groups showed that this differentiation is justified, even if the gender-specific differences with regard to information needs and the expectations of risk communication should not be too strongly weighted. Although the outlined ideal-typical concepts address gender-specific aspects, therefore, they also simplify some aspects and only depict other gender-typical differences in a nuanced fashion.

Against this backdrop, the creation of one **information portal** on the Internet as the central information measure for both target groups appears to be a suitable strategy in terms of realising the recommendable communication elements. In addition, the portal can act as a meaningful starting point for Internet-based dialogue formats, which play a key role in risk communication (cf. Chapter 5.2.1). This includes such things as comment functions, the possibility of asking questions and live chats on the site as well as the creation of profiles in social networks.

In terms of content, the services provided by this kind of information portal should address the following information needs of consumers:

- Basic **scientific information**: what is nanotechnology about?
- **Areas of application**: what are the various applications? Today and in the future? In the scientific and consumer fields?
- **Potentials**: what are the opportunities and options offered by nano? What are the real benefits of nanoproducts?
- **Risks**: what are the dangers? Which potential risks have already been investigated and which risks have not yet been researched?

It is also advisable to create a comprehensive website from an economic point of view, as the cost of implementing and editing the site would be a one-time expense. The content could also build on the existing topic pages of the BfR on nanotechnology[58].

In order to take account of the main gender-specific requirements and information needs, the information services and the presentation of the content should be specified accordingly. This means that the ideal-typical **male** concept focuses on providing information on the scientific, technical and application-related aspects of nanotechnology. The ideal-typical **female** concept is geared towards providing information on the application-related aspects of nanotechnology and helping consumers to make informed everyday (purchase) decisions.

A further idea to cater to the different communication requirements of the two target groups is to offer different start-off options on the homepage of the information portal. A section entitled "Fascinating Nanoworlds" could appeal to male addressees, for example, while a section called something like "How Nanotechnology Changes Everyday Life" would be more popular with the female target group.

Last but not least, it is important to emphasise one of the key success factors, namely the ongoing efforts to publicise the portal and make people aware of its existence. This can be achieved with the help of supporting (offline) measures. These measures also serve to extend the communication content of the portals and can be expanded step by step.

5.7 Summary of the risk communication concepts

The findings of the representative survey underline the need to inform the public at the earliest possible date about scientific knowledge as well as the potential and possible risks of nanotechnology. For this reason, the challenge was to develop two alternative target group-specific risk communication concepts. The drafting of these concepts was a two-phase process and took account not only of the prior work done in the research project but also of the insights gained from two group discussions with consumers (focus groups).

Against the backdrop of the findings from the representative survey, which confirmed the gender-specific differences in the perception of nanotechnology, it was decided in consultation with the client to develop an ideal-typical male and an ideal-typical female concept. Both concepts comprise the following elements:

[58] On the A-Z index page, for example, or on the Research into the Use of Nanotechnology page, which can be reached via the following links (German content): http://www.bfr.bund.de/de/a-z_index/nanotechnologie-7585.html or http://www.bfr.bund.de/de/forschung_zum_einsatz_von_nanotechnologie-8077.html

- Initial situation
- Positioning statement
- Copy strategy
- Possible communication measures

The job of the focus groups was to review and optimise the conceptual considerations drawn up in the first step. This phase comprised two gender-specific group discussions each lasting three hours. The focus groups were moderated using a detailed theme catalogue.

The first step was to survey - aided and unaided – **spontaneous associations, experiences, opinions and attitudes** with regard to nanotechnology. The discussions on nanotechnology showed that attitudes to this topic, which at first glance appears to be part of everyday life, unproblematic and interesting, can change rapidly. People begin thinking about the issue more deeply and become unsettled when they gain an awareness of potential risks and their lack of power to influence and steer their own purchasing decisions due to the non-existent labelling of products.

On the one hand, **information needs** tend to concern scientific and technical matters, such as information on basic principles and research findings. On the other hand, there is also a desire for information on consumer-related topics such as the applications, benefits and risks of nanotechnology with regard to health and the environment. In addition, consumers ask themselves what steps they can take and how they can identify nanoproducts when making purchase decisions.

The second part of the group discussions focused on acceptance for and the relevance of the ideal-typical communication concepts. In terms of the conceptual approach – the initial situation and the objective – the **ideal-typical male concept** meets the expectations of the male target groups (nano-types "supporters" and "cautious observers"). However, the concrete communication measures do not adequately achieve the objectives. The measures are too specific and give the impression of being overly focused on technical fascination and not addressing potential risks to the desired degree. These findings show that even target groups whose attitude towards nanotechnology is generally positive are not happy if all they are given is abstract scientific or technical information. This communication strategy falls short if it does not also comprise specific information for consumers (on products and risks, for example).

The conceptual approach of the **ideal-typical female concept** meets the expectations of the female target groups (nano-types "sceptics" and "cautious observers") and additionally even caters to the information needs of some of the men ("cautious observers"). Out of all the discussed concrete communication measures, acceptance levels are particularly high for the online platform and the brochure. These measures represent the most effective channels for the provision of basic information. The respondents had not previously been aware of the Information services that already exist (like the Internet platform operated by the federal state of Baden-Württemberg). This therefore raises the central question of how to generate awareness both for these information services and for the issue of nanotechnology among consumers.

When consumers themselves are asked to **draw up communication approaches**, it become clear that the main focus is on the interlinking of two areas, namely scientific aspects and everyday consumer aspects. Both facets are necessary to ensure a satisfactory communication concept concerning nanotechnology. The importance attached to the two different areas varies between target groups, however. The most clearly defined profile is found in older women (who are primarily interested in the consumer perspective) and older men (who are mainly interested in the scientific perspective). Younger men and women are somewhere between these two extremes and are interested in both consumer and scientific aspects.

With regard to the communication media, the surveyed men and women prefer a website that provides basic information presented in a stimulating format. This website should be publicised through suitable advertising and promotional activities.

Finally, the two concepts were revised based on the insights gained in the focus groups (more detailed information in Chapters 5.4 and 5.5). With regard to the central communication measure, the creation of an **information portal on the Internet** appears to be the most meaningful strategy. In addition, such a portal is also a good starting point for Internet-based dialogue formats and other flanking measures. The information services and the content should be prepared and presented in such a way that they cater to the specific main gender-sensitive requirements and information needs. The ideal-typical **male** concept is geared towards the provision of information on scientific, technical and application-related aspects of nanotechnology, for example. The ideal-typical **female** concept focuses on the provision of information on application-related aspects of nanotechnology and support for everyday (purchase) decisions.

6 List of Figures

7 List of Tables

8 References

The following list comprises only those publications which are cited in the report and which were not separately evaluated (cf. Annex 8.1.2):

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Böl, G.-F.; Epp, A.; Hertel, R. (2010): Wahrnehmung der Nanotechnologie in internetgestützten Diskussionen – Ergebnisse einer Onlinediskursanalyse zu Risiken und Chancen von Nanotechnologie und Nanoprodukten. Berlin: BfR Wissenschaft, 04/2010.

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Hertel, R. F.; Henseler, G. (Hrsg.) (2005): ERiK – Entwicklung eines mehrstufigen Verfahrens der Risikokommunikation.

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Zimmer, R.; Domasch, S.; Scholl, G.; Zschiesche, M.; Petschow, U.; Hertel, R.; Böl, G.-F. (2007): nanotechnology im öffentlichen Diskurs. Verbraucherkonferenz zur Nanotechnologie. Technikfolgenabschätzung. Theorie und Praxis, Heft 3/2007, 16. Jg., p. 98–101.

9 Annexes

9.1 Literature evaluation

9.1.1 Evaluation procedure

Bibliographic details: …	
Publication context/Commissioning entity: …	**Reference country:** …
Research interest/Objectives/Initial hypotheses of the study: - …	
Research design: - Details of sample - Data collection method - Statistical procedures, e.g. descriptive statistics, multivariate methods, cluster analysis etc. - Study design (e.g. experimental approach with varying framing) - Concrete presentation of nanotechnology, e.g. text-based/visual product description, product samples etc.	
Factors influencing the variable "Perception of nanotechnology": Dependent variable(s): - e.g. perceived risk, perceived benefit, willingness to purchase etc..	
Independent variables:	Relevance:
Object-related factors:	
- e.g. knowledge/information status, area of application, product acceptance, assessment of benefit and risk (also relative to one another), familiarity, knowledge dissemination channels etc.	low/average/high or text-based explanation
Sociodemographic factors	
- e.g. gender, age, marital status, highest educational qualification, size of household, income (main earner or household), migration background etc.	low/average/high or text-based explanation
Psychosocial factors	
- Milieu affiliation, trust in institutions (government, information sources, political parties etc.), general value orientation (attitude towards science etc.), attitude towards technological progress, attitude towards interventions in nature (against the backdrop of religious views, for example), fascination, worry, feeling of control/manageability, concern, optimism/pessimism for the future etc.	low/average/high or text-based explanation
Other factors	
- Media utilisation, membership of parties etc.	low/average/high or text-based explanation
Conclusions/Points of reference for Nanoview - e.g. conclusions and recommendations of the study - e.g. notes on risk communication	

9.1.2 Overview of evaluated publications

1. Bainbridge, W. S., 2002. Public attitudes toward nanotechnology. *Journal of Nanoparticle Research,* 4(6), p. 561–570.
2. Berube, D. M. et al., 2011. Comparing nanoparticle risk perceptions to other known EHS risks. *Journal of Nanoparticle Research*, 13, p. 3089–3099.
3. Bieberstein, A. et al., 2009. Consumer choices for Nanofood and NanoPackaging in Germany and France. (Preliminary Draft).
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6. Brossard, D. et al., 2009. Religiosity as a perceptual filter: examining processes of opinion formation about nanotechnology. *Public Understanding of Science*, 18(5), p. 546.
7. Cacciatore, M. A. et al., 2011. From enabling technology to applications: The evolution of risk perceptions about nanotechnology. *Public Understanding of Science*, 20(3), p. 385.
8. Cobb, M. D. und Macoubrie, J., 2004. Public perceptions about nanotechnology: Risks, benefits and trust. *Journal of Nanoparticle Research,* 6(4), p. 395–405.
9. Cobb, M. D., 2005. Framing effects on public opinion about nanotechnology. *Science communication,* 27 (2), p. 221–239.
10. Conti, Joseph et al., 2011. Vulnerability and Social Justice as Factors in Emergent U.S. Nanotechnology Risk Perceptions. *Risk Analysis*, 31, p. 1734–1748.
11. Cook, A. J. and Fairweather, J. R., 2007. Intentions of New Zealanders to purchase lamb or beef made using nanotechnology. *British Food Journal,* 109(9), p. 675–688.
12. Currall, S. C et al., 2006. What drives public acceptance of nanotechnology?. *Nature Nanotechnology,* 1 (3), p. 153–155.
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14. Einsiedel, E., 2005. In the Public Eye: The Early Landscape of Nanotechnologies among Canadian and US Publics. *Online Journal of Nanotechnology*, 1, p. 1–10.
15. Farshchi, P. et al., 2011. Nanotechnology in the public eye: the case of Iran, as a developing country. *Journal of Nanoparticle Research*, 13, p. 3511–3519.
16. Frewer, L.J. et al., 2011. Consumer response to novel agri-food technologies: Implications for predicting consumer acceptance of emerging food technologies. *Trends in Food Science & Technology*, 22(8), p. 442–456.
17. Gardner, G. et al., 2010. Students' Risk Perceptions of Nanotechnology Applications: Implications for science education. *International Journal of Science Education*, 32, p. 1951–1969.
18. Gaskell, G. et al., 2003. Europeans and biotechnology in 2002: Eurobarometer 58.0. (A report to the EC Directorate General for Research from the project „Life sciences in European society" QLG7-CT-1999- 00286.) London. European Commission.
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23. Ho, S.S. et al., 2011. Value Predispositions, Mass Media, and Attitudes Toward Nanotechnology: The Interplay of Public and Experts. *Science Communication*, 33(2), p. 167–200.

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	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
1	Bainbridge, W. S., 2002. Public attitudes toward nanotechnology. *Journal of Nanoparticle Research,* 4(6), p. 561–570.	US	Non-representative survey (n=3,909)	Societal benefit, threat/risk potential of future technology	None	Age, gender, education	Political views	None
2	Berube, D. M. et al., 2011. Comparing nanoparticle risk perceptions to other known EHS risks. *Journal of Nanoparticle Research*, 13, p. 3089–3099.	US	Representative survey (n=1,250)	-	-	-	-	-
3	Bieberstein, A. et al., 2009. Consumer choices for Nanofood and NanoPackaging in Germany and France. (Preliminary Draft). Munich.	FR, DE	Representative survey (n=295)	Willingness to pay for nano-food and nanopackaging	Area of application, familiarity with the issue	Surveyed but not discussed in the paper	Risk assessment of GM foods	Information on possible effects (on health, society, the environment)
4	Binder, A. R. et al., 2011. Measuring risk/benefit perceptions of emerging technologies and their potential impact on communication of public opinion toward science. *Public Understanding of Science.*	-	Meta analysis	-	-	-	-	-
5	BMRB Social Research; The Royal Society and Royal Academy of Engineering Nanotechnology Working Group, 2004. Nanotechnology: Views of the General Public. Quantitative and qualitative research carried out as part of the Nanotechnology study.	GB	Representative survey (n=1,005), non-representative survey (n=50)	Awareness of/Familiarity with the issue, perceived influence on quality of life	Areas of application, familiarity with the issue, overall societal investment cost relative to the benefit, functionality of the new technology, danger of non-intended side-effects	Gender, age, migration background, social status/ milieu affiliation	Manageability, effects on own life	Media utilisation
6	Brossard, D. et al., 2009. Religiosity as a perceptual filter: examining processes of opinion formation about nanotechnology. *Public Understanding of Science*, 18 (5), p. 546.	US	Representative survey (n=706)	Support for the public promotion of nanotechnology	Factual knowledge about nanotechnology, perception of risks, perception of benefits	Age, gender, education	Religiousness	Utilisation of scientific media

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
7	Cacciatore, M. A. et al., 2011. From enabling technology to applications: The evolution of risk perceptions about nanotechnology. *Public Understanding of Science*, 20 (3), p. 385.	US	Representative survey (n=1,015)	Support for nanotechnology, assessment of usefulness	Knowledge about nanotechnology, association of nanotechnology with various fields of application, assessment of risks, assessment of benefit	Gender, age, education	Ideology, religiousness	Awareness of scientific themes in the media (newspaper, television, internet)
8	Cobb, M. D. und Macoubrie, J., 2004. Public perceptions about nanotechnology: Risks, benefits and trust. *Journal of Nanoparticle Research,* 6 (4), p. 395–405.	US	Representative survey (n=1,536)	Ratio of risks to benefits, faith in industry to minimise risks	Level of knowledge	Gender, ethnicity, age, education	Affective reaction, trust in industry, general attitude towards science, political ideology	-
9	Cobb, M. D., 2005. Framing effects on public opinion about nanotechnology. *Science communication,* 27 (2), p. 221–239.	US	Representative survey (n=1,536)	Perceived ratio of risks and benefits, emotions in relation to nanotechnology	-	-	-	Risk framing, benefit framing and balanced framing of nanotechnology
10	Conti, J. et al., 2011. Vulnerability and Social Justice as Factors in Emergent U.S. Nanotechnology Risk Perceptions. *Risk Analysis*, 31, p. 1734–1748.	US	Representative survey (n=1,100)	-	Area of application/Type of product	Gender, ethnicity, age, education, income	Vulnerability, affinity for environmental justice	-
11	Cook, A. J. and Fairweather, J. R., 2007. Intentions of New Zealanders to purchase lamb or beef made using nanotechnology. *British Food Journal,* 109 (9), p. 675–688.	NZ	Representative survey (n=565)	Purchase intentions, basic attitude, subjective-normative assessment, self-control, identity	Basic attitude, subjective-normative assessment	Gender, age, income, qualifications (no relevance for the explanatory model)	Self-control, identity	-
12	Currall, S. C et al., 2006. What drives public acceptance of nanotechnology?. *Nature Nanotechnology,* 1 (3), p. 153–155.	US	Representative survey (n_1=503, n_2=501), non-representative survey (n_3=4,542)	Risk-benefit perception for society, probability of use	-	-	-	-
13	Dialego AG, 2010: Nanopartikel in Nahrungsmitteln. Aachen.	DE	Representative survey (n=1,000)	Information status, acceptance	Information status	Gender, age	-	-

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
14	Einsiedel, E., 2005. In the Public Eye: The Early Landscape of Nanotechnologies among Canadian and US Publics. *Online Journal of Nanotechnology*, 1, p. 1–10.	US, CA	Representative survey (N_{US}=1,200, N_{CA}=2,000)	Conditions for basic attitude towards manotechnology	Familiarity with the technology, perceived benefit, perceived risks	Age, education, gender	Moral acceptance of the technology, satisfaction with regulatory framework, satisfaction with responsibility of science	Regular reading of newspapers, awareness of media reporting on nanotechnology, nanotechnology as a subject of debate
15	Farshchi, P. et al., 2011. Nanotechnology in the public eye: the case of Iran, as a developing country. *Journal of Nanoparticle Research*, 13, p. 3511–3519.	IR	Non-representative survey (n=759)	Benefit-risk ratio, trust in science	Familiarity with issue, knowledge about nanotechnology	Age, education, gender	Affective assessment, trust in sources of information/ institutions	-
16	Frewer, L.J. et al., 2011. Consumer response to novel agri-food technologies: Implications for predicting consumer acceptance of emerging food technologies. *Trends in Food Science & Technology*, 22(8), p. 442–456.	-	Meta analysis	-	-	-	-	-
17	Gardner, G. et al., 2010. Students' Risk Perceptions of Nanotechnology Applications: Implications for science education. *International Journal of Science Education*, 32, p. 1951–1969.	US	Non-representative survey (N_1=102, N_2=21)	Perceived risk or perceived benefit	Areas of application (of the products)	-	Interest in and knowledge about nanotechnology	Existence of competing risks
18	Gaskell, G. et al., 2003. Europeans and biotechnology in 2002: Eurobarometer 58.0. London. European Commission.	EU 15	Representative survey (n=16,000)	Way of life	Type of technology	-	-	-
19	Gaskell, G. et al., 2005. Imagining nanotechnology: cultural support for technological innovation in Europe and the United States. *Public Understanding of Science*, 14 (1), p. 81–90.	EU 15, US	Representative survey (n_{EU}=15,000, n_{US}=850)	Way of life	-	Gender, age, education	Environmentally related values, progress-related values, interest in science	Culture, trust in key players and decision-makers
20	Gaskell, G. et al., 2006. Europeans and biotechnology in 2005: patterns and trends: Eurobarometer 64.3., Nr. 244b/Wave 64.3 (Special Eurobarometer).	EU 25	Representative survey (n=25,000)	Way of life, awareness levels for technologies, support for technology	Type of technology	Gender	-	Country

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
21	Gaskell, G. et al., 2010. Europeans and biotechnology in 2010: winds of change? Eurobarometer 73.1 (A report to the European Commission's Directorate-General for Research). Luxembourg. Publications Office of the European Union.	EU 27 + HR, IS, NO, CH, TR	Representative survey (n=31,243)	Way of life, support for nanotechnology, awareness, concern, safety, benefit	Type of technology	Scientific background of family members	Assessment of safety, benefit, concern, just distribution	Country, awareness
22	Grobe, A. et al., 2008. nanotechnology: Was Verbraucher wissen wollen. Berlin.	DE, CH	Non-representative, qualitative survey (n=100)	Knowledge about nanotechnology, attitudes towards nanotechnology, attitudes towards technical change due to nanotechnology, fears with regard to nanotechnology, attitude towards regulation, desired sources of information, trust in sources of information, type of information	-	Gender, age, education	-	-
23	Ho, S.S. et al., 2011. Value Predispositions, Mass Media, and Attitudes Toward Nanotechnology: The Interplay of Public and Experts. *Science Communication*, 33(2), p. 167–200.	US	Representative survey (n=1,015), non-representative survey (n=363)	Perceived risk, perceived benefit of nanotechnology	-	Gender, age	Religious values, recognition of scientific authortiy, trust in science	Utilisation of scientific media, scientific status
24	Kahan, D. et al., 2007. Nanotechnology Risk Perceptions: The Influence of Affect and Values. Cultural Cognition Project at Yale Law School.	US	Representative survey (n=1,850)	Perceived ratio of benefit to risk	Prior nano knowledge	Ethnicity, gender, age, education, income, parental status, party membership, political preferences	General basic attitude towards NT (affect), cultural worldview, trust in official institutions to regulate risks	Risk perception in other areas
25	Kahan, D. et al., 2008. Biased assimilation, polarization, and cultural credibility: An experimental study of nanotechnology risk perceptions. Project on Emerging Nanotechnologies Issues Brief Nr. 08-25 (Harvard Law School Program on Risk Regulation Research Paper).	US	Representative survey (n=1,600)	Perception of the risk of nanotechnology	Knowledge about nanotechnology	Gender, ethnicity	General fear of environmental risk, perceived values of experts	-
26	komm.passion GmbH, 2004. Wissen und Einstellungen zur Nanotechnologie. Berlin.	DE	Representative survey (n=1,019)	Awareness, risk assessment	Awareness	Place of residence, gender, age, education, income	-	-

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
27	Lee, C. et al., 2005. Public attitudes toward emerging technologies. *Science communication*, 27 (2), p. 240.	US	Representative survey (n=706)	General support for nanotechnology, perception of benefit and risk	Knowledge about natural science and technology, knowledge about nanotechnology	Age, gender, education, household income, ethnicity	Negative feelings about natural science and technology, negative feelings about nanotechnology, trust in scientists, religiousness	Media utilisation on the issue of politics, media utilisation on natural science and technology
28	Lee, C. und Scheufele, D., 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), p. 819–834.	US	Representative survey (n=706)	General support for nanotechnology, knowledge about natural science and technology, trust in scientists	Knowledge about natural science and technology in general	Gender, age, education, household income	Trust in scientists	Media utilisation (TV, newspaper, internet) on the topics of natural science and technology
29	Macoubrie, J., 2005. Informed public perceptions of nanotechnology and trust in government. (Project on Emerging Nanotechnologies of the Woodrow Wilson International Center for Scholars).	US	Non-representative survey (n=177)	Perceived risk, perceived benefit, willingness to buy etc.	-	-	-	-
30	Macoubrie, J., 2006. Nanotechnology: public concerns, reasoning and trust in government. *Public Understanding of Science,* 15(2), p. 221–241.	US	Non-representative survey (n=152)	Attitude towards nanotechnology	-	Gender	-	-
31	Marette, S. et al., 2009. Impact of environmental, societal and health information on consumers' choices for nanofood. *Journal of Agricultural & Food Industrial Organization*, 7(2), p. 11.	DE	Non-representative survey (n=97)	Willingness to purchase "nano" orange juice	General information, health, environment and society-related information on benefit and risks	-	-	-
32	Peter D. Hart Research Associates, 2006. Report Findings. Based on a national survey of adults. Washington. Woodrow Wilson Centre for Scholars.	US	Representative survey (n=1,014)	Familiarity with nanotechnology, perceived ratio of benefits to risks	Familiarity with nanotechnology, Information about nanotechnology	Gender, age, education, income	-	-

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
33	Peter D. Hart Research Associates, 2008. Awareness of and attitudes toward nanotechnology and synthetic biology. A report of findings. Based on a national survey among adults. Washington. Woodrow Wilson Centre for Scholars.	US	Representative survey (n=1,003)	Familiarity with nanotechnology, perceived ratio of benefits to risks	Familiarity with nanotechnology, information about nanotechnology	Gender, age, education, income, ethnicity religion	-	-
34	Peter D. Hart Research Associates, 2009. Nanotechnology Synthetic Biology & Public Opinion. Washington. Peter D. Hart Research Associates Inc.	US	Representative survey (n=1,001)	Familiarity with nanotechnology	-	-	-	-
35	Priest, S. H., 2006. The North American opinion climate for nanotechnology and its products: opportunities and challenges. *Journal of Nanoparticle Research* 8, p. 563–568.	US, CA	Representative survey (n_{US}=1,200, n_{CA}=2,000)	Benefits, level of knowledge familiarity	-	-	-	-
36	Priest, S. H., 2008. North American audiences for news of emerging technologies: Canadian and US responses to bio and nanotechnologies. *Journal of Risk Research*, 11, p. 877–889.	US, CA	Representative survey (n_{US}=1,200, n_{C}=2,000)	Membership of sub-groups	-	National and regional origin	-	Media utilisation
37	Priest, S. H. et al., 2009. Risk perceptions starting to shift? U.S. citizens are forming opinions about nanotechnology. *Journal of Nanoparticle Research*, 12, p. 11–20.	US	Non-representative survey (n=76)	Development of risk perception in various risk areas	-	-	-	Media utilisation, active information procurement, discussion of nano-related issues
38	Priest, S. H. und Greenhalgh, T., 2011. Nanotechnology as an experiment in democracy: how do citizens form opinions about technology and policy? *Journal of Nanoparticle Research,* 13, p. 1521–1531.	US	Non-representative survey (n=76)	Benefit perception, risk perception, need for regulation	-	-	-	Time of survey

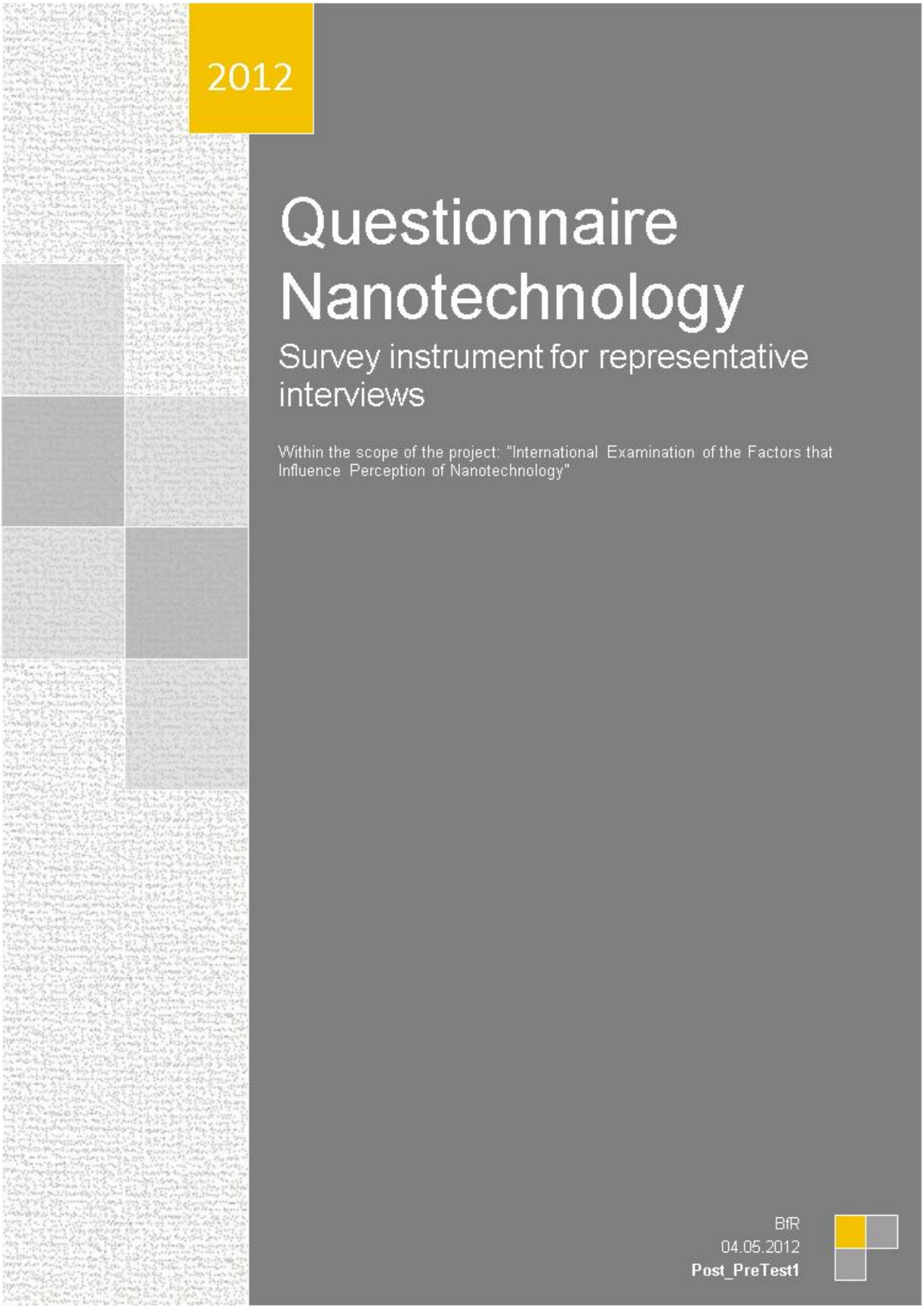
	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
39	Retzbach, A. et al., 2011. Public understanding of science and the perception of nanotechnology: the roles of interest in science, methodological knowledge, epistemological beliefs, and beliefs about science. *Journal of Nanoparticle Research*, 13(12), p. 6231–6244.	US	Representative survey (n=587)	Perceived benefit, perceived risk	Familiarity with the issue of nanotechnology	Gender, age, education	Interest in science, scientific commitment, epistemological attitudes, perceived uncertainty of scientific knowledge, attitude towards science	Knowledge of technology and scientific work methods
40	Rollin, F. et al., 2011. Consumers and new food technologies. *Trends in Food Science & Technology*, 22(2–3), p. 99–111.	EU	Literature study	-	-	-	-	-
41	Rosenbladt, B. v., Schupp, J., Wagner, G.G., 2007. Nanotechnologie in der Bevölkerung noch wenig bekannt. Wochenbericht des DIW Berlin Nr. 45/2007, p. 673–677	DE	Representative survey (n=1.063)	Level of knowledge, ratio of potential to risk	Information status	Education, age, gender	-	-
42	Scheufele, D. et al., 2005. The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research,* 7(6), p. 659–667.	US	Representative survey (n=706)	General attitudes towards nanotechnology	Familiarity with nanotechnology, level of knowledge, perceived risk, perceived benefit	Gender, age, education, income	-	Science-related media utilisation
43	Scheufele, D. et al., 2007. Scientists worry about some risks more than the public. *Nature Nanotechnology*, 2(12), p. 732–734.	US	Representative survey (n=1,015), non-representative survey (n=363)	Perceived risks, perceived benefits	-	-	-	Expert or layperson status
44	Scheufele, D. et al., 2008. Religious beliefs and public attitudes toward nanotechnology in Europe and the United States. *Nature nanotechnology*, 4(2), p. 91–94.	EU, US	Representative survey (n_{EU}=29.193, n_{US}=1,015)	Moral acceptance of nanotechnology	Knowledge about nanotechnology	-	Religiousness, trust in science	National PISA score (as variable for "science competency"), number of national studies on nanotechnology
45	Schütz, H. und Wiedemann, P. M., 2008. Framing effects on risk perception of nanotechnology. *Public Understanding of Science*, 17(3), p. 369.	AU	Non-representative survey (n=194)	Assessment of probability of occurrence of individual risk scenarios	Perceived benefit, corporate characteristics	-	-	-

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
46	Siegrist, M. et al., 2007a. Public acceptance of nanotechnology foods and food packaging: The influence of affect and trust. *Appetite*, 49(2), p. 459–466.	CH	Non-representative survey (n=153)	Willingness to purchase	Perceived benefit, perceived risk	-	Trust in institutions, basic emotional standpoint	-
47	Siegrist, M. et al., 2007b. Lay-people's and experts' perception of nanotechnology hazards. *Risk Analysis*, 27(1), p. 59–69.	CH, AU, DE	Representative survey (n_1=375), non-representative survey (n_2=46)	Perceived risk of application in question	Areas of application, perceived benefit	Gender	Attitude towards technology, trust in official bodies, ethical justification	Expert or layperson status
48	Siegrist, M. et al., 2007c. Risks and nanotechnology: the public is more concerned than experts and industry. *Nature Nanotechnology*, 2(2), p. 67–67.	CH, AU, DE	Non-representative survey (n_1=375, n_2=46)	Perceived risk of application in question	Areas of application	-	-	Expert or layperson status
49	Siegrist, M. et al., 2008. Perceived risks and perceived benefits of different nanotechnology foods and nanotechnology food packaging. *Appetite*, 51(2), p. 283–290.	CH	Representative survey (n=337)	Perceived benefit of applications, perceived risk of applications	Areas of application, perceived benefit	Gender, age	Risk components, preference for natural foods, social trust	-
50	Siegrist, M. et al., 2009. Acceptance of nanotechnology foods: a conjoint study examining consumers' willingness to buy. *British Food Journal*, 111(7), p. 660–668.	CH	Non-representative survey (n_1=255, n_2=266)	Willingness to purchase food products	Price, aroma, added health benefit, type of product	Gender, age	-	-
51	Smiley Smith S. et al., 2008. Americans' nanotechnology risk perception: Assessing Opinion Change. *Journal of Industrial Ecology*, 12(3), p. 1–9.	US	Representative survey (n=1,014)	Level of knowledge on the issue of nanotechnology, change in perceived risk-benefit ratio	-	Gender, age, education, household income, marital status, employment status, children, ethnicity	Trust in official institutions, trust in industry, political affiliation, status of voting registration	-

	Study	Country	Type of survey	Dependent variable(s)	Investigated factors			
					Object-related	Sociodemographic	Psychosocial	Other
52	Stampfli, N. et al., 2010. Acceptance of nanotechnology in food and food packaging: a path model analysis. *Journal of Risk Research*, 13, p. 353–365.	CH	Representative survey (n=514)	Willingness to purchase nano-foods, perception of the benefit and risks of nano-foods	Perception of the benefit and risks of nano-foods, area of application	-	Trust in science and consumer protection, trust in the food industry and retail trade, attitude towards technology, attitude towards genetic engineering, preference for healthy foods, preference for organic foods	-
53	TNS BMRB, 2011. FSA Citizens Forums: Nanotechnology and food. TNS-BMRB Report Nr. JN 219186, April 2011.	GB	Non-representative survey (n=120)	-	-	-	-	-
54	Vandermoere, F. et al., 2009a. The morality of attitudes toward nanotechnology: about God, techno-scientific progress, and interfering with nature. *Journal of Nanoparticle Research*, 12 (2), p. 373–381.	DE	Representative survey (n=750)	Familiarity with nanotechnology, attitude towards nanotechnology	Familiarity with nanotechnology	Gender, age, education	Attitude towards science and technical progress, attitude towards human intervention in nature, religiousness	-
55	Vandermoere, F. et al. 2009b. The public understanding of nanotechnology in the food domain. *Public Understanding of Science*, 20 (2), p. 195.	FR	Representative survey (n=750)	Familiarity with nanotechnology, ratio of perceived risks to perceived benefits of the application	Areas of application (food, food packaging)	Gender, age, education	Trust in official bodies. attitude towards science and technical progress, attitude towards human intervention in nature	-
56	Waldron, AM, Spencer, D & Batt, CA, 2006. The current state of public understanding of nanotechnology. *Journal of Nanoparticle Research*, 8, p. 569–575	US	Non-representative survey (n=1,500)	Familiarity with nanotechnology	-	Gender, age	-	-
57	Zimmer, R. et al., 2008. Wahrnehmung der Nanotechnologie in der Bevölkerung. BfR-science 05/2008	DE	Representative survey (n=1,000)	Acceptance, overall feeling about nanotechnology, risk-benefit ratio, willingness to purchase, trust in official institutions	Areas of application, information status	Gender, education, age, income	Behaviour (anxiety versus hope)	-

9.2 Representative population survey

9.2.1 Questionnaire



Contents

Introduction, Welcome

INTERVIEWER: Welcome

Good morning/ good afternoon/ good evening, Ms/ Mr..., my name is ...
(introduction of interviewer and institute),

We are currently conducting a survey for a federal institute on the subject “New Technologies” in which your telephone number has been selected at random.

All of the information you give us will of course be treated with strict confidentiality. The Institute gives you its express assurance that all of the information you provide will be evaluated in summarised form in such a way that it is not possible to trace it back to any individual respondent.

➔ *INTERVIEWER: Continue with question S1*

INTERVIEWER: If there are questions about the institute commissioning the survey.

If the respondent wants to know who the institute commissioning the study is (to which they are entitled), please respond in two phases:

Phase 1: We are conducting the survey on behalf of a federal institute active in the field of consumer protection.

Phase 2: If he/she explicitly disagrees with this, you can mention that it is the Federal Institute for Risk Assessment.

➔ *INTERVIEWER: If Phase 2 was reached, please make a note that the contact person knows that the commissioning party is the Federal Institute for Risk Assessment.*

INTERVIEWER: If the respondent doubts his/her own knowledge

If an interviewee is worried that their technical knowledge will not be sufficient to participate in a survey on new technologies, please reassure and encourage them as follows:

This survey doesn’t involve technical knowledge, it’s about the attitudes and views of citizens towards new technologies and how they are applied in everyday life.

➔ *INTERVIEWER: Please make a note if the detailed explanation was required.*

S1 Screening

Before I get to the actual subject, I would like to know….

S1.1 …. how old you are |___|___| years

INTERVIEWER: The survey is for persons aged between 16 and 60 /
(Friendly termination if the person you are talking to is younger or older)

S1.2. Gender:

INTERVIEWER: Question only to be read out if in doubt!

Male	☐1
Female	☐2

A1 Status of nanotechnology

Status: Unchanged Question 4 / 2007

The following questions are about new technologies. I'll read out various technologies, then I'd like you to tell me which ones will gain or lose in significance in our lives in your opinion and which ones will neither gain nor lose in significance.

INTERVIEWER: Read out!

Programming: Rotation of statements

	Significance will increase	Significance will stay the same	Significance will decrease	Never heard of it
Nanotechnology	1	2	3	4
Biotechnology	1	2	3	4
Environmental technology	1	2	3	4
Information technology	1	2	3	4
Genetic technology	1	2	3	4

A2 Spontaneous knowledge

Status: Unchanged Question 5 / 2007

PROGRAMMING: Filter:

- *If for A1 -> Nanotechnology -> Never heard of it (4): continue with B1*
- *Otherwise: continue with A2*

I'd now like to talk to you about nanotechnology.

What have you heard or read about nanotechnology or nanomaterials?
Please tell me everything you know about them!

INTERVIEWER: Intensive probing! Note down everything!

_____

_____

_____

B1 Info on nanotechnology

Status: Unchanged

We'd now like to know what you think about nanotechnology. I'll explain to you briefly first what nanotechnologies are:

Version B1.1:

(Programming: For Random Sample 1)

Nanotechnology makes it possible to produce particles with a size of one millionth of a millimetre or a human hair split 50,000 times. Materials made up of these particles have special physical, chemical and biological properties.

Version B1.2.:
(Programming: For Random Sample 2)

Nanotechnology makes it possible to produce particles with a size of one millionth of a millimetre or a human hair split 50,000 times. Materials made up of these particles have special physical, chemical and biological properties.

(Programming: Rotation of paragraphs)

Several scientists are assuming significant progress through nanotechnology. Even today, nanomaterials can improve the properties of paints, clothing and cosmetics. In future, they could contribute among other things to treating diseases more effectively, making foods keep for longer, improving computers and repairing environmental damage. That's why they could possible trigger a new economic boom.
(54 words)

Several scientists have pointed out the possible risks of nanotechnology. Nanomaterials could penetrate into the organism, for example, and endanger human health. They could promote resistance to certain bacteria and possibly cause cancer. In addition to this, nanomaterials could pollute the environment or be used for the development of new weapons, surveillance and bugging devices.
(55 words)

I'd now like to ask you how much you've heard about nanotechnology up to now?

INTERVIEWER: Read out!

- Nothing at all ☐1
- A little ☐2
- A lot ☐3

B2 Areas of application

Status: Updated

I'll now read out several different areas of application for nanomaterials to you and would like you to tell me whether you approve or disapprove of each one.

Please distinguish here between "I would fully approve", "I would tend to approve", "I would tend to disapprove" and "I would fully disapprove".

(Programming: Rotation of applications)

Use of nanomaterials for…	Fully approve 1	Tend to approve 2	Tend to disapprove 3	Fully disapprove 4	Don't know / no answer[1] 77
… a reduction of the salt content in foods while retaining the same taste	☐	☐	☐	☐	☐
… the enrichment of foods with vitamins and other nutrients	☐	☐	☐	☐	☐
… indoor paint that prevents the accumulation of odours (e.g. cigarette smoke)	☐	☐	☐	☐	☐
… an increase in the efficiency of sun screen	☐	☐	☐	☐	☐
… active substances of skin cream that reach deeper skin layers	☐	☐	☐	☐	☐
… the prevention of the occurrence of unpleasant odours in textiles	☐	☐	☐	☐	☐
… the improvement of foil quality to increase the durability of foods	☐	☐	☐	☐	☐
… drugs which release their active substance in a concentration at the desired spot	☐	☐	☐	☐	☐
… the repair of damaged tooth enamel	☐	☐	☐	☐	☐
…more efficient cleaning of waste water	☐	☐	☐	☐	☐

[1] The category "Don't know / no answer" was added to every question. It is not to be read out actively by the interviewer but has to be available if a respondent is unable to give an answer.

B3 Estimation of risks / benefits

Status: B3.1. same as Question 8/ 2007, B3.2. changed

B3.1. When you think about the explanations of the term nanotechnology that have just been read out, how do you estimate the risk-benefit ratio? Which of the following statements would you agree with?

INTERVIEWER: Read out!

ADP: Alternate by starting with the risks (Codes 1 to 4) or benefits (Codes 4 to 1)!

- The risks of nanotechnology will by far exceed the benefits. ☐ 1
- The risks of nanotechnology will slightly exceed the benefits. ☐ 2
- The benefits of nanotechnology will slightly exceed the risks. ☐ 3
- The benefits of nanotechnology will by far exceed the risks. ☐ 4

B3.2. I would now like to ask you how you estimate the risk-benefit ratio with each of the following uses of nanomaterials?

Please tell me which statement applies in each instance in your opinion:

- The risks will by far exceed the benefits.
- The risks will slightly exceed the benefits.
- The benefits will slightly exceed the risks.
- The benefits will by far exceed the risks.

Programming: Rotation of the uses.
If possible, alternate by starting with the risks (Codes 1 to 4) or benefits (Codes 4 to 1)!

Use of nanomaterials for…	The risks will by far exceed the benefits. 1	The risks will slightly exceed the benefits. 2	The benefits will slightly exceed the risks. 3	The benefits will by far exceed the risks. 4	Don't know / no answer 77
… a reduction of the salt content in foods while retaining the same taste	☐	☐	☐	☐	☐
… the enrichment of foods with vitamins and other nutrients	☐	☐	☐	☐	☐
… indoor paint that prevents the accumulation of odours (e.g. cigarette smoke)	☐	☐	☐	☐	☐
… an increase in the efficiency of sun screen	☐	☐	☐	☐	☐
… active substances of skin cream that reach deeper skin layers	☐	☐	☐	☐	☐
… the prevention of the occurrence of unpleasant odours in textiles	☐	☐	☐	☐	☐
… the improvement of foil quality to increase the durability of foods	☐	☐	☐	☐	☐
… drugs which release their active substance in a concentration at the desired spot	☐	☐	☐	☐	☐
… the repair of damaged tooth enamel	☐	☐	☐	☐	☐
…more efficient cleaning of waste water	☐	☐	☐	☐	☐

B4 Willingness to buy

Status: Unchanged Question 10/2007

B4.1. Would you buy products from the following groups if they contained nanomaterials? Please answer with “Yes, I would buy them” or “No, I wouldn’t buy them”.

(Programming: Rotation of statements)

	Yes	No
• Surface sealants and care	1	2
• Clothing	1	2
• Cosmetics	1	2
• Foods	1	2

C1 Information sources

Status: Unchanged Questions 11, 12 and 13 / 2007

C.1.1 How well informed do you feel about nanotechnology compared to other modern technologies, such as biotechnology and information technology?

INTERVIEWER: Read out!

Better	☐ 1
Equally well	☐ 2
Worse	☐ 3

Programming: Filter:
- *If for A1 -> Nanotechnology -> Never heard of it (4): continue with C.1.3.*
- *Otherwise: continue with C.1.2*

C1.2. Where have you already heard, read or seen something about the subject nanotechnology? I'll read out some possible answers and I'd like you to tell me in each instance whether you picked up something about nanotechnology there!

INTERVIEWER: Read out!
Programming: Rotation of statements

	Yes	No
• TV	1	2
• Radio	1	2
• Internet	1	2
• Newspapers	1	2
• Magazines	1	2
• Personal discussions with friends, colleagues etc.	1	2
• Personal discussions with experts, e.g. doctors, tradesmen, chemists etc.	1	2
• Are there any other information sources in which you heard, read or saw something?	(Other: *Please note*) _____ _____)	

C1.3. Where or how would you find out about nanotechnology? I'll read out a few possible answers to you here too.

INTERVIEWER: Read out!

Programming: Rotation of statements

	Yes	No
• TV	1	2
• Radio	1	2
• Internet	1	2
• Newspapers	1	2
• Magazines	1	2
• Personal discussions with friends, colleagues etc.	1	2
• Personal discussions with experts, e.g. doctors, tradesmen, chemists etc.	1	2
• Are there any other information sources you would use?	(Other: *Please note*) _____ _____)	

C2 Trust in institutions

Status: Unchanged Question 14 / 2007

How much trust would you place in the following persons or institutions if they were to inform you about nanotechnology?

Please categorise your answers as follows: “Trust them absolutely”, “Trust them a bit”, “Don’t really trust them”, “Don’t trust them at all”.

INTERVIEWER: Read out!

(Programming: Rotation of statements)

	1 = Absolute trust	2 = Bit of trust	3 = Not much trust	4 = No trust at all	Don’t know / no answer 77
Executives from trade and industry	☐	☐	☐	☐	☐
Government representatives	☐	☐	☐	☐	☐
Scientists	☐	☐	☐	☐	☐
Health and occupational safety authorities	☐	☐	☐	☐	☐
Pharmacists	☐	☐	☐	☐	☐
Doctors	☐	☐	☐	☐	☐
Consumer organisations (*Stiftung Warentest*, consumer advice centres)	☐	☐	☐	☐	☐
Environmental organisations (Greenpeace, Foodwatch)	☐	☐	☐	☐	☐

D1 Feelings

Status: Question 15 / 2007 (with changed programming instruction)

What are your overall feelings on the subject nanotechnology?

INTERVIEWER: Read out!

Programming: If possible, alternate by starting with positive feelings (Codes 1 to 4) or negative feelings (Codes 4 to 1)!

- Very good ☐1
- Good ☐2
- Bad ☐3
- Very bad ☐4

C3 Trust in the government

Status: Unchanged Question 18 / 2007

To what extent do you agree with the following statement? People can trust that the government will protect the general public from environmental and technical risks.

INTERVIEWER: Read out!

- Completely agree ☐1
- Tend to agree ☐2
- Tend to disagree ☐3
- Completely disagree ☐4

- 77= Don’t know / no answer

C4 / C5 Need for information and action

Status: New questions

PROGRAMMING: Each respondent is asked either Question C4 or Question C5 with a probability of 50 %. i.e. approx. half of the respondents get Question C4 and the other half Question C5.

C4 In which areas would you like more information on nanotechnology?

INTERVIEWER: Intensive probing! Note down everything!

_____
_____
_____

C5 What in your view should state bodies (e.g. government or national authorities) do with regard to nanotechnology?

INTERVIEWER Intensive probing! Note down everything!

_____
_____
_____

D2 Attitudes to nanotechnology

Status: Update and expansion of Question 19 / 2007

I'll now read out some statements and attitudes from consumers to you and would like you to tell me the extent to which the statement also applies to you personally.

You can decide here whether the statement applies completely, to an extent, not really or not at all to you personally.

INTERVIEWER: The respondent should if possible give an answer to every statement but if this is completely impossible, you can put a cross at "No answer".

Scale:

1 = Applies completely

2 = Applies to an extent

3 = Doesn't really apply

4 = Doesn't apply at all

---

77 = Don't know / no answer

(Programming: Rotation of statements)

Dimensions[2]	***Possible statements***
Fascination with technology/belief in progress	• Nanotechnology will open up fantastic opportunities for technical development (Q. 19/2007). • I am very interested in scientific topics.
Economic benefits	• If Germany wants to remain globally competitive, it has to embrace technologies such as nanotechnology.
Everyday benefits	• If nanotechnology makes everyday products better, I'll gladly use it. • I am looking forward to the many nano-products that will soon be on the market. • I believe this whole nano thing is a marketing trick to improve sales of certain products.
Environmental / health benefits	• I believe that nanotechnology offers many chances to cure and recognise diseases. • I am sure that nanotechnology will help to protect the environment and repair environmental damage.
Social / moral benefits	• I am convinced that nanotechnology is of benefit to society

[2] The dimensions serve analytical structuring and are not read out to the interviewees

	as a whole.
Scepticism towards technology	• It's really frightening when you consider how many nano-products there are already supposed to be (Q. 19/2007).
Environmental and health risks	• I'm worried that nanotechnology could lead to completely new health problems. • I'm concerned that nanomaterials could damage the environment and nature.
Social risks	• I believe that nanotechnology can lead to job cuts in traditional branches of industry. • I'm afraid that nanotechnology will have the result that it will be more and more possible for individuals to be monitored and controlled by miniaturised technology.
Vulnerability	• I believe it's hardly possible to control the health risks of nanotechnology.
Support	• I would approve of nanotechnology being promoted through state funding.

S2 Social milieu as an indicator

STATUS: New in 2012

The following section deals with opinions on various aspects of life, such as society, occupation and private life. I'll now read out a few statements to you and would like you to tell me the extent to which these opinions and views apply to you personally.

You can decide here whether each statement applies completely, to an extent, not really or not at all to you personally.

INTERVIEWER: The respondent should give an answer to every statement!

Scale:

1 = Applies completely
2 = Applies to an extent
3 = Doesn't really apply
4 = Doesn't apply at all

Statements

(Programming: Rotation of statements)

- It's important to me to be able to introduce new ideas and impulses.
- I'm prepared to spend more on environmentally friendly products.
- I'm not worried about my future.
- I live with the feeling that I could always start over again.
- I trust in the powers of the free market. The market will ensure that what has to change will change.
- I like living in an environment in which I can meet very different people.
- I sometimes consciously treat myself to top quality.
- I don't mind working more if I am able to afford more.
- There are only a few opportunities for us to make a success of our lives nowadays.
- We need economic growth, even if it harms the environment.
- I've got enough to do with my own problems; I can't take care of others too.
- I am very interested in new developments in the cultural scene.

➔ *Remark: These are not (only) statements in themselves, they are indicators for statistical classification into the following social segments:*

1. *Sophisticated milieus*
2. *Socially critical milieus*
3. *Mainstream*
4. *Young milieus*
5. *Simple milieus*

S3 Sociodemographic characteristics

STATUS: Partially adapted

Just a few general questions for the statistics now to finish off the interview.

S3.1. Would you please tell me the highest level of formal education you have reached? *(Q. 21/2007, slightly changed)*
INTERVIEWER: Read out!

- Junior secondary school (with and without vocational training) ☐1
- Intermediate secondary school (polytechnic high school, technical or commercial training without university) ☐2
- University/college entrance qualification ☐3
- University or college degree ☐4

- No formal qualifications (yet) ☐6

S3.2. Are you currently employed? *(Q. 22/2007, slightly expanded)*
INTERVIEWER: Read out!

- Yes, fully employed ☐1
- Yes, partially employed (part-time, hourly basis / temporary) ☐2
- No, temporarily out of work / unemployed ☐3
- No, no longer employed / retired ☐4
- Housewife / house husband ☐5
- Still training/ school pupil, student, apprentice etc. ☐6
- Other ☐7

S3.3. Monthly net household income
INTERVIEWER: Please read out before placing a cross!
"The average net household income in Germany is currently approx. € 2,500 per month. How is it with you? Is your net household income well above this figure, slightly above it, roughly the same, slightly below it or well below it?"

- Well over € 2,500 ☐1
- Slightly over € 2.500 ☐2
- Roughly € 2,500 ☐3
- Slightly under € 2,500 ☐4
- Well under € 2,500 ☐5

PROGRAMMING: Only ask S3.3.1 if the respondent refused to answer Question S3.3.

S3.3.1 To which occupational category does or did your occupation belong? I'll read out a few different options to you:

- Blue collar worker
- Skilled worker
- White collar worker
- Middle management
- Qualified manager or executive
- Lower grade civil servant
- Middle grade civil servant
- Upper or top grade civil servant
- Self-employed farmer
- Freelance professions (e.g. doctor, lawyer, architect, accountant, scientist, artist)
- Self-employed without employees
- Self-employed with employees

- Never had a job

S3.4. How many persons – yourself included – live in your household? *(Q. 24/2007)* (This includes people who live together with joint housekeeping. Please include all children living in the household too.)

|___|___| persons

<u>Programming</u>: Only ask Question S3.5 if more than 1 person in Question S3.4

S3.5. How many persons in your household are… *(Q. 25/2007 expanded)*

- under 14 years of age: |___|___| persons
- between 14 and 17 years of age: |___|___| persons
- 18 years of age and older: |___|___| persons

S3.6 Were you or one of your parents born abroad?
Interviewer: Do not read out

- I was born abroad
- One or both parents born abroad
- I and my parents were born in Germany

- 77= Don't know, no answer

Many thanks for participating in this survey!

9.2.2 Factor analysis

Factor 1: Potential of nanotechnology		Factor 2: Health and ecological risks	
I believe that nanotechnology has great potential to heal and identify diseases.	.76	I think that it is almost impossible to control the health risks of nanotechnology.	.79
Nanotechnology will open up fantastic opportunities for technical development.	.72	I am concerned that nanotechnology may result in completely new health problems.	.73
I am in favour of nanotechnology being supported with state funds.	.62	I am concerned that nanomaterials may be harmful to nature and the environment.	.68
I am convinced that nanotechnology is beneficial for society.	.58		
In order to hold its own in the global competitive arena, Germany has to rely on technologies like nanotechnology.	.52		
Factor 3: Fascination of nanoproducts		**Factor 4: Dangers of nanotechnology for society**	
If nanotechnology makes everyday products better, then I will be happy to use them.	.73	I believe that nanotechnology may lead to a loss of jobs in traditional sectors of industry.	.86
I hope that nanotechnology will help to protect the environment and to remedy environmental damage.	.65	I fear that nanotechnology will lead to a situation in which the individual is increasingly monitored and controlled by miniaturised technology.	.64
I am looking forward to the many new nanoproducts that will soon be available.	.52		

Factor 1: Applications in medicine and environmental protection		Factor 2: Applications outside the human body		Factor 3: Applications in foods and cosmetics	
Medications that can release their active substances in concentrated form in the desired target location	.83	Indoor paint coatings that prevent odours (e.g. cigarette smoke) from becoming ingrained	.83	Enrichment of foods with vitamins and other nutrients	.85
Recovery of damaged tooth enamel	.73	Prevention of unpleasant odours in textiles	.79	Reduction in the salt content in foods without affecting the taste	.72
More efficient cleaning of waste water	.63	Improved foil quality to increase the shelf life of foods	.61	Active substances of skin lotions that reach deeper layers of the skin	.50
Increased efficacy of suntan lotions	.62				

9.3 Communication concepts

9.3.1 Examples of risk communication for nanotechnology

The following examples of risk communication for nanotechnology were collected during the development of the alternative risk communication concepts (cf. Chapter 0; correct as of November 2012). For the sake of completeness, the collection is outlined below based on the three types of risk communication - namely, information, dialogue and participation.

9.3.1.1 Information

Internet platforms

- Baden-Württemberg nanoportal: consumer portal providing comprehensive information on nanotechnology (applications, safety, legal aspects, dialogue options etc.): http://www.nanoportal-bw.de/pb/,Lde/55726.html

- nano&me (UK): website of the Responsible Nano Forum with information on products, safety, legal aspects, nano debate etc.: http://www.nanoandme.org/home/

Fig. 40: Internet platform "nano&me"

Source: http://www.nanoandme.org/home/

- Nanoparticles: knowledge platform of the DECHEMA Society for Chemical Engineering and Biotechnology: http://www.nanopartikel.info/cms

- Swiss Nano Cube (CH): Swiss education platform featuring general information, applications and products, science and research etc., including the NanoTechBox with teaching materials: http://www.swissnanocube.ch/home/

- Nano-Sicherheit.de: information platform of the Hessen Ministry of Economics, Transport and Regional Development; service for the companies active in Hessen; information platform for the responsible use of nanotechnology. It is designed to help companies as well as scientists, users and interested citizens to gain a rapid and effective overview of current research activities and the debate on the safety of nanotechnology: http://www.nano-sicherheit.de/dynasite.cfm?dsmid=10890

- VerbraucherFenster Hessen (Hessen Consumer Window): "How safe is nanotechnology? - internet platform for consumers": http://verbraucherfenster.hessen.de/irj/VF_Internet?rid=HMULV_15/VF_Internet/nav/d1d/d1d0e41f-c30f-a21f-012f-31e2389e4818,5f570ca2-eccf-f21f-012f-31e2389e4818,,,11111111-2222-3333-4444-100000005003%26overview=true.htm&uid=d1d0e41f-c30f-a21f-012f-31e2389e4818

- InfoNano (CH): InfoNano is the central national information source for nanotechnology in Switzerland. The Federal Offices for Health, Environmental Affairs and Agriculture, the Commission for Technology and Innovation, Swissmedic and the State Secetariats for Economic Affairs and for Education and Research are involved in the website: http://www.bag.admin.ch/nanotechnologie/

- nanoforum (EU): European Nanotechnology Gateway: http://www.nanoforum.org/index.php?code=2f885d0fbe2e131bfc9d98363e55d1d4&userid=46242968

- The Innovation Society (CH): information services for nanotechnology: safety, risk and regulation (http://www.innovationsgesellschaft.ch/de/index.php?page=125) as well as the Webinar: "Nano-Risiken managen - Ausbau des Risikomanagements für den sicheren Umgang mit Nanomaterialien" (Managing Nano-Risks - Development of Risk Management for the Safe Use of Nanomaterials)": http://www.innovationsgesellschaft.ch/de/index.php?section=news&cmd=details&newsid=565

- CORDIS (Community Research and Development Information Service) Nanotechnology Homepage of the European Commission: http://cordis.europa.eu/nanotechnology/

- European Safety Authority (EFSA): http://www.efsa.europa.eu/de/topics/topic/nanotechnology.htm

- Nanosafety at the OECD: http://www.oecd.org/env/chemicalsafetyandbiosafety/safetyofmanufacturednanomaterials/

Videos, films, interactive games, "offline" games

- NanoramaLoft of the Swiss Nano Cube: interactive online "learn-search" game where users have to search for nanoproducts in a loft apartment using the mouse and then answer questions on the products: http://www.swissnanocube.ch/nanorama/

Fig. 41: Online game "NanoramaLoft"

Source: http://www.swissnanocube.ch/nanorama/

- Project NanoTV (EU): short films presenting the findings of European nanotechnology research. They were produced for TV and internet, and broadcast in several European countries: http://www.youris.com/Nano/NANOTV

- The experiment kit "SimplyNano 1" (CH) contains eight experiments from the world of nanotechnology and is designed to demonstrate elementary nanotechnology phenomena. It is targeted at teachers and schoolchildren (school years 7 to 10), and the 8 simple experiments are from the fields of nanodimension, nanosurfaces (lotus effect) and the reactivity of nanoparticles. The experiments can be conducted as demonstration or pupil experiments. All experiment instructions and background information on the experiments are contained on the accompanying USB stick in electronic format. The consumables in the kit can also be easily procured (most are available in DIY stores or can be re-ordered direct from the suppliers): http://www.simplyscience.ch/Home/Mach-mit/Tipps/Experimente-Tipp-SimplyNano-1-Experimentierkoffer.aspx

- "Nanoreisen – Nano hinterm Komma" (Nanoreisen - Adventures Beyond the Decimal): interactive website of the German Ministry of Education and Research for schoolchildren with three itineraries for virtual expeditions to the nanocosmos: http://nanoreisen.de/

Fig. 42: Online game "NanoReisen"

Source: http://nanoreisen.de/deutsch/index.html

Brochures and flyers

- Flyer "Im Reich des Winzigen – Nanotechnologie" (In the Realm of the Tiny - Nanotechnology), published by the Federation of German Consumer Organisations (vzbv; 2008): http://www.vzbv.de/mediapics/nano_broschuere.pdf

- Brochure "Nanos überall – Nanotechnologie im Alltag" (Nanos Everywhere - Nanotechnology in Everyday Life), published by BUND (Friends of the Earth Germany): http://www.bund.net/fileadmin/bundnet/publikationen/nanotechnologie/20090429_nanotechnologie_imalltag_flyer.pdf

- "Nano Maßstäbe" (Nano Benchmarks), information brochure published by the broschüre Öko-Institut (Institute for Applied Ecology; 2008): http://www.oeko.de/oekodoc/1161/2008-322-de.pdf

- "Nanotechnologie bei Lebensmittel" (Nanotechnology in Foods), flyer published by the "aid" information service: http://www.aid.de/shop/pdf/0085_2011_nanoflyer_x000.pdf

- Study by BUND (Friends of the Earth Germany): "Aus dem Labor auf den Teller. Die Nutzung der Nanotechnologie im Lebensmittelsektor" (From the Lab to the Plate. The Use of Nanotechnology in the Food Sector): http://www.bund.net/fileadmin/bundnet/publikationen/nanotechnologie/20080311_nanotechnologie_lebensmittel_studie.pdf

- nanotrust dossiers: http://nanotrust.ac.at/dossiers.html

Databases

- Nano product database of BUND (Friends of the Earth Germany): http://www.bund.net/nc/themen_und_projekte/nanotechnologie/nanoprodukte/produktsuche/

- Nanotechnology product database of the Project on Emerging Nanotechnologies (US): http://www.nanotechproject.org/inventories/consumer/

- Database of Nanowerk (UK): http://www.nanowerk.com/phpscripts/n_dbsearch.php

- Database of ANEC/BEUC (EU): http://docshare.beuc.org/Common/GetFile.asp?ID=30511&mfd=off&LogonName=Guesten

- Nano-list of BG BAU (German statutory accident insurance organisation for the construction industry); "Nanoteilchen in Bau- und Reinigungsprodukten" (Nanoparticles in Building and Cleaning Products): http://www.bgbau.de/praev/fachinformationen/gefahrstoffe/nano/pdf-files/nano-liste.pdf

Mobile

- Smartphone app "nanotörn": the free app developed by the Leibniz Institute for Science and Mathematics Education at the University of Kiel (IPN) and the Rijksuniversiteit Groningen shows examples of nanoscience applications in everyday life, be it in the coating of outdoor jackets, in loudspeakers or adhesive tape modelled on the footpads of geckos. Moreover, "nanotörn" transforms a mobile phone into a kind of microscope: 3D images render invisible nanostructures visible, accompanied by explanatory texts. http://www.uni-kiel.de/aktuell/pm/2012/2012-174-nano-app.shtml

Fig. 43: Start screen of the "nanotörn" app

Source: http://www.uni-kiel.de/download/pm/2012/2012-174-2.jpg

9.3.1.2 Dialogue

Conferences

- Euronanoforum (sponsored by the EC; takes place every two years, most recently in 2011) with conference, exhibition, matchmaking etc.: http://www.euronanoforum2011.eu/home

- 6th International "Nano-Authorities-Dialogue" (CH): "Governance in the Field of Nanomaterials": http://www.innovationsgesellschaft.ch/de/index.php?newsid=607&section=news&cmd=details

- Nanosafe 2012: http://www.nanosafe.org/scripts/home/publigen/content/templates/show.asp?L=EN&P=55&vTicker=alleza

- Workshop entitled "Eine Reise in die Nanowelt mit dem SimplyNano 1-Experimentierkoffer" (Journey to the Nanoworld with the SimplyNano 1-experiment kit) (CH): the new "SimplyNano 1" experiment kit was developed by the SimplyScience Foundation and the St. Gallen-based Innovation Society. It contains ready-to-use teaching materials, chemicals and laboratory materials for 8 exciting experiments from the world of nanotechnology. The topics of nanodimension, reactivity of nanoparticles and nanosurfaces are presented in a descriptive and easy-to-understand format. The kit is designed to promote an enthusiasm for and an understanding of natural science and technical themes in lower secondary classes. http://www.innovationsgesellschaft.ch/de/index.php?section=calendar&cmd=event&id=5&phpMyAdmin=9f344366dce9ce0dc652ad8001d36d05&phpMyAdmin=54e1534fb7a1706b5dd25fe164a312d1

Citizens' dialogues

- "NanoCare" citizens' dialogues: as part of the "NanoCare" project of the German Ministry of Education and Research (BMBF; 2006-2009), dialogue events (and demonstrations in the NanoTruck) were held to provide interested local people with information on the safety of nanoparticles in a well-researched and easy-to-understand format. The goal of "NanoCare" was to shed light on new scientific findings on the environment and health-related effects of nanoparticles and present these findings to a broad public. More information at: http://www.nano-sicherheit.de/dynasite.cfm?dsmid=12196 and: http://www.nanopartikel.info/cms/Projekte/NanoCare/NanoCare-Dialogveranstaltungen

- Nano-Dialog Baden-Württemberg". The Baden-Württemberg Ministry for Rural Regions and Consumer Protection (MLR) launched the "Nano-Dialog Baden-Württemberg" back in 2009. The focus is explicitly on the consumer perspective: http://www.nanoportal-bw.de/pb/,Lde/Startseite/Nano_Dialog/Nano_Dialog+BaWue.html

- BASF "Dialogforum Nano": http://www.basf.com/group/corporate/de/sustainability/dialogue/in-dialogue-with-politics/nanotechnology/stakeholder-engagement

- "risk:dialog" of the Environment Agency Austria (A). The "risk:dialog" called into being by Radio Österreich 1 and the Environment Agency focuses on complex issues that are almost impossible to manage in isolation. It provides a platform for interdisciplinary network-

ing beyond the borders of science and politics, and builds bridges between scientific expertise, administration, industry, NGOs and civil society. The "risk:dialog" gives participants the opportunity to position themselves, as it addresses future issues and actively shapes societal processes:
http://www.umweltbundesamt.at/risikodialog

- "FachDialoge nanotechnology" specialist dialogues (German Environment Ministry (BMU)): potential of research as a locational factor:
http://www.oekopol.de/de/themen/chemie/nano/nanofachdialog/fachdialog-4.php

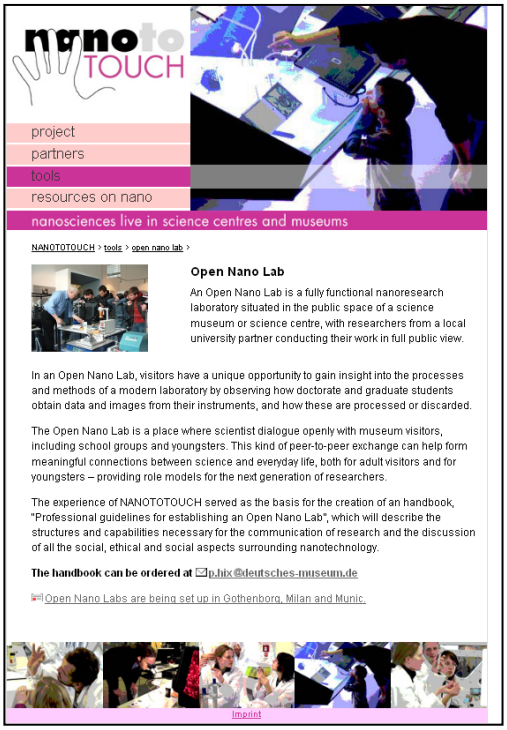
- "FachDialog" specialist dialogue (German Environment Ministry (BMU)): sustainability of nanotechnology – green nano:
http://www.oekopol.de/de/themen/chemie/nano/nanofachdialog/fachdialog-3.php

Events and exhibitions

- Open Nano Labs: as part of the European project "NanoToTouch (2011)", the public can obtain information on the latest nanoresearch in purpose-designed nanolands in science centres and museums - and can also talk directly to scientists. In Transparent laboratories for nanoresearch have been developed in local cooperation ventures between science centres, museums and universities in Munich, Milan and Gothenburg. Website: http://www.nanototouch.eu/; final project report: http://www.museoscienza.org/museo/rapportiInternazionali/download/Nanototouch%20final_jan_2012.pdf

- On the exhibition at the Deutsches Museum in Munich: http://www.deutsches-museum.de/de/ausstellungen/neue-technologien/nano-u-biotechnologie/

Fig. 44: Open Nano Lab on the "NanoToTouch" project website



Source: http://www.nanototouch.eu/tools/open-nano-lab/

- "nanoTruck" – the nanoworld meeting place. The mobile exhibition and communication centre of the German Ministry of Education and Research (BMBF) provides information on the potential and risks of nanotechnology and outlines career prospects in this research field. Visitors can obtain information on numerous topics - such as how nanodyes can be used to create forgery-proof credit cards, or why nanofoams are particularly effective when it comes to thermal and sound insulation. The free-admission nanoTruck started touring in 2011 and is spending three years driving from one end of Germany to the other. it can be requested by schools, universities, cities and municipalities. The www.nanotruck.de website features tour reports, photos, prize competitions and much, much more.

- "Nano" exhibition at the DASA in Dortmund: http://www.dasa-dortmund.de/sonder-ausstellungen/rueckblick/ausstellungen-2011/#c1793; flyer: http://www.dasa-dortmund.de/fileadmin/user_upload/pdf/WA_Nano_Flyer_web.pdf

Competitions and activities

- Viral campaign:
  The "Nana's Small World Paper Chase", which leads to the exhibition "Nano! Benefit und Visionen einer neuen Technologie" (Nano! Benefits and Visions of a New Technology) at the TECHNOSEUM State Museum for Technology and Work in Mannheim. The story: the scientist Nana has shrunk herself and is on a voyage of discovery in the nanoworld. She needs the held of the people of Mannheim to find her way back into the normal world. She has hidden hints in the form of cards at different locations in Mannheim, and there is a new clue on the current hiding place every day. At the end of the paper chase, the cards lead to the TECHNOSEUM. The search for the cards can also be followed on Facebook and Twitter. In addition, Nana's website features short blog posts with interesting facts and information from the field of nanotechnology. http://www.nanas-kleine-welt.de/

Fig. 45: Website of the "Nanas kleine Welt" (Nana's Small World) event

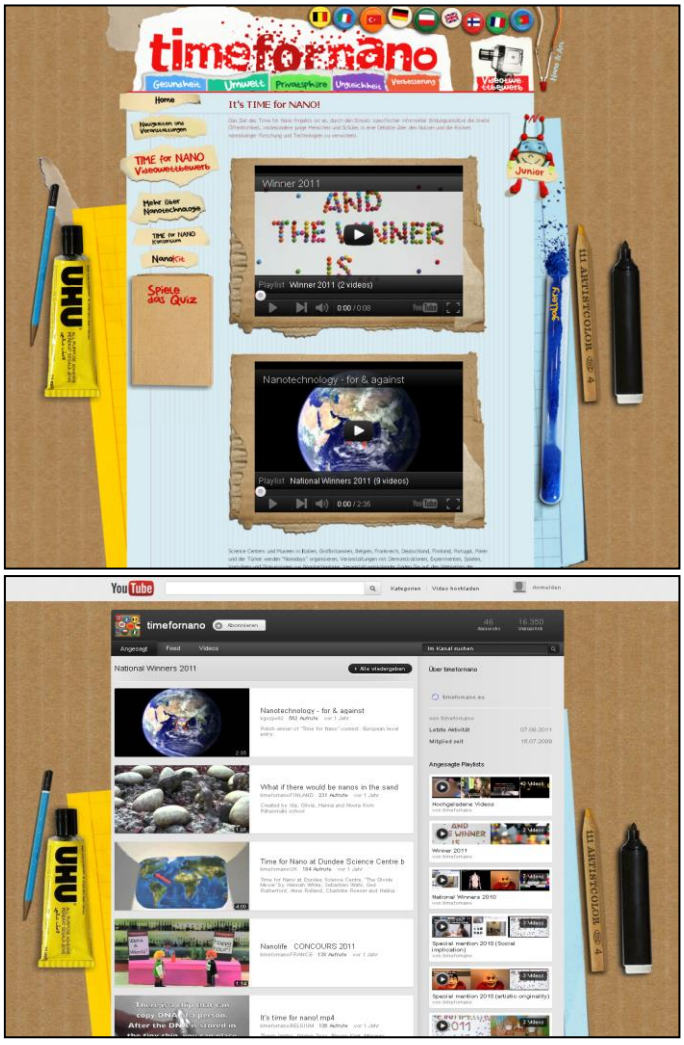
Source: http://www.nanas-kleine-welt.de/

- Art competition "NanoArt 21 Online Exhibition": http://nanoart21.org/nanoart-exhibitions/

- Art competition "Nano+Art" (5th round in 2010): http://www.nano-4-women.de/nanospots/impressionen/nanoart-5.html?tx_gooffotoboek_pi1[fid]=23

- Video competition: as part of the EU project "Time For Nano", schoolchildren in Europe were called on to submit entries for a video competition on nano-dilemmas (2011): http://www.timefornano.eu/de

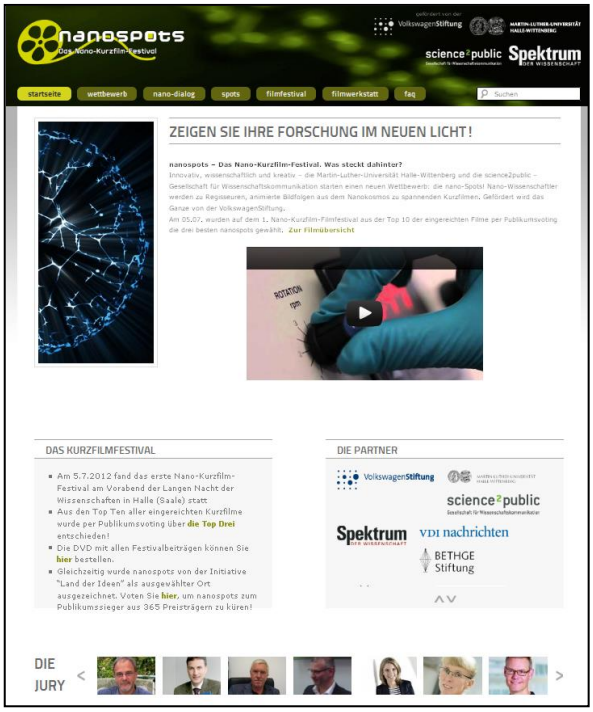
Fig. 46: Website and youtube channel on the video competition "Time for Nano"



Source: http://www.timefornano.eu/de; http://www.youtube.com/user/timefornano

- nanospots – the nano short-film festival (sponsored by the Volkswagen Foundation): the first nano short-film festival took place in July 2012 on the eve of the "long Night of Science" in Halle (Saale): http://www.nanospots.de/

Fig. 47: Website of the "nanospots" short film festival



Source: http://www.nanospots.de/

Social media

Nanoresearch on Facebook: nanotechnology expert Uwe Hartmann has set up a dedicated Facebook page for his new nanotechnology textbook where readers can discuss the book and nanotechnology directly with the author: http://www.facebook.com/Nanoforschung

9.3.1.3 Participation

Consumer conferences

- BfR consumer conference on the perception of nanotechnology in the fields of food, cosmetics and commodity goods in November 2006; programme: http://www.bfr.bund.de/cm/343/programm_verbraucherkonferenz_nanotechnologie.pdf

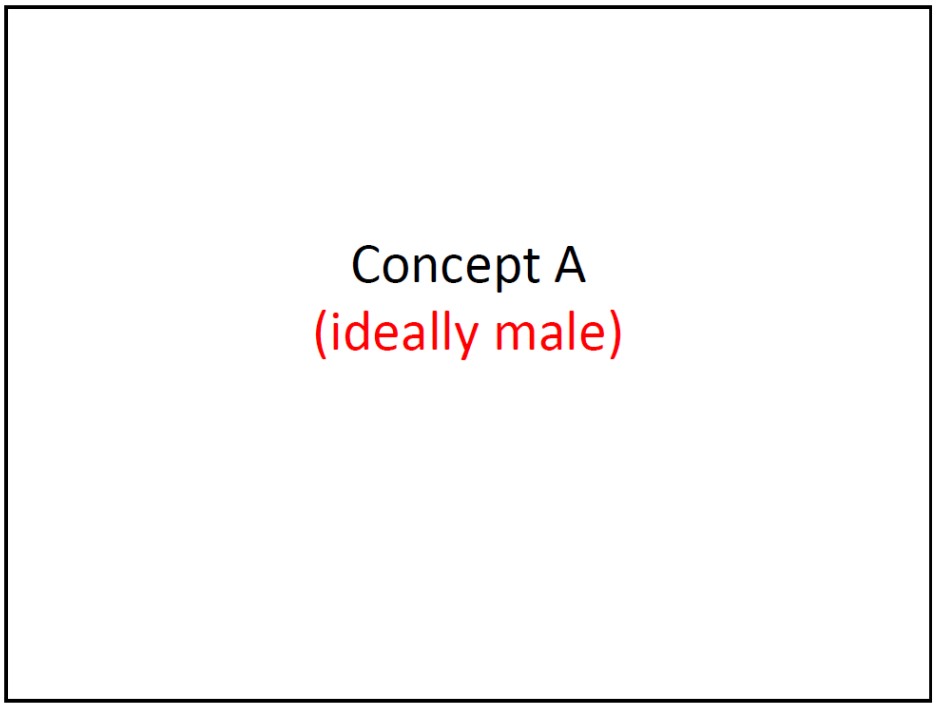
Fig. 48: Title page of the invitation flyer for the BfR consumer conference

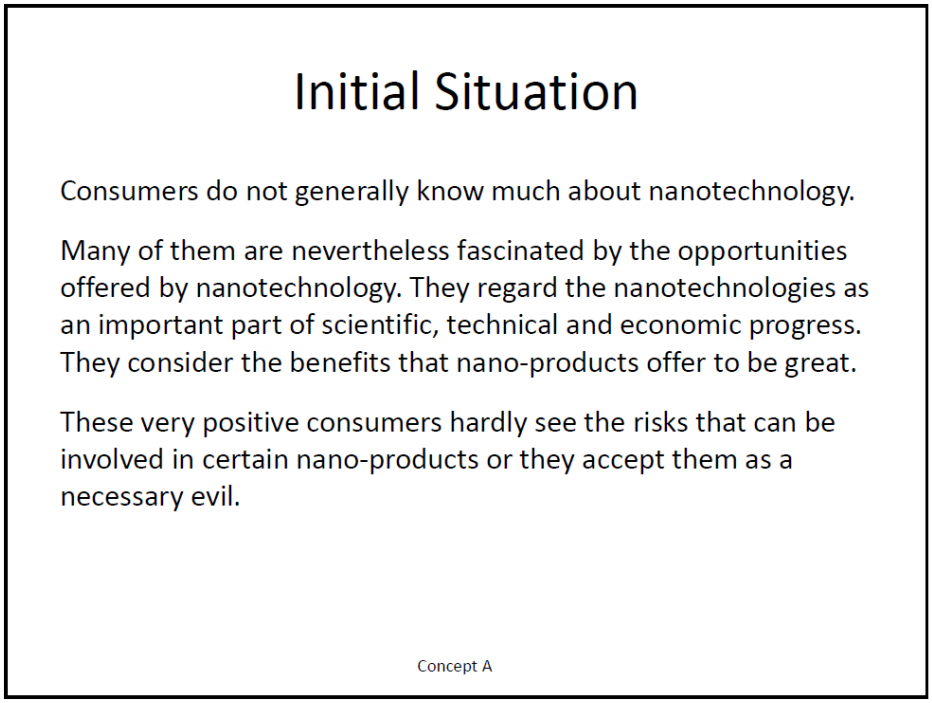
Source: http://www.bfr.bund.de/cm/343/programm_verbraucherkonferenz_nanotechnologie.pdf

- Conference on consumer aspects of dealing with nanotechnology entitled "Kleine Teilchen, große Fragen!" (Small Particles, Big Questions) staged by the Consumer Protection Ministry in Baden-Württemberg in December 2011; http://www.nanoportal-bw.de/pb/,Lde/129992.html

9.3.2 Materials from the focus groups

9.3.2.1 Ideal-typical male concept





Goals & Originators

- Goals
  - The level of information on nanotechnology available to consumers is to be increased so that they can make responsible (purchasing) decisions
  - Innovative and technical areas of application in particular should be presented
  - Possible risks and (state) measures to avoid and reduce risks should be mentioned at the same time
- Originators
  - State authorities in cooperation with independent experts, technicians and scientists

Concept A

Topics & Areas of Application

- Features and modes of functioning of nanotechnologies
- Economic potential; Germany as a location
- Technical applications, e.g. …
  - … Environmental technology
  - … Information technology
- Applications in the area of Health
- Applications in the area of Food

Concept A

Possible Measures

Experiment case

Road show

App

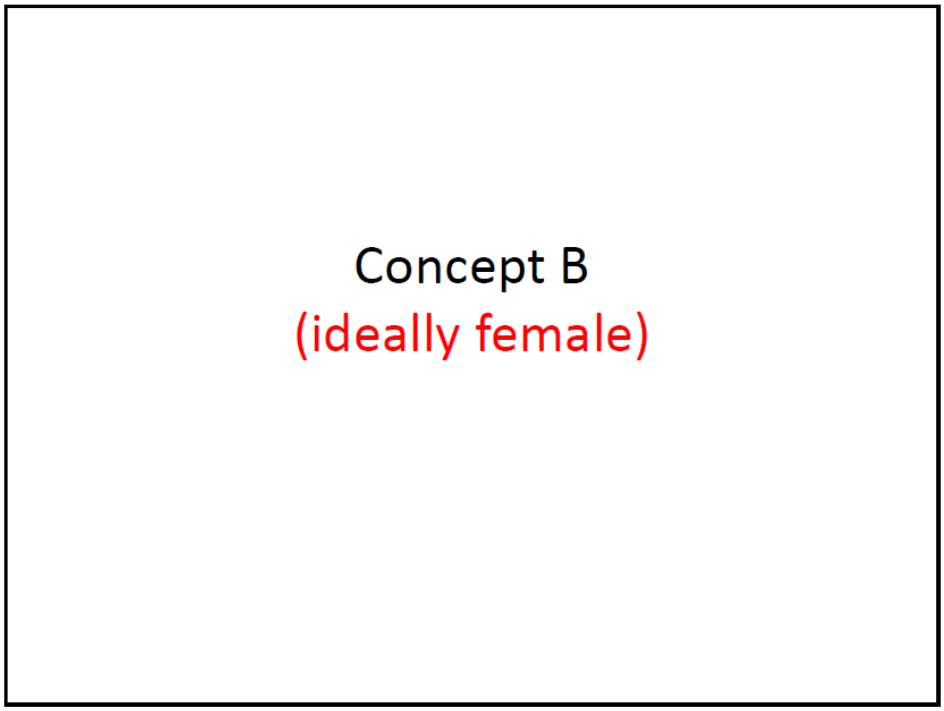
Open Nano Lab

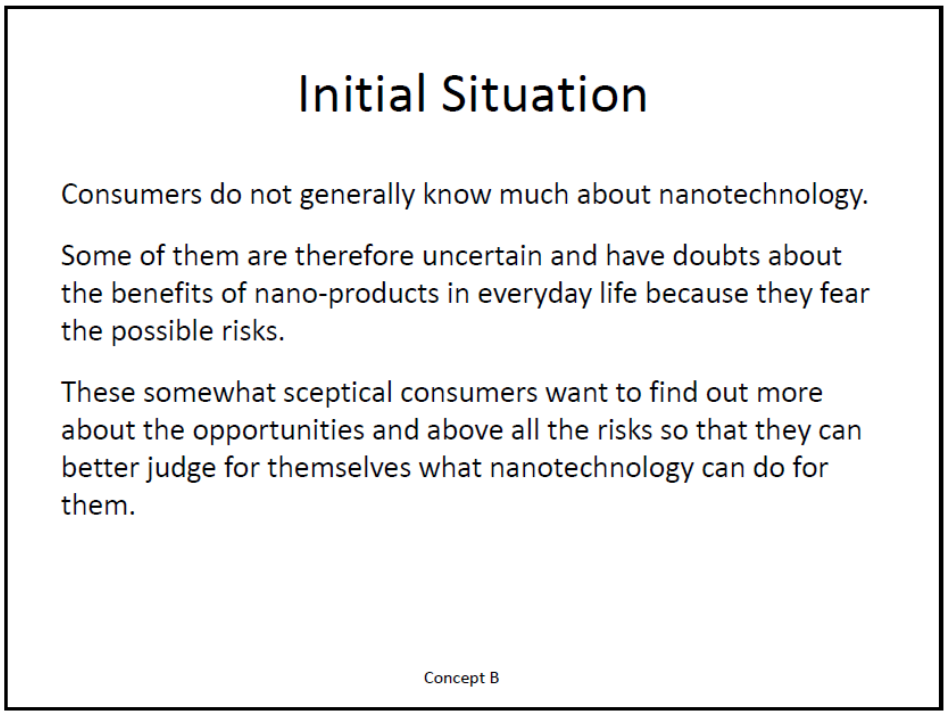
Concept A

Possible Media

- Internet
- Technology media
  - Print: …
  - TV: …

9.3.2.2 Ideal-typical female concept





Goals & Originators

- Goals
  - The level of information on nanotechnology available to consumers is to be increased so that they can make responsible (purchasing) decisions
  - Everyday areas of application in particular should be presented
  - Possible risks and (state) measures to avoid and reduce risks should be mentioned at the same time
- Originators
  - State authorities in cooperation with independent consumer organisations

Concept B

Topics & Areas of Application

- Practical benefits of nano-products
- Everyday applications, e.g. in the areas of …
  - … Health
  - … Food
  - … Cosmetics
  - … Textiles

Concept B

Possible Measures

Online game

Internet platform

Brochure

Museum exhibitions

Concept B

Possible Media

- Internet
  - Consumer forums
- Print
  - …
- Public relations work
  - Campaign in schools