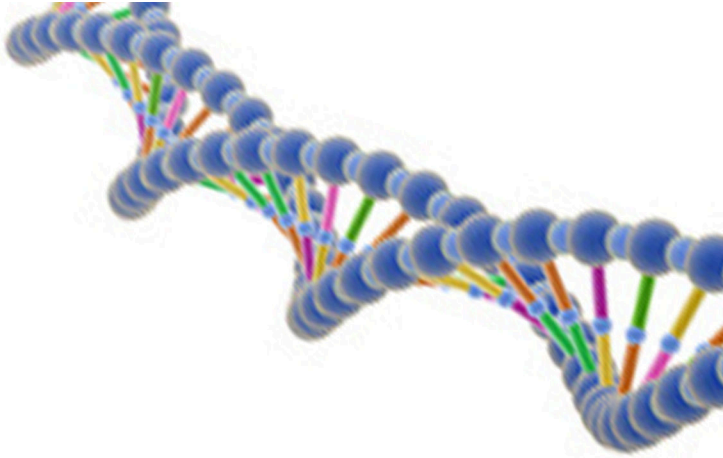
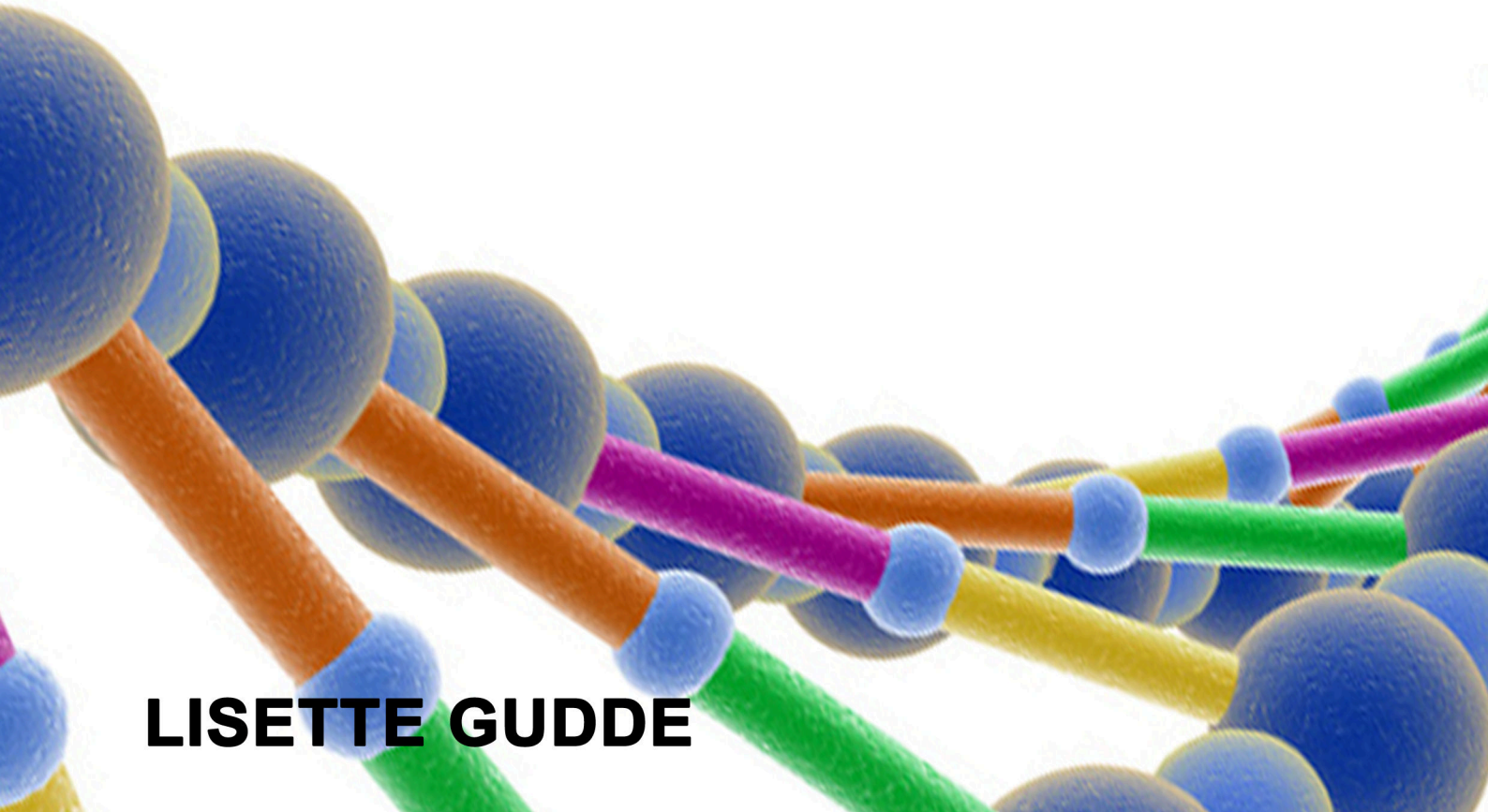


TOWARDS A SUCCESSFUL IMPLEMENTATION OF NUTRIGENOMICS

EXPERTS AND THEIR VISIONS ON PUBLIC ACCEPTANCE



LISETTE GUDDE

TOWARDS A SUCCESSFUL IMPLEMENTATION OF NUTRIGENOMICS

– Experts and their visions on public acceptance –

Master's thesis

Communication Studies

15 May, 2009, Enschede

Author: Lisette Gudde
s0051497

Supervisors: Drs. Renske R. Pin
Dr. Anne M. Dijkstra
Dr. Jan M. Gutteling

ABSTRACT

This paper, derived from research conducted by means of 19 semi-structured interviews and three focus group discussions, adds to a better understanding of the context of nutrigenomics. Moreover, it provides a useful first glance at possible significant factors for a successful implementation of nutrigenomics applications in the future. First, results from the interviews showed that scientists, food industries, patient/consumer organizations, and the government, can be considered to be the most influential expert groups in this context. Subsequently, focus group discussions, with representatives from these four expert groups, provided useful insights regarding the influence of perception, communication and participation on nutrigenomics acceptance. Furthermore, current findings reflect some possible shortcomings in expert's ways of thinking that might hinder a successful implementation process.

1. INTRODUCTION

In the past years developments in gene technology have brought about a lot of public indignation, just as food technologies always have been a hot topic for public concern and interest. People worry about the impact of human genetics on natural integrity, privacy and controlling sensitive information (Frewer, Howard, & Shepherd, 1998). Moreover, the past shows several technological food applications, with as best known example the introduction of genetically manipulated foods, which have been obstructed because of a lack of adoption by insufficient public support (Bredahl, 2001; Ronteltap, Van Trijp, & Renes, in press; Sparks, Shepherd, & Frewer, 1994). Considering this, it is not hard to imagine that implementing applications of a new technology like nutrigenomics, with both genomic and food elements in it, will possibly await a big challenge as well.

Nevertheless, it should be noted that the way people perceive risks and benefits of a new technology cannot be generalized, as every (potential) hazard will be judged on the basis of its own particular context, existing of different social, cultural and institutional processes (Pidgeon, 1998). To successfully implement nutrigenomics in society, therefore, at first it is important to understand how related risks are represented and communicated, and how they, in this specific context, are framed by social processes. In his article, Pidgeon (1998) posited a list with arguments that indicated the usefulness of applying public risk perceptions by risk regulators for shaping risk policies. According to him, risk regulators (such as government, business, or interest groups) should understand the operation of social processes, in order to be able to predict the behavior of various groups in society, as well as to promote effective dialogue with and between these groups. This is in line with statements from a large number of researchers, who stress the essence of taking into account the perspectives of all relevant parties, publics as well as other stakeholders, to ensure a successful implementation of new technologies (Frewer, 2003b; Ronteltap et al., in press; Shepherd, 2008). Adopting such an interactive approach calls for sufficient insight into the various visions and perceptions of different parties, which, more or less, can be separated in experts on the one hand, and the common public on the other hand (Einsiedel, 2000). Regarding the implementation process of a new technology, experts generally have an initiating role in framing the content of its policies. However, despite of their expected unbiased gold standards of judgments, considerable literature suggests that experts, just like the public, might not be that objective after all. It has been demonstrated that experts exhibit systematic biases in their judgment about potential hazards (Pidgeon, 1998), and overconfidence in their own judgments (Henrion, & Fischhoff, 1986). Moreover, experts have difficulties with accepting the different way of risk assessment by the public (Renn, 2003). Certain biases might affect expert's framing of public perceptions, and the

influences of related social processes, as well. Without providing detailed feedback on the quality of expert's predictions, their future (interactive) policies regarding the implementation of a new technology, might be insufficient to attain widespread acceptance.

The current research project provides an insight in ways for optimizing the implementation process of nutrigenomics. To find out who the expert parties are in the context of nutrigenomics, the first research question included the identification of all relevant stakeholder groups that are, or will be, involved in the developmental process of nutrigenomics. An overview of stakeholder's mutual relationships will also provide a better understanding of their role, commitment and expertise with regard to the nutrigenomics developments. Besides, furthermore it is unclear what experts think about public perception and related social processes that might influence public acceptance concerning nutrigenomics. So, to take account of expert's awareness of the public's likely perception of nutrigenomics, including related contextual factors, it first has to be found out what experts actually think about the context of public perception and acceptance. Understanding expert's visions on (the context of) public risk perception provides valuable information about how they might frame a future implementation process of nutrigenomics. Subsequently, comparing expert's visions with the visions of the public in a following phase can provide useful information about to what extent possible biases of experts, regarding the public, have to be adjusted, in order to maintain a successful implementation of nutrigenomics. For these reasons, the second research question aimed at getting a better understanding of how nutrigenomics experts perceive public risk perception and related social processes that might influence public acceptance.

Before answering the two research questions, more insight in some of the contextual elements regarding public perception and the acceptability of a potential hazard, will be convenient. This paper begins with a discussion of previous research on public (risk) perception on new technologies, in relation to leading perspectives about the influential role of communication and, correspondingly, public dialogue, with regard to public acceptance. It then describes the research design of this study, which consisted of two parts. The first part employed 19 expert interviews to identify relevant expert groups, their relation with each other, and their role in the process of nutrigenomics development. In the second part, three focus groups with 21 representatives of relevant stakeholder groups were organized, in order to understand their perception of public acceptance regarding nutrigenomics developments. The results of these studies are followed by a discussion on the derived outcomes. Finally, implications from the conclusions are drawn for optimizing the implementation of nutrigenomics in the Netherlands, by showing some main points of interest.

2. THEORETICAL FRAMEWORK

Successful implementation of a technological innovation in a society often appears to be a long process which requires a lot of effort. In his well-known theory about the diffusion of innovations, Rogers (1995) describes five different phases of the process in which an innovation spreads over time among members of a social system. Diffusion theory shows the importance of a public acceptance in making a technological innovation develop successfully. In subsequent studies large numbers of researchers have tried to distinct essential elements that contribute to acceptation of innovations, or in particular, of new food technologies and personalized nutrition. With regard to this, three central themes can be discerned from literature. At first *risk perception*, which refers to people's beliefs, attitudes, judgments and feelings, as well as the wider cultural and social dispositions they adopt towards threats to things that we value (Pidgeon, 1998), seems to be essential. The risk perception of a potential hazard is determinative for people's attitudes and their future acceptance concerning a new technology. As perceptions on new technologies are influenced to a large extent by the (content of) *communication* about it, researchers also stress the need for attention on adequate communication processes (Ronteltap, Van Trijp, Renes et al. 2007; Shepherd, 2008). Nevertheless, thoughts about communication have been through some transformation in the past decennia. Ideas of communication depicted as a one-way process are outdated by now and, instead of this, more and more scientists are convinced of the importance of involving all relevant parties in the process of designing and implementing new technologies. They indicate that public *participation* concerning technological developments is indispensible in order to ensure a long term adoption of new technologies.

Because risk perception, communication and participation exert influence on the acceptability of possible perceived hazards of a food technology like nutrigenomics, these subjects will act as central themes this article. Next paragraphs show a global outline of the scientific findings on (risk) perception, communication and participation in relation to food innovations.

2.1 Risk perception

With regard to different processes and technologies in the food sector, understanding risk perceptions probably is the most important step for apprehending public attitudes (Frewer, 2003b). Considerable research has been conducted to explain the shaping of public perception on food technologies, and accordingly, of all different paradigms and theories, the psychometric paradigm (Slovic, 1987; 1992) is likely to be the most widespread taxonomy used by researchers. This theory puts that public risk perception relies more on intuitive risk judgments than on technical risk assessments, as is the way most

experts assess risks, to evaluate possible hazards. People for example perceive risks on the basis of involuntarily exposure to a hazard, or the extent to which they believe a hazard is potentially catastrophic or uncontrollable (Slovic, 1993; Van Kleef, Frewer, Chryssochoidis et al., 2006; Frewer, Howard, Hedderley et al., 1999; Berry, 2004). This is related to the (communication of) perception of scientific uncertainty that also seems to play an important role in accepting food innovations (Cardello, 2003; Frewer et al., 1998; Frewer, Miles, & Marsh, 2002). Bennett, Coles and McDonald (1999) suggest after reviewing several studies that risk perception leads to more worries and less acceptance when a hazard will be perceived to be involuntarily, poorly understood by scientists, a subject of opposite statements, unnatural, sent by a new or unknown source, or is characterized by unauthorized implementation. These kinds of result suggest that people not only value the outcomes of actions, but also care about how these outcomes occurred (Pidgeon, 1998).

When innovations appear to be unpredictable and unknown, this causes senses of uncertainty and lack of control for the consumer (Van Tulder, Kapitein, Van Mill et al., 2004). In these circumstances the perception of trust and distrust is essential in a mediating way (Frewer, 2003a). When people have more trust in companies and scientists that take part in the developmental process of a new technology, less risk and more benefits towards that technology are perceived (Siegrist, 2000). Besides, also the perception of trust in government of public authorities (Jelsøe, & Gaskell, 2000) or other risk regulators (Frewer, & Salter, 2002; Slovic, 1993) seems to be an important explaining factor for attitudes toward new technologies. The importance of trust has also been subscribed in relation to risk communication, as will be enlarged on further on in this article.

Apart from assessing risks and uncertainty, the consideration between costs and benefits plays an important role in accepting or rejecting innovations as well. There seems to be some evidence that, in the sphere of technological innovations, perceived personal benefits influence public acceptance more dominantly than the perception of possible risks, on condition that these risks are not totally intolerable (Frewer, 2003b). The limited number of perceived benefits can possibly explain the failure of attaining widespread acceptance for genetically modified foods in the past (Lassen, Madsen, & Sandøe, 2002).

Summarized, this overview reflects the presence of many different determinants that contribute to the shaping of public perception on new technologies like nutrigenomics. These elements however, are not at themselves. Substantial research has pointed out that the influence of communication affects public perception in a significant way as well.

2.2 Communication

Determinants of the perception of new food technologies can strongly be influenced by communication (Ronteltap, Van Trijp, & Renes, 2007). From the past we have learned of the importance of adequate risk communication (Shepherd, 2008), especially in situations when people have to revert to their own judgment (Frewer et al., 1999) as is also characteristic of nutrigenomics. Nevertheless communication of risks appears to be clearly complex and multifaceted (Berry, 2004) and poor risk communications can create threats larger than those posed by the risks that they describe (Granger Morgan, Fischhoff, & Atman, 2002).

First of all, the content and frequency of information (Deliza, Rosenthal, & Silva, 2003; Frewer et al, 1998), as well as the communicator and the moment of informing, affect people's attitude about a technological innovation. This effect is not one-dimensional and depends on different factors, like former experiences with the technology (Frewer, 2003b) or contextual factors, like social and historical context (Jelsøe et al., 2000). Also expected motives of information sources or societal actors can have an effect on the way people perceive messages (Frewer et al., 1999). Research has revealed that trust in information sources, characterized by the perceived competence and honesty of the communicator (Frewer, 2003a), forms an essential part of a successful communication process (Van Tulder et al., 2004).

Furthermore, the influence of information on public attitude is also affected by how people elaborate information. Elaboration of information has been defined as a complicated process which depends on the perception of relevance of a message and whether a person agrees with it or not, but also on a person's capability to make good decisions (Petty, & Cacioppo, 1986). Many people are not well equipped, either cognitively or emotionally, to understand complex probabilistic information and to apply it to their own circumstances (Berry, 2004). For this reason, and because of the complexity of the nutrigenomics message, it is important to send a simple message by giving understandable information and tangible benefits (Oliver, 2005). Nevertheless, risk communication comprehends more than just telling about benefits. Communication about new, potential controversial technologies should contain all information the public needs to make informed, independent judgments about risk (Granger Morgan et al., 2002). In relation to the implementation of nutrigenomics, Ronteltap et al. (in press) point out the importance of giving understandable, honest, transparent and realistic information by influential communicators. This is related to several findings about the communication of uncertainty, which is mentioned as an essential part of risk communication (Shepherd, Barker, French et al., 2006). Previous studies show both positive as negative responses on uncertainty by the public (Viscusi, Magat, & Huber, 1991), but researchers have also demonstrated that presenting information about uncertainty and

acknowledging the uncertainties about potential hazards, will have at least a positive effect on the perception of credibility and trustworthiness of the information source (Frewer, 2003b; Ronteltap, Van Trijp, & Renes, 2007). Furthermore, communicators should not forget to bring up public thoughts, like ethical worries, in their messages to get people interested (Frewer et al., 1999).

Finally, regarding communication of new technologies, a special role is been taken by the media. Mass media play an essential part in the shaping of risk perceptions (Berry, 2004; Frewer et al., 2002), especially because media reports on risks directly influence the scope and extent of social responses to a risk source (Berry, 2004; Wiedemann, Clauberg, & Schutz, 2003). People that not get directly into touch with the new applications still can feel the consequences of the new technology in a different way, for example by reactions from family and friends (Bennett et al., 1999). This effect is better known as the social amplification of risk (Kasperson, Renn, Slovic et al., 1988).

All of the mentioned aspects reflect the complexity of adequate risk communication. Except for the fact that it is hard to determine one perfect way of communication in this context, general expert visions about what is good communication and what is not, have also been changed over years. Communication strategies in the past that aimed at consumer acceptance of new food applications were especially focused on technology-driven, top-down practices. Information was driven by technological risk assessments from experts and was only used to educate people (Frewer, 2003b). It was assumed that all risks could be identified by scientific measurement and calculations, without being subjective or uncontrolled (Berry, 2004). This approach is called the 'cognitive deficit model' of public understanding (Von Grote, & Dierkes, 2000) and corresponds with the 'technocratic view' in risk communication (Dijkstra, 2008; Rowan, 1994). Critics of the 'cognitive deficit model' focus more on societal acceptance by involving all parties in a dynamic decision process. They believe that people are more than just passive recipients of 'scientific wisdom' (Einsiedel, 2000), and suppose that all parties involved have relevant knowledge concerning the main issue. In the 'interactive science model', which is related to the 'democratic view' in risk communication (Rowan, 1994), uncertainty of scientific information, an active public, two-way, multi-way communication and a mutual understanding by dialogue are central concepts (Dijkstra, 2008).

Despite of the increasing scientific interest in interactive communication processes, there is no hard evidence for one best practice (Einsiedel, 2000). However, when talking about the implementation of new technologies which can have an effect on substantial societal facets, many researchers agree on the importance of a participative decision making process, including involvement of both publics and other relevant stakeholders (Frewer, 2003b; Frewer, & Salter, 2002; Renn, 1998; Shepherd, 2008).

2.3 Participation

With regard to acquiring widespread acceptance of a technological innovation, a growing number of researchers emphasizes the importance of involving publics (and other stakeholders) in the decision making process about risks (e.g., Renn, 1992; Ronteltap et al., in press; Shepherd, 2008). Adopting more open and participatory decision processes could provide valuable early information about potential sources of stigmatization and encourage all parties to engage in a dialogue about the nature of the proposed technology and the reasons for possible public worries (Gregory, Slovic, & Flynn, 1996; Slovic, 1993). In the case of food related technologies the need for public involvement seems to be even more of concern, because food is fundamental, not ignorable, and every day returning for every person in society (Frewer, 2003b). Furthermore, the fact that nutrigenomics is mainly science-driven and could have unknown effects on society, brings about ethical dilemmas and indicates all the more the importance of a dialogue between science and public (Van Tulder et al., 2004).

In contrast to these optimistic inclinations, some researchers have also pointed out the shortcomings of allowing perceptions of the public to influence policies. According to them, public perceptions are manipulable and biased, as individuals do not have knowledge to accurately evaluate what will harm them. Moreover, the public is not homogeneous in its risk perceptions, and their attitudes might be prejudiced. So, when using public visions in policy making, these factors can bring along a (systematic) bias. Pidgeon (1998) however, invalidated these statements by putting forward a list with strong arguments in favor of a role for risk perceptions in policy activities like the implementation process of nutrigenomics. According to him, in the first place there exist moral or ethical grounds for incorporating perceptions into decisions that affect them. Additionally, he stated that public perceptions will always have consequences for public behavior, what indicates that policy makers must show awareness of the public's likely perception of a given hazard, and a willingness to act on it. Furthermore, public risk perceptions can augment expert risk analyses with additional useful information, as the public, for example, may possess knowledge not readily available to the experts. Finally, Pidgeon (1998) stated that just like the public, experts can be biased as well. A deliberation of the arguments mentioned above, indicate the value of introducing an interactive participation process. Below, the parties partaking in a participation process and the definition of participation will be elaborated on.

When talking about participation, researchers used different appellations to specify parties that should been involved in a participation process. In this article the definition 'stakeholders' refers to all parties that have an interest in nutrigenomics, experts as well as lay-persons (Ronteltap et al., in press).

Furthermore, 'experts' refers to all persons who are involved in the development of nutrigenomics because of their discipline, specialism or job. 'The public' or 'lay persons' are all remaining people, who by some means or other have to deal with the results of nutrigenomics developments. Experts as well as lay persons are heterogeneous groups of people (Einsiedel, 2000). In relation to nutrigenomics applications, former research has distinguished several expert groups: academics, policy makers, food industry, non-governmental interest groups, health care professionals, and media (Ronteltap, Van Trijp, Renes, & Frewer, 2007). All groups have different interests and opinions about the desirability of the development of nutrigenomics (Ronteltap, et al., in press), and every group of experts has his own technical expertise and level of involvement to the issue (Shepherd, 2008). In comparison with the experts, the public is even harder to define. Members of the public can be endlessly divided into subgroups on the basis of wide varieties of characteristics, and boundaries between public and science also differ from time to time (Einsiedel, 2000). When someone in one situation has been defined as a lay person, he may be the expert in another context, depending on the knowledge he has (Einsiedel, 2000; Von Grote et al., 2000). Due to other ways of distributing and gathering knowledge, a separation between science and society is no longer obvious (Regeer, & Bunders, 2007). However, because nutrigenomics is a relatively new and complex science and as the development yet has been limited to scientific exploration and the search for scientific foundation, the boundary between public and experts is clearer in this case. At the moment the public of nutrigenomics exists of all people, sick or healthy, who will be probable consumers of nutrigenomics applications, experts excluded.

Just like at the parties in the participation process, also the definition of the participation process itself requires some explanation. Saying that public participation is the same as public engagement will be not enough (Rowe, & Frewer, 2005), because there are different levels of engagement. Arnstein (1969) developed a typology of participation by identifying eight participation formats that differed according to the degree to which publics are empowered, and she illustrated each by reference to one or more examples of mechanisms or specific exercises. Other researchers as well have put into words the distinctions between different forms of public engagement (Ronteltap, Van Trijp, & Renes, 2007). A clear distinction has been made by Rowe and Frewer (2005). They discerned from three levels of public engagement: public communication, public consultation, and public participation. Only in the latter level of engagement there will be some degree of dialogue in the process that takes place, which may involve representatives of all essential stakeholder groups. Communication in their typology refers to one-way communication from experts or regulators to the public, and consultation is the possibility of the public to react upon decision making, without an interactive process.

Next to participation, also communication and consultation increase public engagement by some means or other. Communication can make people more interested in the possibilities of the new technology, and the expansion of knowledge will lead to more engagement and creates the possibility to make informed decisions. The impact of information should be seen as a part of the wide processes of social and political debate and decision-making (Jelsøe et al., 2000). Consultation will give people a better feeling, because this process demonstrates that new applications are not enforced by institutes that are uninterested in public worries and values (Frewer, 2003b). Furthermore a better understanding of the perception and opinion of all relevant parties will initiators give the possibility to better cater to societal aspects, which accordingly will increase a sense of engagement among the public as well.

In the development and implementation process of nutrigenomics, it is yet undefined to what extent every party should get engaged, and from which moment some kind of participation is desirable. It is also of importance to watch that public attitude presumable differs from the attitude of experts (Ronteltap et al., in press), since both parties perform a leading role in the implementation of a new technology like nutrigenomics. One of the main challenges of the democratic process in implementing new technologies is to satisfy all relevant stakeholders, and attain a widespread societal acceptance.

To summarize, previous research has offered valuable results on how public perception affects acceptance of new food technologies, and what can be the role of communication and public participation in attaining acceptance. Research has also revealed the importance of interaction between experts and the public, especially in case of a new, uncertain food technology like nutrigenomics. What has not yet been examined is how these subjects are related to the context of nutrigenomics implementation. One way to find this out is to examine what nutrigenomics experts think about these themes. Moreover, understanding expert's visions on (the context of) public risk perception provides valuable information about how they might frame a future implementation process of nutrigenomics. As expert's perceptions about the context of a potential hazard can be biased, insight in their visions will be needed to provide feedback on wrong statements. Furthermore, examining these subjects might provide some insight in expert's visions about public acceptance in general. This paper looks at the most influential expert parties in the development process of nutrigenomics, and attempts to find out more about expert's visions regarding public perception and related subjects, like communication and participation.

3. METHOD

To answer both research questions, two research methods have been used in this study. The first objective was to identify relevant stakeholder groups in the Netherlands, and to exemplify their mutual relationship and roles regarding nutrigenomics innovations. Therefore, a stakeholder's analysis was conducted by means of semi-structured interviews among a wide variety of experts. Subsequently, information derived from this analysis has been used to select respondents for the focus group discussions, which were organized to give an answer on the second research question that implied getting a better understanding of how the most important stakeholder groups perceive public perception and public participation in the process of nutrigenomics acceptance.

3.1 Stakeholder's analysis

To create an overview of Dutch stakeholders and their roles in the context of nutrigenomics developments, 19 individual semi-structured interviews with experts were conducted in November and December 2008. Semi-structured interviews provide the possibility to combine a structured agenda with the flexibility to ask additional questions and to go down an unexpected conversational path. In this way general information relevant to specific issues can be obtained, and insight in these specific issues can be gained (Lindlof, & Taylor, 2002).

Respondents for the interviews were selected in their capacity as an expert in a certain field related to the implementation of nutrigenomics applications. These professional fields were determined on the basis of earlier research conducted by Ronteltap, Van Trijp, Renes and Frewer (2007) in which academics, governmental bodies, food and biotech companies, non-governmental interest groups, health care practitioners and the media were distinguished as being the most relevant disciplines concerned in nutrigenomics developments. The respondents were approached by email and by telephone, and interviews were conducted by telephone. Interviews lasted 35 minutes on average, and were audio-recorded and transcribed for data analysis afterwards.

3.1.1 Procedure

Every interview was structured by a format with four open questions that were asked with regard to the context of nutrigenomics as being an innovational food science and which may have considerable societal impact in the future. This was exemplified by giving the example of personalized nutrition as a possible application. The first question was: '*Who do you consider to be the most important stakeholders in the context outlined before?*' In the interviews this question was often followed by asking the

respondent to prioritize the involvement of every stakeholder group. Whether this question was asked or not, depended on the capability of an interviewee to answer this question. Unlike the first question, the next three questions were specifically applied to the expertise of the respondent. These questions were: '*How do you see the role of … in the context outlined before?*'; *With what stakeholders … has/have most often to do in the context outlined before?*'; and, '*With what stakeholders … has/have least often to do in the context outlined before?*'. For example, when a respondent was a representative of a patient organization, the dotted lines were filled in with 'your patient organization and patient organizations in general', and, when a respondent was a nutrigenomics expert, this was filled in as 'natural scientists'.

3.1.2 Data analysis

The transcribed interviews provided a direct input for the results, without the need for an extensive content analysis. Answers on the first question, including the extra question concerning indicating priorities, were counted by stakeholder group. This same procedure was applied for analyzing answers on the third and fourth question. Answers on the second question, and all remaining data that were acquired thanks to the semi-structured nature of the interviews, were used as background information for the researchers.

3.2 Focus group discussions

The second part of this research consisted of examining expert views on nutrigenomics developments, and in particular, the way they perceive the role of the public and public participation in relation to nutrigenomics adoption. To answer this question, three focus groups with representatives from relevant expert groups were conducted in February 2009. Focus groups are characterized by their explicit use of group interaction to collect data and insights that might be less accessible without the synergetic effect of the interaction in a group. In addition, because participants shape the content of the discussions, focus groups are explorative and open to themes not anticipated by the researcher (Krueger, 1994) and provide a wider diversity of answers and arguments (Rowe et al., 2005).

Participants of the focus groups were selected on the basis of their expertise. Every participant had experience in one of the four professional fields that were identified from the stakeholder's analysis as being most relevant regarding nutrigenomics innovation. The focus group discussions lasted approximately 2 hours, and were moderated by a member of the research team. At the beginning of the session, participants were asked to briefly introduce themselves. Foregoing the discussion, each

participant completed a background questionnaire and received a small present for their participation. The focus group discussions were audio – and video-taped and transcribed verbatim.

Table 1 Protocol for the conduct of the focus group discussions

Section	Questions
A. Introduction	
B. Discussion	
1. Common vision on nutrigenomics	*Scenario 1: Personalized nutrition and nutrigenomics* 1.1. What do you think about personalized nutrition? 1.2. What do you think the public thinks about personalized nutrition? 1.3. Is it important to involve public opinion regarding this innovation?
2. Stakeholders	*Scenario 2: Stakeholders overview derived from stakeholder's analysis* 2.1. What do you think about the scenario concerning stakeholders? 2.2. From which stakeholders knowledge is useful to reckon with? 2.3. To what extent it is important that expectations from all stakeholders are alike?
3. Perception on risks and benefits	3.1. What risks do you see, and what risks does the public see? 3.2. What benefits do you see, and what benefits does the public see? *Scenario 3: Public perception as a result of research from Pin (2009).* 3.3. How do you explain this rather positive vision of the public?
4. Communication	4.1. To what extent active communication to the public is important? 4.2. What is the role of trust regarding communication? 4.3. Do you think the public feels engaged in this innovation?
5. Participation	5.1. To what extent public participation desirable? 5.2. What are benefits and drawbacks of public participation? 5.3. To what extent stakeholders are open to public participation? 5.4. To what extent the public's are open to active participation? 5.5. What are conditions to make public participation succeed? 5.6. What will be possible outcomes of public participation?
C. Conclusions and closing	

3.2.1 Procedure

Given that the second research question is mainly explorative in nature, the theoretical framework outlined before has been only applied to identify the main concepts regarding acceptance of nutrigenomics innovations. These concepts were used as a starting point for the protocol by which every focus group discussion was structured to facilitate semi-structured data collection. The protocol existed

of five main themes that were discussed through 18 relating key questions, which were each divided in more concrete questions. The key themes concerned: common vision on nutrigenomics, stakeholders, perception of risks and benefits, communication, and participation. The first three themes involved a scenario to clarify the context, in which the example of personalized nutrition was used as a concrete starting-point. Except for the questions about stakeholders, all themes were derived from the theoretical framework. Questions about stakeholders were only used to verify previous stakeholder's analysis. A global overview of the contents used in the protocol for the conduct of the focus group discussions is outlined in table 1.

3.2.2 Data analysis

Transcripts from the focus groups were analyzed using Atlas 5.0, a software package that facilitates many of the activities involved in textual content analysis. To facilitate content analysis, a scheme with 94 exclusive and exhaustive codes was developed by an inductive analysis. To make valid inferences from the transcripts and to ensure reliability, rater-bias was minimized by employing two independent observers to code the transcripts with the scheme. The percentage agreement among the two coders was calculated to be 70%, which indicates good inter-coder reliability, as it regards an exploratory research (Lombard, Snyder-Duch, & Bracken, 2002). Subsequently, interpretative analyses were written to outline the opinions concerning nutrigenomics among expert stakeholder groups.

4. RESULTS

4.1 Results stakeholder's analysis

For the stakeholder's analysis 19 respondents have been interviewed. Nearly all respondents had a background in one of the six professional fields derived from Ronteltap, Van Trijp, Renes and Frewer (2007), as is showed in table 2. Respondents from social research institutes, public private partnerships and natural science institutes all represent academics, and patient and consumer organizations represent non-governmental interest groups. Though Ronteltap, Van Trijp, Renes and Frewer (2007) placed health insurance among the industry, insurance companies or accompanying legislators, can also be considered to be part of the government or health care. For this reason, insurance companies in this research are considered to be a separate stakeholder group.

Table 2 Professional fields of interviewees

	Respondents
Social research institutes	3
Governmental bodies	3
Public private partnerships	3
Patient/ consumer organizations	3
Natural science institutes	2
Health care	2
Food industry	1
Insurance companies	1
Media	1

Respondents together mentioned a total of 12 different stakeholder groups that are or will be involved in the development and implementation process of nutrigenomics. They used two different arguments to determine the degree of involvement of a particular stakeholder group: the interest of a certain stakeholder group (e.g., high interest is high degree), and the moment of involvement of a certain stakeholder group (e.g., early involvement is high degree) in the development and implementation process of nutrigenomics. Table 3 shows an overview of the stakeholder groups that are distinguished, the degree of involvement of each group and the times a certain stakeholder group has been mentioned by respondents. The degree of involvement is only mentioned in the table when a stakeholder group was ascribed a top three position.

Table 3 Frequency of interviewees' reported stakeholder groups and their perceived degree of involvement in nutrigenomics development and implementation

Stakeholder group	Degree of involvement			Frequency
	1st	*2nd*	*3th*	
Scientists *(universities, research institutions)*	6	1		14
Food industries *(including R&D)*	4	2		16
Consumer/ patients	4	1	1	14
Consumer/ patient organizations	4	2	1	13
Government *(policy makers, research institutions, regulating agencies)*	3	2	2	19
Health care *(family doctors, dieticians, hospitals)*		1	1	13
Small companies *(start-up companies, small biotech companies)*	1	1		9
Insurance companies			1	9
Retail companies				4
Information agency's *(e.g. Netherlands nutrition centre)*				3
Related industries *(e.g. marketing, related equipment)*				2
Media				2

Note: Representatives from the stakeholder groups that are marked bold, participated in the second part of this research conducted by means of focus group discussions.

Five stakeholder groups were perceived to be most important, i.e. scientists (e.g., at universities or research institutes), food industries (producers of food products and dietary supplements), consumers or patients, and related to that, consumer or patient organizations, and the government. The government was mentioned most often, but concerning involvement, respondents allocated the government more background roles, such as facilitation and supervision. Patients and consumers were seen as the presumable main target group of nutrigenomics applications, which are represented by patient organizations or consumer organizations. In particular, patient organizations were perceived to be important, because they always have an interest in scientific findings regarding (the prevention of) diseases. Consumer organizations, on the contrary, are only interested when applications will be put on the market, which is not that much the case yet. Furthermore, health care specialists, such as family doctors or dieticians, were often mentioned as a relevant stakeholder group, but were a lot less perceived to be involved in nutrigenomics than the other five stakeholder groups. Experts assumed that family doctors or hospitals frequently will get into touch with nutrigenomics applications in the future, but that they are not interested in this innovation yet (although they should be, according to some interviewees). It was argued that the emphasis in health care practice still lies on cure instead of prevention, and, that health care practitioners, except for dieticians, are not food minded at all. Besides, experts referred to recent research findings from Bouwman (2009), which indicate a lack of knowledge and interest among dieticians concerning this kind of innovations. Moreover health care professionals do not seem to have time to concentrate on every innovational science that could possibly lead to implications on health.

Scientific institutes, food industries and governmental departments all are mutual related with each other concerning nutrigenomics, either directly or via public private partnerships. Scientists share knowledge and cooperate in research projects with both stakeholder groups. Food industries also share knowledge with both parties. The government is a more complex institute, existing of different bodies each having their own responsibilities. Next to the exchange of information, the government is especially related with scientists by means of funding and facilitation, and their determinative role concerning the formulation of research frameworks. With regard to the food industries, the governmental role will be more controlling and supervising. Because of their commercial purposes, food industries are stronger related with consumers than scientists. Scientists however, in research projects, cooperate more directly with parties like patient organizations, than most food industries do. Moreover, patient organizations benefit from scientific findings that provide new relevant information concerning the people they represent.

4.2 Results focus group discussions

A total of 21 experts participated in three focus group discussions. All experts had a background in four of the five professional fields that were indicated to be most relevant from stakeholder's analysis, i.e. science, food industry, patient and consumer organizations, and the government. Although consumers and patients themselves were indicated as relevant stakeholders as well, representatives from these groups were not involved in the focus group discussions, as this research project concentrates on experts only. Given that science, industry and government are mutually related, selected experts often had experience in more than one field. With the exception of representatives from patient organizations, all participants were knowledgeable from their professional experience concerning the development of nutrigenomics. Table 4 lists the participant's demographic characteristics. These data show a representative group of experts, characterized by higher education and middle age. Every focus group composition reflected the four identified professional fields. The mean age of participants ranged from 43 to 51. About 67 percent of the participants were male, and 95 percent of the participants completed a higher level of education.

Table 4 Focus group demographics

	Focus group 1 (n = 8)	Focus group 2 (n = 7)	Focus group 3 (n = 6)
Age			
Mean (range)	48 (28-66)	43 (23-61)	51 (37-65)
Gender			
Male	4	6	4
Female	4	1	2
Level of education			
Middle	1		
Higher	7	7	6
Job experience			
Science	3	1	
Government			1
Patient organization	2	1	1
Science/food industry	1	1	1
Science/government	2	1	2
Science/industry/government		3	1

Note: Higher education refers to university levels and higher vocational education. Middle education refers to intermediate vocational education.

A consistent observation that emerged from the focus group analyses was that the central issues, discussed in the focus groups, approximately got the same frequency of attention by the experts. Also, experts were quite homogeneous in their visions. One difference, discerned from the discussions, implied that representatives of patient organizations tend to relate their answers more to their own perspective and background, whereas other experts tried to generalize their visions. Furthermore, representatives of patient organizations had more difficulties to get the meaning of nutrigenomics clear, and asked more often for an explanation of the concept of nutrigenomics than participants of other expert groups.

Most experts argued their statements by indicating objective findings, like the essence of nutrigenomics and the (im)possibilities of nutrigenomics science and applications in the future. They frequently drew upon uncertainties about the relation between nutrition and health on a personal level and presented personalized nutrition as not yet evidence based. The complexity of nutrigenomics was pointed out as the most prominent cause of the long-term characteristic of the developmental process, but, on the contrary, it was also discussed that simple applications related to nutrigenomics findings already have been brought into use. Few statements were underpinned by personal feelings or social arguments like the influence of subjective norm on people's perception. The main results that were revealed from the group discussions are examined below, divided in the key themes that were derived from the theoretical framework: perception, communication, and, participation. Quotations of participants are added to illustrate the results. Every quotation is marked with gender and job experience of the corresponding expert.

4.2.1 Results regarding perception

With regard to the perception of nutrigenomics, three main themes from the participants' discussions during the focus groups could be revealed: involvement, perception of risks and benefits, and, trust in nutrigenomics. Findings on the subject of these themes are described in the next paragraphs.

Experts associated public acceptance regarding nutrigenomics mostly with public *involvement*. Several factors were perceived to exert influence on the extent of people's involvement. Experts mentioned the characteristics of individuals and the final format of nutrigenomics applications, together with the perceived risks and benefits of these applications, as interrelating factors. For example, when someone knows that he stands a relative big chance to get a serious disease, then he will probably be more open for everything that could decrease this chance and works preventive. On the contrary, when someone already has developed a disease, he will be more interested in curative applications.

Furthermore, experts related knowledge about nutrigenomics to the degree of involvement, as they expect that more knowledge leads to more engagement. Knowledge coming from information about nutrigenomics was also related to awareness of the existence of the innovation. The respondents regarded awareness as essential for a sense of involvement, since people cannot feel commitment to something they have never heard of. Some experts argued that the interest and involvement will be low at the moment, because of a lack of knowledge.

> […] But if you study earlier researches, you will see that not much people know that this is possible. And in that group, just a small number of people are really interested in it, if you will ask them about their perception of the possibilities. They just don't know that. *(Male – Science/food industry)*

As it regards risk perception, experts associated *risks* of nutrigenomics in particular with possible negative consequences perceived by people in general, instead of showing worries about their own situations. Some experts discussed the negative impact of deceptive information about nutrigenomics on the image of nutrigenomics applications and initiators, but this is more like a negative consequence of the commercial market than it can be called a risk. Only one representative of a patient's organization spoke as if the negative aspects of nutrigenomics would affect her personal life itself. Furthermore, participants of the focus groups most frequently mentioned ethical risks as a potential hazard for the public, which was often associated with deception by personal food advices that are not evidence based yet. This was the only social risk that is already present at the moment concerning nutrigenomics applications.

Other risks will come up when applications of the food innovation are more diffused among society. Examples of these risks that were mentioned by the experts are the possibility of stigmatization by insurance companies or privacy risks, and the ethical dilemma about what to do when you know your chances of getting a serious disease in the future. Moreover, financial risks were discussed as a result of buying misleading or useless tests, or discriminating policies of insurance companies. On the contrary, some experts declared that risks in this particular case are not present that obviously, for example, because insurance agencies will never been able to draw firm conclusions from someone's genetic passport:

> But this is an ethical question. When a mom and dad are diabetic, and they will have a child, than there will be a big chance… And are insurance companies that know about this, allowed to…? That is a societal question. *(Male – Science/food industry)*
> That can be called a risk indeed. *(Moderator)*
> But not concerning nutrigenomics, because the connection between your genetic profile and a disease is very weak. *(Male – Science/food industry)*

In contrast to the perception of risks, the focus group participants tend to relate the *benefits* they perceived more often to their own situation. Participants referred most frequently to the positive possibilities that nutrigenomics brings about for a better understanding in the sphere of scientific innovations with regard to food and genes. In line with this, some experts noticed that insight is not only beneficial for scientific progress, but that it can also contribute to better regulations by the government or product innovations by food industries.

> […] I think that in relation to that claim regulation, nutrigenomics, and not nutrigenetics, of course is an important tool, also for governmental agencies, to pass more accurately judgments about the effectiveness of an ingredient or food. And in that context it is also significant for the government, and I think that an EFSA for example already is watching these developments. *(Male – Science/food industry)*

A number of experts emphasized the benefits of giving a personalized advice in particular, because this could encourage people to eat healthier, as the advice is specifically addressed to their individual circumstances. Moreover, according to some experts, personalized nutrition will be a useful addition to the general food advice as it already exists.

> Of course, a common food advice like 'you have to eat more broccolis' does not catch on […], but a personal food advice based on your personal genome is far more interesting: 'Wait a minute, that's me, so it is not my neighbor who has to eat more broccolis. […] This is about me'. So when you address people this personal, you approach them far more emphatically and you have more chance to succeed in the field of prevention. *(Male – Science/food industry)*

However, just as much as experts perceived benefits, they also elaborated on the current lack of scientific evidence with regard to connections between genes, health and food. According to them, direct benefits for the public will not be that obvious, as underlying biological processes are very complex and personalization will be almost impossible. Some experts were even skeptical about the chance that personalized nutrition will ever be applied in the future.

> […] I think that the term 'personalized nutrition' actually is deceiving, because it suggests that it could develop in some kind of personal food advice for every individual and that is pure science fiction, if you ask me. *(Male – Science/government)*

Eventually, participants mostly pointed out that risk and benefits, perceived by the public, will strongly depend on the actual appearance of nutrigenomics in the future. When applications will make sure that people really become healthier, for example by getting an individual food advice, experts could imagine that people perceive a strong beneficial aspect. One of the experts argued this as follows:

> Risk perception of course is a special field. We all daily get in our cars […] and by this behavior we run tremendously more risks than when we eat a wrong peace of meat or something like that. But food is something we wish to have zero risk in […]. And when you then can offer something that makes food more safety for yourself again, than people will be positive about that. That is something I can imagine. *(Male – Science/government)*

On the contrary, when a personal food advice will involve for instance more control and regulation by governmental agencies as well, experts expected the public to be less positive. The expected outcomes of nutrigenomics developments are essential for the way people think about this innovation.

Regarding *trust* in nutrigenomics more current characteristics of the technological development were perceived to be essential determinants. Experts referred to the uncertain possibilities of nutrigenomics developments and, connectedly, to the dynamic nature of a complex science like nutrigenomics, as being undermining for public trust. When people first hear that nutrigenomics will have concrete applications in about ten years, and ten years later there is still no implementation expected in the following ten years, people who are not directly involved in the research part, lose their trust in the technological possibilities. One of the experts defined this at follows:

> [...] A few years ago [...], we all had to stop with eating eggs, because of the cholesterol and cardiovascular diseases. And by now we revert to that and tell people that it is not so bad after all [...]. And the consumer doesn't say: 'How great, this advancing insight', but he will think: 'Those scientists don't know what they want neither.' [...] And that it is, despite the fact that I'm exaggerating a little bit, a ruling opinion among consumers and nutrigenomics research. *(Male – Science/industry/government)*

Furthermore, also the distribution of unfounded information by dubious companies can have a negative impact on public trust in nutrigenomics. Experts are especially worried of this latter cause, because these kinds of methods are against their values. Besides, too much negative attention could financiers make the decision to stop their subsidization. Important financiers, like the government, are well-informed about the long-term aspect and the complexity that nutrigenomics brings about, but they are not insensitive for negative publicity.

The consequences of factors like complexity and uncertainty on communication about nutrigenomics, and the role of public trust in communication that experts perceive, are elaborated on in the next part of these results.

4.2.2 Results regarding communication

In the focus group sessions, communication, often associated with informing people, was perceived as a central issue in acquiring public acceptance of nutrigenomics applications. Experts associated adequate information in general with an increase of trust in nutrigenomics applications and information sources, an accumulation of knowledge, and a growing awareness of the future possibilities. Subsequently, these factors where perceived to be interacting with the shaping of attitude and a growing sense of engagement. During every focus group meeting participants elaborated on how adequate communication about nutrigenomics should look like. At this they discussed extensively about issues concerning the desired content of information, possible target groups of information, communication sources and the convenient moment of providing information.

With regard to the framing of communication, characteristics of the scientific development of nutrigenomics were seen as a decisive factor. Experts referred to the uncertainty and complexity of nutrigenomics, as well as the general dynamics of scientific developments, and examples of deception by dubious companies in the past, when substantiating the importance of adequate communication. The resulting observations experts made about adequate communication, could be divided in four

characteristics that future communication about nutrigenomics should comprise: completeness, objectivity, transparency and easiness.

First of all, experts pointed out that communication should be *complete*. It was frequently mentioned that information should show the positive aspects of nutrigenomics, but also what nutrigenomics applications cannot portend for your health, just to anticipate on unrealistic public expectations. According to the experts it should be made clear that the effect of compliance to a personal food advice is not a calculation of probability about getting sick or not, and that knowledge about your personal genetic makeup will bring about a lot of consequences for your daily life as well as for your offspring. In relation to personalized nutrition experts mentioned for example the importance of sufficient communication about the complexity of the relationship between food and health, as there are many intervening factors that can affect this relationship.

> [...] It is important to explain how it works very well. In fact we are talking about chances, the risk of getting a disease, but the risks associated with certain genetic variants are often very little. So you change your risks a bit, but this cannot guarantee that person of not getting that disease. That is not where we are right now, so you have to communicate very well about this. *(Female – Science/government)*

Secondly, when talking about *adequate* communication, experts often referred to the objective character of information. Scientific evidence should underlie the content of information, and information should be spread by trustworthy sources. Statements about the importance of objective communication were often related to statements about deceptive information emanating from dubious companies (in the past) and the detrimental consequences of this deception for the public and public perception.

> [...] I can imagine that large food companies, when nutrigenomics is in a position to found some of their claims, will communicate more about this. And there is nothing wrong with that, on the condition that they do it in a considered way. *(Male – Science/government)*

> [...] Everything that can provide a better adoption of food advice is desirable. However, you have to take care of giving honest food advices, which are relied on sufficient grounded methodologies. [...] I have seen this kind of advices already, but to be honest, I think that

> applying these advices at this moment is deception of the public. *(Male – Science/industry/government)*

Furthermore, experts discussed the importance of *transparent* information. With this they referred to giving the public open information about the communication sources and the processes that lie behind nutrigenomics science and applications. In the discussions experts linked more transparency directly to a higher credibility of the technological findings of nutrigenomics perceived by the public.

> [...] It is desirable to make knowledge accessible. You can try to give persons a reward for the invention they made, and subsequently use this knowledge for the design of new products in other companies. And for this, openness is needed: let everybody know what is happening in relation to this subject, and talk about it with the whole public, that is how I like it. This will automatically get going a movement of things which are credible. *(Male – Science/food industry)*

The final distinction that experts made in talking about requirements for communication was the profit that could be yielded by making information about nutrigenomics *simple* and understandable. It was noticed that nutrigenomics is a complex science as a result of which even the simplest findings are hard to understand for lay persons. Experts stated that, when communicators make information about nutrigenomics easy to understand, receivers will comprehend more, and therefore, will be more concerned with it. Telling people step by step what to do, make people feel more empowered. According to the experts, this could lead to more assertive behavior and usage of nutrigenomics applications. A number of participants referred to the very popular books of a Dutch weight management consultant that exactly described how to lose weight:

> [...] And who has been sold more than a million of books? Someone who exactly describes on which shelf in which supermarket you can get the products for your diet. That is exactly prescribed and is incredibly successful. *(Female – Patient organization)*

Because nutrigenomics research still finds itself in the exploring phase, experts stated that the final appearance of arising nutrigenomics applications ultimately will determine how the main target group for communication shall look like. On the one hand, when nutrigenomics especially will be used in the prevention field, common publics with an interest in food and health, as well as groups that run a risk of

getting sick, and groups that already are patient, all were pointed out as possible target groups of information. On the other hand, when nutrigenomics applications will be used for curing, only patient groups will be interested in receiving information. One participant mentioned a striking detail about the consequences of telling healthy people that they will have a chance to get some kind of disease:

> But then you are talking about the preventive phase; nothing is wrong yet. Your genetic profile has been determined as a result of which you know that you had better not taking certain fatty acids because they increase risk. [...] These people are no patients yet, but they will be actually made some kind of patient after having completed a genetic test. *(Male – Government)*

In addition to the target group discussion a number of experts indicated that the technology of nutrigenomics shall never be able to draw preventive conclusions from someone's genetic makeup. In that case patients are expected to be the only target group for nutrigenomics applications and accordingly, of accompanying information. Also, when nutrigenomics will be able to provide conclusions on the basis of simple gene combinations, this presumably will affect only homogenous groups of people like patient groups. On the contrary, other experts perceived the possible preventive benefits of nutrigenomics as the most important added value of the technology, in spite of the great challenge of providing a correct preventive advice concluded from genetic information. According to them the main focus should be for example on healthy people that want to prevent getting sick or persons who attach significance to live a healthy life. One expert mentioned that this is just what food is about:

> I think everything that has to do with food, is more related to prevention than to other things. *(Female – Science)*

In their statements expert participants appeared to make a distinction between direct communications to the public by stakeholders involved in fundamental science about nutrigenomics, like scientists or researchers in food industry, and indirect communications to the public by sources that get their information from those fundamental researchers, like for example governmental agencies, patient organizations or health care providers. According to a number of them it should be the first priority to inform stakeholders like patient organizations or policy makers about nutrigenomics, because they first have to have sufficient knowledge for representing the public. Also health care providers like family doctors should have sufficient knowledge about nutrigenomics for being able to manage questions from

patients. A number of experts furthermore drew upon the correctness of diffusing information by multiple senders to give the public a more objective overview.

> The purpose of this moment should be aimed at the importance of people, not the common public, but other people, to let experience them the developments of nutrigenomics, so that they also get an impression of the findings that are gradually created. Finally I think it is more important that a number of alignments representing consumers, patients or citizens, like politicians and all kind of stakeholders like NGO's or so, are able to follow the developments and have a say about what we are working at. *(Male – Science/government)*

Some focus group participants drew possible unfavorable consequences of direct communication to attention, for example when scientists will hype their findings too soon, or when food industry communicators rely to their own subjective research results for commercial purposes. This is perceived as deceptive informing and may lead to a decreased trust of the public in nutrigenomics. When information from these parties, instead of being directly communicated to the public, is communicated via agencies or authorities that profit by a well informed public, information probably will be more objective and correct. Besides the public may perceive information sources like family doctors or governmental agencies as more credible, and therefore will accept information from these sources more easily. A few experts pointed out that awareness, engagement and acceptance of nutrigenomics applications only can be achieved if a person's social environment has been totally imbued with nutrigenomics information. When important opinion leaders and leading organizations are positive about genes and foods, this enthusiasm will automatically be transmitted to other people.

> [...] It is like you said before, that stratification when talking about communication: you have to begin somewhere, but you should not directly begin with the consumer, but with the environment of this consumer. You have to inform the environment very well. *(Male – Government)*

Furthermore, experts regarded the *media* as being an effective instrument in communicating about nutrigenomics findings. At this a distinction can be drawn between expert observations about the role of specialist journals and their observations about the influences of popular media. Experts emphasized the importance of more publications of understandable reviews in scientific journals, as they can exert

positive influence on the perception of other scientists in related areas, and increase the change of being published in scientific publications of newspapers, which is a first step in reaching the public. Experts frequently indicated, with several examples from the past, that popular media like newspapers, television shows and periodicals seem to affect public opinion in a strong way. In addition, they discussed advantages and disadvantages of this popular media influence. When nutrigenomics issues are mentioned in popular media items, people who read or hear about it will become aware of the developments and feel more concerned with it, which is one step in attaining nutrigenomics acceptance. However, experts also point at the tendency of media to provide information when they want to, even if scientific developments are still in an exploring phase. As most people do not verify information from media sources very well, this can end in informing people with unrealistic or ungrounded arguments. Furthermore, inconsequent communication about scientific findings can people getting lose their trust in nutrigenomics, as has also been discussed in the 'perception' part of these results.

> Food technology is a scientific field that stands close to citizens and consumers, and therefore it is interesting to publish about in newspapers or other media, with as consequence that you bring a discussion that rages among scientists in the public domain. [...] And that is what it makes difficult for. Scientists for example, are being raised with mutual discussions and divided camps. But if you let different parties outline every two weeks another vision, like for example yoghurts with left turning and right turning bacteria... *(Male – Science/food industry)*

In relation to the distribution of information, experts also discussed the right moment for informing the public. Some experts indicated the importance of early information about the current possibilities of nutrigenomics, because there already have been some kind of (deceptive) nutrigenomics products put on the market, which people can buy from the internet. Other experts pointed out the risks of informing the public too early. One participant has put this dilemma well into words:

> [...] Yes, you have to inform the public, because at the end it is all in for the population and it would be almost unethically to insulate advancing insights, but on the other hand I think that you should be careful not to forfeit your credibility. [...] we can do two things: wait till you know everything and communicate afterwards, but this can last for hundreds of years; or inform now, and comply with the probability of a decrease of certain statements in the future. *(Male – Science/industry/government)*

4.2.3 Results regarding participation

Practically every expert in the focus groups recognized the benefits that public participation could bring in relation to acquiring acceptance or adoption of nutrigenomics applications in the future. However, experts scarcely related participation directly to benefits like increasing commitment or achieving acceptance of nutrigenomics. More frequently they indicated the importance of involvement without giving a specific reason for this. Only the increase of relevant knowledge for initiators, for example about the variety of beliefs or other background information, was mentioned frequently as being a positive consequence of public participation. Furthermore some participants named transparency and ethical rightness as possible benefits as well.

Participation was in particular associated with the developmental process of nutrigenomics products. Experts elaborated on the possibilities of participation for researchers and product makers, in better understanding public opinion, wishes and fears by taking account of the publics' knowledge and vision during decision processes. Public participation processes were most often defined as letting lay persons judge about research (subjects) or letting people participate in research projects. Experts also referred to participation in terms like 'communication', 'information', 'getting the public involved' or 'societal feedback'.

> I think participation is about bringing up existing beliefs and anticipating on this, taking account of this, but not a democratic process. *(Male – Science/government)*

Only two participants, both social scientists, pointed out the significance of participation as a democratic process. Other experts were more skeptical about fully democratic processes and mainly mentioned disadvantages when discussing about this type of engagement. They substantiated this for example with examples from the past that show how drawing in public opinions can end in extreme outcomes, or indicated the impossibility of finding one solution when involving a wide variety of visions.

> [...] Advising, not decision-making, as it seems to me. On a particular moment you cannot bring about democracy down to the minutest detail, for then I think you will never find a solution. *(Male – Science/government)*

During the focus group discussions experts discerned three separate conditions for public participation in particular: sufficient knowledge to give an informed reaction, interest in (a good direction of) nutrigenomics developments, and, motivation to take a part in the participation process.

Knowledge was frequently perceived as being crucial in letting people participate in research projects. Given that it seems challenging to provide lay persons with adequate knowledge about nutrigenomics, participants often used this argument to assume that decision-making by lay persons is not desirable.

> [...] But you want the population to have knowledge, as a result of which they can say something about it with insight, and that is what is missing at the moment. So you should first give them knowledge about what it is, and only then they can form an opinion about it. *(Male – Science/food industry)*

Another condition experts often referred to, is the degree of *interest* people will have in a certain subject, which was strongly related with involvement or commitment. Interest will be created when people perceive that a subject can affect their daily lives, or when a technology involves fundamental societal dilemmas. A few experts argued that the only real threat that nutrigenomics brings about and that could increase public interest, is the ethical aspect of it.

> There are so many subjects about whom you can have a societal debate, and at that list of priorities this will have a low position, lower than euthanasia and that kind of things. *(Male – Science/food industry)*

Furthermore, experts discussed about the *motivation* of individuals. Motivation can be created by interest, but can also be an intrinsic characteristic of a person himself, for example when someone is very interested food technologies.

A number of experts used the three discerned factors to indicate the right moment for starting with participation processes. They argued that it is not much useful to start up a participation process without people having sufficient knowledge, or having an interest in nutrigenomics (for example because there are no concrete applications yet, or because there are no big personal or societal risks when implementing the technology). Experts related the three conditions of public participation in particular to examples of decision-making in research projects. Some of them argued that it is only

useful to ask a person's opinion about research, when a person has sufficient knowledge about the research subject. According to these experts, for that reason it is not needed to involve lay persons in decision-making about elemental parts of the scientific process. Moreover, it was stated that people will probably have no interest in information about gene combinations interacting with each other. Above all public participation in research projects is recommended when lay persons can provide extra relevant information to researchers or product makers, or the expected outcomes may affect a person's lifestyle.

> It depends on the level of participation. […] When someone at Volkswagen's designs a new Golf, there will be extensively thought about who is going to drive in it, and people will be questioned about that. […] But, what you [nutrigenomics scientist] are doing in your lab is the equivalent of the little screw in the back of that Golf's suspension. And you probably will not extensively discuss the design of that little screw, but you talk about the car. *(Male – Science)*

Some experts also indicated that they did not associate the concept of participation literally with involving a lot of lay persons into decision-making processes, but that specific parties or people should represent the public majority. One expert argued that there will never be a matter of real public participation, whereas participation always occurs via representatives. Representative parties that were mentioned in the focus group meetings were for example (ethical commissions or expert panels of) patient organizations, consumer organizations or governmental agencies. Experts indicated that these parties are better participation actors because they have more knowledge about the subject and are intrinsically more involved in scientific developments, as it is part of their job. Furthermore, another benefit of making other relevant stakeholders part of the decision making process, may be that it will make them be better able to diffuse actual information to the public acquired by knowledge provided from the participation processes. This is related to the concept of indirect communication, as mentioned in the results concerning 'communication'. Provision of adequate information by representative parties, may increase public knowledge and can let them be better participants in future participation processes, when subjects that really matter will be discussed.

5. DISCUSSION

This paper contributes to a better understanding of experts and their visions on issues with regard to public perception and acceptance, applied to the context of the implementation of nutrigenomics. The research project has been conducted on the basis of two research questions, each discussed by means of its own method. The first question implied identification of the relevant stakeholder groups that are or will be involved in the developmental process of nutrigenomics. Stakeholder's analysis, conducted by semi-structured interviews, provided an overview of these stakeholders, including their extent of involvement or expertise regarding nutrigenomics. The second research question aimed at getting a better understanding of how experts perceive public (risk) perceptions and related social processes that might influence nutrigenomics acceptance. To answer this question, focus group discussions were conducted, with representatives from four expert groups that through stakeholder's analysis were indicated as being most involved. Three main themes, regarding acceptance of food technologies, were derived from literature research to provide a guideline for the content of the discussions: perception, communication, and participation. In the following paragraphs the results from this research will be discussed. Furthermore, a light will be thrown on the implications these results have regarding the implementation process of nutrigenomics, in order to reveal some main points of interest.

5.1 Conclusions and discussion

5.1.1 Science, industry, patient organizations, governance, and… health care?

From the stakeholder's analysis 12 different types of stakeholder groups were distinguished, of which five stakeholder groups were identified as being most involved in nutrigenomics. Regarding these five stakeholder groups, a distinction could be drawn between stakeholders that have a say in nutrigenomics developments already (scientists, food industries, and to a lesser extent, sections of the government) and stakeholders that should be involved in the future implementation process (consumer/patient organizations and the public). Scientists, food industries, government and consumer/patient organizations were considered to be the most influential expert parties. This implies that they are most likely to exert considerable influence on future implementation policies as well. Hence, it is important that they will be aware of, and take into account the perceptions of that other important stakeholder group: the public (Pidgeon, 1998). For this reason, representatives of the four indicated expert groups were also consulted on their visions about public perception and acceptance in the second section of this research project.

To the stakeholder's analysis the government was most frequently mentioned to be an important stakeholder, although governmental bodies were not perceived to be very much involved. Researchers dedicate this result to the framing of the theme, since nutrigenomics was presented as a scientific development with possible societal consequences in the future. Because of this, interviewees sometimes considered main actors, such as scientists and researchers in food industries, as being the innovators themselves, and, for that, they were not perceived to be subordinate stakeholders as well. Moreover, it was also interesting that experts indicated the health care sector as an important stakeholder, but that health care practitioners were practically not perceived to be involved at all. Experts considered health care practitioners as a stakeholder group, that will definitely have to deal with nutrigenomics in the future, but that is not yet interested in this innovation. For this reason, it might be useful to involve the health care sector at an early stage in scientific and application developments of nutrigenomics as well. Furthermore, this conclusion raises the question if health care practitioners, like the other four expert groups, should also have been involved in this research' focus group discussions after all. Further research considering nutrigenomics should not overlook the possible influential role of health care practitioners.

Furthermore, it has to be mentioned that, although this stakeholder's analysis shows a useful percept of nutrigenomics stakeholders, it should be noted that research findings concerning the presence, roles and mutual relationships of stakeholders, are only applicable to the context of the Netherlands. In the interviews of the current research, this context was described as being characterized by about 10 years of nutrigenomics research history for which relative high attention and financing was, and will be, available in comparison to other countries. Moreover, also the presence of some major food industries and a traditional interest in food sciences seem to make the Netherlands a precursor in the field of nutrigenomics. These factors, as well as the position of the government and rules or regulations, affect the involvement and mutual relationships of main stakeholder groups in every country. Further research is recommended to uncover certain institutionalizations in other countries as well.

5.1.2 A more public like perception for patient organizations so far?

In the second part of this research, focus group discussions were conducted to reveal expert's visions on issues regarding public perception, communication and public participation in the context of nutrigenomics. Participants of the focus groups covered the four most important professional fields regarding nutrigenomics developments. Despite the relative small number of participants used in this study, findings from the focus groups provided a better insight in the way experts perceive the context

of attaining societal acceptation of nutrigenomics. Since the information derived from this research cannot be used as the only empirical evidence to support conclusions, this research especially provides a starting-point for possible further research.

During the focus group discussions, subjects on public perception, communication and participation got about the same frequency of attention by the experts, which implies that experts, despite of differences in their professional background, are a quite homogeneous group with respect to their views on nutrigenomics developments and implementation. These findings correspond with former researches where the homogeneity of expert groups has also been observed (e.g., Van Kleef et al., 2006). Similarities between experts can be explained mainly by common educational backgrounds. In this research, the common vision of experts was also confirmed by their overall inclination to underpin statements more often with observations and facts, than with affective reactions. A difference was found for patient organizations, which representatives knew consequential less about nutrigenomics developments, and, for that, gave more often arguments based on their own experiences.

5.1.3 Involving the public for expert's own good?

Expert's visions were largely focused on the scientific and application developments of nutrigenomics, and considerable lesser on the role of the public. The little observed attention for the public can be attributed to the developmental phase of nutrigenomics at this moment. Because it is still unclear which societal implications nutrigenomics will bring about, experts tend to focus on the developmental process, instead of the implementation process, first. However, as has been discussed earlier in this article, the essence of being aware of public perceptions should not be neglected. Understanding the public and their visions is essential to predict their behaviors and promote dialogue to make nutrigenomics succeed (Pidgeon, 1998). The 'application focused' vision that experts showed in this research, might undermine the effectiveness of their implementation policies in a later phase.

Nevertheless, notwithstanding their focus on technical aspects, experts, when talking about attaining public acceptance, frequently indicated the importance of involvement of the public. Certain arguments demonstrate that expert groups, to a certain extent, are aware of the essence of taking into consideration the social context of the nutrigenomics implementation process. Moreover, expert's excessive attention to involvement in particular is interesting because involvement is, according to literature, just one out of many determinants for acceptance.

Furthermore, experts logically indicated that public involvement will depend on the actual implicational outcomes concerning the development of nutrigenomics and on the accompanying risks or

benefits of these applications perceived by the public. Also individual characteristics, such as interest in health innovations or one's health status, were interrelated to public involvement. Experts stated that public interest and involvement will be low at the moment, because most lay persons are not aware of the existence of nutrigenomics possibilities and do not have knowledge about it. These findings are in concordance with former research from Pin (2009), who demonstrated that personal interest, knowledge and involvement are related with each other, and together provide a basis for the intention to adopt a new technology like nutrigenomics.

5.1.4 Differences in risk perceptions?

With regard to the public acceptance of nutrigenomics, experts furthermore discussed the risks and benefits of this innovational technology. Therefore, not only worries and chances, but also the relativity of positive and negative expectations, were stressed. Experts associated possible risks more often with situations for individuals and the common public, whereas perceived benefits were more frequently associated with purposes of their own organizations or institutes. This way of thinking can possibly also explain why experts expected the public to be rather negative about nutrigenomics. After all, several researches in the past showed that lay persons, in general, perceive more risks than experts do, amongst others because they perceive risks more intuitively instead of by an objective assessment (Rowe & Wright, 2001; Slovic, 1987; Wiedemann et al., 2003). To avert these differences to hinder societal acceptance of nutrigenomics, experts should be very well aware of the divergent risk perceptions of the public.

Furthermore, it is noteworthy that the possible central position of attitude was almost never pointed out during the focus group discussions. This finding could be explained by the abstract and general content of the concept of attitude, which is difficult to code in the data-analyzing process. As data-analysis, used in this sort of qualitative research, strongly relies on interpretation, it is not strange that more tangible concepts instead of abstract concepts were detected. Accordingly, this could be the reason for a scarce detection of affective reactions from experts as well. This latter finding however, can also be explained by the inclination of experts to assess risks and benefits of innovations in a rational way (Slovic, 1987). Such a rational consideration stands in contrast with the way lay persons perceive food innovation. Research from Pin (2009) demonstrates that positive and negative affect have a dominant role in behavioral intentions related to nutrigenomics applications. The results of this research may indicate a gap in the way experts and the public experience the developments and future applications of nutrigenomics. Further research should be conducted to find out what these differences

in perceptions actually contain. Such insights might also contribute to a better awareness of experts regarding possible differences in the way they perceive risks, compared to the public.

5.1.5 Expert's visions on communication

Experts emphasized that communication (which was generally referred to as a one-way process of sending information from experts or regulators to the public) is a central instrument for acquiring public acceptance of nutrigenomics applications. This is also supported by a large number of studies that indicate the importance of adequate communication in contexts comparable to the introduction of nutrigenomics as well (Frewer et al., 1999; Ronteltap, Van Trijp, & Renes, 2007; Shepherd, 2008). In the focus groups discussions, information sharing was often associated with increasing public awareness and public knowledge, which is one step of involving the public to attain widespread societal acceptance at the end. Accordingly, experts stressed the importance of using various information sources, not only to ensure a complete overview, but also because it lets people get into touch with nutrigenomics through many different ways. A special role seems to be allocated to the media, as experts considered these senders to have a major influence of public opinion and popularization of concepts.

In the focus group discussions, the essence of communication was often related with public trust. Experts pointed out that people's trust in nutrigenomics could be negatively affected by the uncertainty and complexity regarding findings about the relationship between the genome, food, and health, which is characteristic of nutrigenomics developments. Besides, the dynamic nature of science and examples of deception in the past may also contribute to a decrease of public trust. These findings are in concordance with previous research which pointed out the negative influence of similar characteristics on risk perception (Bennett et al., 1999; Cardello, 2003). Because these characteristics are hard to change, adequate communication about the possibilities and impossibilities of nutrigenomics, according to the experts, should have precedence. However, as risk perceptions, next to objective assessments, also will be framed by people's underlying values (Pidgeon, 1998) it should not been passed over to reflect these values in the communication process (and other implementation policies) as well.

Furthermore, experts agreed that, when communicators provide information to the public, they should take into account the complex characteristics of nutrigenomics research. According to them this calls for complete, adequate, transparent and simple information. Almost exactly the same features of adequate communication were derived from earlier research, conducted by Ronteltap et al. (in press). Experts emphasized the relevance of open communication, but, on the contrary, also some

shortcomings of an open communication process were identified by indicating drawbacks of spreading information too early. For this reason, some experts preferred knowledge improvement of other relevant stakeholders, such as the governmental bodies, patient organizations and health care practitioners, first. An extra benefit of this approach is that these stakeholder groups, in comparison to scientists or food industries, then will be able to provide more objective and targeted information to the public. Nevertheless, it should be noted that it can be questioned whether improving knowledge will be sufficient to communicate correctly to the public. After all, communicators here should also comply with underlying values that are attached importance to in society. Without knowing about these tendencies, the impact of the information about nutrigenomics might be insufficient.

5.1.6 Experts still judging from a technocratic vision?

All experts agreed on the importance of public participation, but they scarcely related a certain approach to affective benefits like better feelings for the public. Most arguments for public participation from experts included benefits for a better development of the food innovation, for example by providing researchers relevant knowledge about consumer's wishes. According to them, after all, suitable products, in an indirect way, may lead to more positive feelings of the public in the end. Furthermore, experts referred to an increase of knowledge and interest of lay persons, as being benefits of public participation. It is conspicuous that experts seem to pay more attention to scientific or commercial benefits instead of rather intrinsic values brought about by a participation process. Carrying out a successful implementation process is not only about letting the public feel positive about nutrigenomics developments and applications; it is about the total process of integrating public perceptions and expert's visions. Perhaps experts are not sufficiently aware of the important implications that legitimate public concerns may have on the way a new technology like nutrigenomics will be accepted in society.

Correspondingly, just like the associated benefits, also the content of participation was generally related to the developmental process of nutrigenomics products, for example by letting lay persons judge about research (subjects) or letting people participate in research projects. It is interesting that most experts do not think lay persons should really make decisions about developmental affairs, which corresponds with the consultation level of engagement, as being described by Rowe and Frewer (2005). This finding can be brought into relation with the fact that experts considered knowledge, interest and motivation as decisive for the public to participate. As nutrigenomics research still finds itself in an exploring phase, and possible (negative) outcomes are not tangible yet, most experts perceived people's

knowledge, interest and motivation not to be sufficient to create an extensive interactive participation process already. Accordingly, a lack of knowledge and motivation of lay persons, can give reason to promote participation by representatives of the public, as patient organizations or the government, more than participation of lay persons. Especially the consideration that knowledge of the public should not be sufficient to participate, is opposite to the beliefs of a considerable number of researchers that support the interactive science model, which states that knowledge of all parties concerned is useful (Einsiedel, 2000). Moreover, Pidgeon (1998) emphasized that estimating risks is not only about science, but also about values. Knowledge about values is not something experts have at their disposal alone; it concerns judgments that will be more completely reflected by perceptions of the public than by scientific considerations.

5.2 Implications derived from this research

This research project provides a useful first glance at probable significant factors of a successful introduction of nutrigenomics applications in the future. Research findings, concerning prominent stakeholders and their position in relation to nutrigenomics developments, contribute to a better understanding of the context of the food innovation. This information can be used as a starting point for the shaping of a societal implementation process of nutrigenomics. Furthermore, this research demonstrates how experts think about public perception, communication, and public participation in relation to the acceptation of nutrigenomics applications. This information can be taken into account for designing a successful implementation process. Below, three suggestions for practical (research) implications are made as a result of the findings in this study. Subsequently, a more general conclusion will be drawn with regard to expert's visions on public acceptance.

First, feeling involved seems to be an important condition for public acceptation of a technology like nutrigenomics. However, to make people feel involved, it can be useful to involve representative opinion leaders or other relevant parties first. Attention should be concentrated on creating interest and knowledge for significant stakeholder groups and opinion leaders, that are not involved in the development process yet, but which are perceived as valuable parties for the public. One important condition implies that representatives from the stakeholder groups should represent the public very well. Initially, this might involve stakeholder groups like patient organizations and health care specialists, because of their central role and direct relationships with the public. When suchlike parties are more involved in nutrigenomics, they will be more capable of representing the public with regard to new food developments and informing the public in a right way. Since health care professionals were perceived

not to be involved at all right now, special attention should be focused on getting them interested as well.

Second, communication seems to play a central role in implementing nutrigenomics successfully, since it creates awareness and a sense of commitment. To inform lay persons about nutrigenomics it could make sense to make sure that information is complete, founded, transparent and easy to understand. Diverse and trustworthy sources may contribute to a more positive image of nutrigenomics. Accordingly, not only scientists or food industries should communicate about nutrigenomics, but, also other stakeholders with an interest in public health should be able to provide information, such as governmental bodies, patient organizations and health care practitioners. Furthermore, attention by the media may add to the dissemination of nutrigenomics. A central issue concerning communication will be at what moment distribution of information is desirable, as, both early and late communication seem to have some side effects. More research about the advantages and disadvantages in relation to the moment of informing will be needed to answer this question. Literature about communicating uncertainty can probably make a contribution as well (e.g., Shepherd et al., 2006).

Third, experts acknowledge the importance of public participation, but refer to more consultation activities as to be adequate. According to them, public knowledge, public interest and public motivation are not sufficient (yet) to let people make decisions with regard to nutrigenomics research. However, former research points out that scientific knowledge is not determinative in adequate decision making about research, and that public participation, in a more interactive format, will contribute to a better implementation process. For that reason, the presence of interest and motivation seem to be better conditions for an interactive participation process. As there are no concrete implications for society yet, public's interest in nutrigenomics and its motivation to participate are not likely to be very high at the moment. It can be questioned if public participation at this moment, without having people interested and motivated, is desirable. To find out at what moment, and in what way, participation, in the context of a food innovation like nutrigenomics, will be efficient, more research is required. The findings regarding expert's visions on public participation that were derived from this study can be used for further research projects.

The three statements made above provide some practical advices for improving the approaching implementation process of nutrigenomics. Despite of these concrete recommendations, this study also reflects some possible shortcomings in expert's way of thinking. Because experts in this research mainly used scientific arguments to indicate the framing of acceptance, and, besides, attached reasonably

much attention to knowledge issues, this might suggest some kind of a bias in their mode of thought. As biases are nearly inevitable, it is especially important that experts are aware of their way of thinking compared to that of lay persons. When experts do not only attach importance to technical (risk) judgments, but also accept that public's perceptions are just as valuable, this will promote an effective dialogue between experts and the public. Being open to social processes and values that are present in society is essential for making the implementation of nutrigenomics a success, so, accordingly, it is fundamental that experts take this seriously. More social research is needed to increase expert's awareness of their limited vision, in order to frame future implementation policies in the right way.

REFERENCES

Arnstein, S.R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216-224.

Bennett, P., Coles, D. & McDonald, A. (1999). Risk communication as a decision process. In: Bennett, P. & Calman, K. (Eds.). *Risk Communication and public health* (pp. 207-221). Oxford: Oxford University Press.

Berry, D. (2004). *Risk, communication and health psychology.* Maidenhead: Open University Press.

Bouwman, L. (2009). *Personalized nutrition advice – An every-day perspective*. Wageningen: Thesis Wageningen University.

Bredahl, L. (2001). Determinants of consumer attitudes and purchase intentions with regard to genetically modified foods – results of a cross-national survey. *Journal of Consumer Policy, 24*, 23-61.

Cardello, A.V. (2003). Consumer concerns and expectations about novel food processing technologies: effects on product liking. *Appetite, 40*, 217-233.

Coppens, P., Fernandes da Silva, M. & Pettman, S. (2006). European regulations on nutraceuticals, dietary supplements and functional foods: a framework based on safety. *Toxicology, 221*, 59-74.

Deliza, R., Rosenthal, A. & Silva, A.L.S. (2003). Consumer attitude towards information on non conventional technology. *Trends in Food Science and Technology, 14*, 43-49.

Dijkstra, A.M. (2008). *Of publics and science – How publics engage with biotechnology and genomics.* Enschede: Gildeprint BV.

Einsiedel, E.F. (2000). Understanding 'publics' in the public understanding of science. In: Dierkes, M. & Von Grote, C. (Eds.). *Between understanding and trust – The public, science and technology*. Amsterdam: Harwood Academic Publishers.

Frewer, L.J. (2003a). Science, society and public confidence in food risk management. In: Belton, P.S. & Belton, T. (Eds.). *Food, science and society: exploring the gap between expert advice and individual behaviour.* Berlin Heidelberg: Spring-Verlag.

Frewer, L.J. (2003b). Societal issues and public attitudes towards genetically modified foods. *Trends in Food Science and Technology, 14,* 319-332.

Frewer, L.J., Howard, C., Hedderley, D. & Shepherd, R. (1999). Reactions to information about genetic engineering: impact of source characteristics, perceived personal relevance, and persuasiveness. *Public Understanding of Science, 8*, 35-50.

Frewer, L.J., Howard, C. & Shepherd, R. (1998). The influence of initial attitudes on responses to communication about genetic engineering in food production. *Agriculture and Human Values, 15*, 15-30.

Frewer, L.J., Miles, S. & Marsh, R. (2002). The media and genetically modified foods: evidence in support of social amplification of risk. *Risk Analysis, 22*, 701-711.

Frewer, L.J. & Salter, B. (2002). Public attitudes, scientific advice and the politics of regulatory policy: the case of BSE. *Science and Public Policy, 29*(2), 137-145.

Granger Morgan, M., Fischhoff, B., Bostrom, A. & Atman, C.J. (2002). *Risk communication – A mental models approach*. Cambridge: Cambridge University Press.

Gregory, R., Slovic, P. & Flynn, J. (1996). Risk perceptions, stigma, and health policy. *Health & Place, 2*(4), 213-220.

Henrion, M. & Fischhoff, B. (1986). Assessing uncertainty in physical constants. *American Journal of Physics, 54*(9), 791-798.

Jelsøe, E. & Gaskell, G. (2000). Biotechnology and the European public. *Nature Biotechnology,* 18(9), 905-1013.

Kasperson, R.E., Renn, O., Slovic, P., Brown, S., Emel, J., Goble, R., et al. (1988). The social amplification of risk: a conceptual framework. *Risk Analysis, 8*(2), 177-187.

Krueger, R.A. (1994). *Focus groups: a practical guide for applied research*. Thousand Oaks, California: Sage publications.

Lassen, J., Madsen, K.H. & Sandøe, P. (2002). Ethics and genetic engineering – Lessons to be learned from GM foods. *Bioprocess and Biosystems Engineering, 24*, 263-271.

Lindlof, T.R. & Taylor, B.C. (2002). *Qualitative communication research methods* (pp. 195). Thousand Oaks, California: Sage publications.

Lombard, M., Snyder-Duch, J. & Bracken, C.C. (2002). Content analysis in mass communication – Assessment and reporting of intercoder reliability. *Human Communication Research, 28*(4), 587-604.

Oliver, D. (2005). *The future of nutrigenomics – From the lab to the dining room (No. SR-889).* Institute for the Future.

Petty, R.E. & Cacioppo, J.T. (1986). *Communication and persuasion: central and peripheral routes to attitude change*. New York: Springer-Verlag.

Pin, R.R. (2009). Perceptions of nutrigenomics – Affect, cognition and behavioral intention. Enschede: Gildeprint BV.

Pidgeon, N. (1998). Risk assessment, risk values and the social science programme: why we do need risk perception research. *Reliability Engineering and System Safety, 59*, 5 -15.

Regeer, B.J. & Bunders, J.F.G. (2007). *Kenniscocreatie: samenspel tussen wetenschap en praktijk – Complexe, maatschappelijke vraagstukken transdisciplinair benaderd.* Den Haag: RMNO.

Renn, O. (1992). Concepts of risk: a classification. In: Krimsky, S. & Golding, D. (Eds.). *Social theories of risk* (pp. 53-79). Westport, Connecticut: Praeger Publishers.

Renn, O. (1998). The role of risk communication and public dialogue for improving risk management. *Risk decision and policy, 3*(1), 5-30.

Renn, O. (2003). Social amplification of risk in participation: two case studies. In: Pidgeon, N., Kasperson, R.E. & Slovic, P. (Eds.). *The social amplification of risk*. Cambridge: Cambridge University Press.

Rogers, E.M. (1995). *Diffusion of innovations.* New York: The Free Press.

Ronteltap, A., Van Trijp, J.C.M. & Renes, R.J. (2007). Expert views on critical success and failure factors for nutrigenomics (2007). *Trends in Food Science & Technology, 18*, 189-200.

Ronteltap, A., Van Trijp, J.C.M. & Renes, R.J. (in press). Making nutrigenomics work – Integrating expert stakeholder opinions and consumer preferences*. Trends in Food Science & Technology*, doi: 10.1016/j.tifs.2008.01.012.

Ronteltap, A., Van Trijp, J.C.M., Renes, R.J. & Frewer, L.J. (2007). Consumer acceptance of technology-based food innovations: lessons for the future of nutrigenomics. *Appetite, 49*, 1-17.

Rowan, K.E. (1994). The technical and democratic approaches to risk situations: their appeal, limitations, and rhetorical alternative. *Argumentation, 8*, 391-409.

Rowe, G. & Frewer, L.J. (2005). A typology of public engagement mechanisms. *Science, Technology & Human Values, 30*(2), 251-290.

Rowe, G. & Wright, G. (2001). Differences in expert and lay judgements of risk: myth or realtity? *Risk Analysis, 21*, 345-356.

Rozin, P. (1999). Food is fundamental, fun, frightening, and far-reaching. *Social Research, 66*(1), 9-30.

Shepherd, R. (2008). Involving the public and stakeholders in the evaluation of food risks. *Trends in Food Science & Technology, 19*, 234-239.

Shepherd, R., Barker, G., French, S., Hart, A., Maule, J. & Cassidy, A. (2006). Managing food chain risks: integrating technical and stakeholder perspectives on uncertainty. *Journal of Agricultural Economics*, *57*, 311-327.

Siegrist, M. (2000). The influence of trust and perceptions of risk and benefits on the acceptance of gene technology. *Risk Analysis, 20*(2), 195-203.

Slovic, P. (1987). Perception of risk. *Science, 236*, 280-285.

Slovic, P. (1992). Perceptions of risk: reflections on the psychometric paradigm. In: Krimsky, S. & Golding, D. (Eds.). *Social theories of risk* (pp. 117-152). Westport, Connecticut: Praeger Publishers.

Slovic, P. (1993). Perceived risk, trust and democracy. *Risk Analysis, 13*(6), 675-682.

Sparks, P., Shepherd, R. & Frewer, L.J. (1994). Gene technology, food production, and public opinion: a UK study. *Agriculture and Human Values, 11*(1), 19-28.

Van Kleef, E., Frewer, L.J., Chryssochoidis, G.M., Houghton, J.R., Korzen-Bohr, S., Krystallis, T., et al. (2006). Perceptions of food risk management among key stakeholders: results from a cross-European study. *Appetite, 47,* 46-63.

Van Tulder, R., Kapitein, M., Van Mill, E.M. & Schilpzand, R.A. (2004). *De Strategische Stakeholderdialoog – opkomst, succesfactoren, toekomst.* Nieuwegein: Hentenaar Boek.

Viscusi, W.K., Magat, W.A. & Huber, J. (1991). Communication of ambiguous risk information. *Theory and Decision, 31*, 159-173.

Von Grote, C. & Dierkes, M. (2000). Public understanding of science and technology: state of the art and consequences for future research. In: Dierkes, M. & Von Grote, C. (Eds.). *Between understanding and trust – The public, science and technology* (pp. 341-361). Amsterdam: Harwood Academic Publishers.

Wiedemann, P.M., Clauberg, M. & Schutz, H. (2003). Understanding amplification of complex risk issues: the risk story model applied to the EMF case. In: Pidgeon, N., Kasperson, R.E. & Slovic, P. (Eds.). *The social amplification of risk*. Cambridge: Cambridge University Press.