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Making Sense of Food Risk Information: The Influence of Opinions of Others

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Abstract

The study aimed to identify how and to which extent the social environment influences the process of making sense of food risk information. Sense-making can be understood in terms of interpretation, searching and sharing of information. People need to make sense of information to get a more precise idea and a better comprehension of a certain topic.

In an online experiment students participated in a simulated conversation with another individual in order to assess the impact of the social environment on the individual's way of processing information. Nanotechnology in food is a mostly unexplored topic and used in the current study to investigate the way of information processing. Important influences of the social environment are the processes similarity and expertise, which shape the way individuals process gained information. The influence of social mechanisms on interpretation, searching and sharing of information are examined by means of the two populations, students and experts as interaction partner.

The results of the study indicate that the content of the reports individuals received about nanotechnology has an impact on searching additional information about this topic. Surprisingly, results show that the content of information has no influence on interpretation and sharing. Furthermore the person individuals are communicating with also seems to have no impact on the information processing.

The framework of the present study suggests further improvements for future research with emphasis on the structure and procedure of the experiment.

Dit onderzoek heeft als doel te bepalen hoe en in welke mate de sociale omgeving van invloed is op het proces om informatie over de risico's van voedsel te begrijpen. Dit proces van het begrijpen van informatie kan worden begrepen in termen van interpretatie, zoeken en delen van informatie. Mensen moeten informatie begrijpen om een preciezer idee en een beter begrip te krijgen van een bepaald onderwerp.

In een online experiment, deden studenten mee aan een gesimuleerde conversatie met een ander individu om te bepalen wat de invloed van de sociale omgeving is om de manier hoe een individu informatie verwerkt. Volgens bestaande literatuur is het onderwerp van nanotechnologie in voedsel voor een groot gedeelte van individuen een nog niet onderzocht onderwerp en wordt gebruikt in dit onderzoek om te onderzoeken hoe informatie wordt verwerkt. Belangrijke invloeden van de sociale omgeving zijn 'process similarity' en expertise, die invloed hebben hoe individuen verkregen informatie verwerken. De invloed van sociale mechanismen op het interpreteren, zoeken en delen van informatie zijn onderzocht met gebruik van twee populaties, de studenten en de expert interactiepartners.

De resultaten van dit onderzoek wijzen erop dat de inhoud van de berichten die individuen krijgen over nanotechnologie van invloed is op het zoeken van verdere informatie over dit onderwerp. Opmerkelijk is dat de resultaten aangeven dat de inhoud van informatie geen invloed heeft op het interpreten en delen hiervan. Verder lijkt het dat de gesprekspartner waarmee het individu communiceert geen invloed heeft op de verwerking van informatie.

Het framework van dit onderzoek geeft verbeterpunten aan voor toekomstig onderzoek, met focus op de structuur en de procedure van het experiment.

Key words: *sense-making, risk information, similarity, expertise, information processing, sharing, searching, interpretation*

Making Sense of Food Risk Information: The Influence of Opinions of Others

The world of today is influenced by changing patterns of food production. With the emergence of new technologies in food production such as nanotechnology, the citizens are flooded by new information about recent findings concerning the technology. The increasing amount of information simultaneously creates a rising confusion and fear about possible new risks. Incidents like the Salmonella (Roslyng, 2011) or EHEC scandals increased fears of health risks and therefore the trust in the safety of nutrition is declining (Böl, 2012).

Because of the fact, that the presented information is often not clear or ambiguous, individuals seek for additional information to gain accuracy and comprehension. Resulting in the ambiguity of information, the receiver needs additional cues to make sense of the gained input (Cialdini & Goldstein, 2004). The present research mainly deals with three main processes of coping with information: interpretation, searching and sharing of information. It focuses on the examination of how people process the information to which they are exposed to and especially how they make sense of the information. Wilson & Wilson (2013, p.8) described the sense-making problem in terms of "[…] users closing a gap (in their knowledge) by trying to build a bridge". To be able to overcome this gap, testing and exploration of information is required as potential solution. Previous studies testify that sense-making involves both, the demand for information and a way to seek this information to satisfy this demand (Wilson & Wilson, 2013).

Influence of Social Environment

The social environment plays a significant role in the way how information is processed. Human beings are social creatures, which are strongly influenced by the people of their social environment. Based on the fact that individuals are social creatures, it seems to be important to include the social environment in the current study to investigate the effects on making sense of food risk information.

The social information processing approach states that people adapt to the attitudes, behavior and beliefs of their surroundings. If the presented information is ambiguous, individuals are likely to communicate about the gained information, to create a reliable socially approved explanation (Salancik & Pfeffer, 1978). Most of the time decisions are

made in interaction with other people. Interaction can refer to consulting other people or just pure being influenced by them (Bonaccio & Dalal, 2006). Related to this information, the following question arises: *"What is the relevance of opinions of others in making sense of food risk information?"*

There are several phenomena and theories which seem to be influential in the process of sense-making. Conformity plays a significant role in this process. This term describes altering one's own behavior to adapt to the responses of others (Cialdini & Goldstein, 2004). Cialdini & Goldstein (2004) differentiate between two kinds of interrelated conformity motivations: firstly informational conformity motivation, which refers to the craving to build proper interpretations of reality, and secondly the normative conformity motivation, which is related to the goal of getting social support. Both kinds of motivations influence the way individuals make sense of the information they are exposed to. With regard to the first motivation, it implies that defining what nanotechnology actually means for individuals, is dependent on the social surrounding. Related to the latter, getting support in interpreting the information, as well as acquiring information and communication about nanotechnology is influenced by the social environment, too.

In addition, social norms seem to be influential in the process of sense-making. Especially in times of uncertainty, individuals search for social norms to improve their understanding of a situation and to increase the effectiveness in reacting in certain situations (Cialdini & Goldstein, 2004). Other research indicates that the confirmation bias has an impact on the way people process information. The conformation bias states that human beings prefer information which fits with their prior knowledge. That means that the individual tends to search, choose and interpret information, which is consistent with their expectations (Nickerson, 1998).

Not just the way of processing the information is important; individuals involved in risk communication also seem to be influential. Several investigations have shown that different processes are involved in risk communication. Research points out that the egocentric bias is one of these processes. The egocentric bias refers to the tendency of the risk information receiving individuals to overrate his or her own opinion instead of adapting to possible useful information (Bonaccio & Dalal, 2006). This phenomenon influences the way individuals interpret the information and underrate the effectiveness of the received

information. Therefore they fail to derive possible benefits. Consequently individuals could ignore any information given about nanotechnology, irrespective of the content of the information or the person who provides the information.

An additional effect has the existence of egocentrism or conservatism on overrating one's own point of view. Egocentrism or conservatism states that one person's personal opinion has a long-term influence on the processing and interpretation of information (Bonaccio & Dalal, 2006). Furthermore, individuals tend to accept the information more easily when the way of the information providing individual to judge is consistent with their own manner. This is called consistency. Hereby the autonomy of the information taker is influential in accepting the opinion of experts (Bonaccio & Dalal, 2006).

Interaction Partner

Population experts. In present research, the population of risk communicating individuals is subdivided in experts and students. First of all an examination of the impact of risk information given by experts and the related underlying mechanism is going to be conducted. This includes a review of the extent to which experts influence the process of sense-making. An expert can be defined as an agent, when only a few other agents can perform it as well (Kraus et al., 2003). The perceived expertise is related to task-relevant expertise as well as demographical facts such as greater age, education, life-experience and wisdom (Bonaccio & Dalal, 2006). Results of latest research show that individuals can be positively influenced by risk information provided by experts, if the information is about self-efficacy and response efficacy or in other words efficacy-beliefs (Verroen et al., 2012).

Another important component in the process of experts offering risk information, are hierarchy theories. Magee et al. define social hierarchy as "an implicit or explicit rank order of individuals or groups with respect to a valued social dimension" (2009, p. 5). Whereas explicit and implicit refer to perception of the hierarchy in which they are set in. Hierarchies can be defined by rules and can be seen as a kind of agreement or they can be understood in individual terms as a natural occurrence. Status and power are terms which should be mentioned in the context of a social hierarchy. A social hierarchy can more specifically be split up in the terms status and power hierarchy. A status hierarchy implies a rank ordering of individuals or groups according to the amount of respect accorded by others. Whereas a

power hierarchy refers more to the rank ordering due to the amount of controlled resources.

Moreover the social status of an individual plays an important role in a social hierarchy. It can be described as the level of respect or admiration, which an individual gets from his or her social environment. Status is formed and shaped by the expectations that people hold for the performance of themselves or the performance of other people, based on prior achievements or on individual's expertise and demographics qualities (status characteristics) (Magee & Galinsky, 2009). Learned through the influence of the society, individuals are reinforced to accept and being conform to the opinions, advices and directives of authorities. When talking about authority it must be differentiated between authorities based on the competence of a person or the hierarchical position the person has in the society (Cialdini & Goldstein, 2004). An example for the power of authority is the well-known experiment conducted by Stanley Milgram. Results of Milgram's experiment indicate that 65% of the participants were obedient to authority, in this case the experimenter, even when they were aware of the fact that they could possibly hurt or even kill another human being (Milgram, 1963). The results of the Milgram experiment, demonstrating the power of authority, could also affect the information processing of the participants. Being conform to the opinion of an expert could have an impact the way respondent's make-sense of the gained information about nanotechnology in food; individuals possibly adapt to their point of view.

Previous studies have shown that different positions in social hierarchies generate various situational pressures on behavior. The concept of power is associated with a high rank status, which is stored in the minds of people. Consequently the representations of power in memory are activated when an individual related with power is available (Magee & Galinsky, 2009). The results of Bonaccio's and Dalal's (2006) research are in line with the previous findings about the influence of experts' opinion. The results testify that risk information expressed by experts, is experienced as more helpful and less invasive than opinions of resembling people. This is supported by the fact that less sophisticated individuals are less likely to find information which supports their own opinion and therefore adapt to the expert's opinion (Bonaccio & Dalal, 2006). Thus it is expected that participants are more likely to adapt to the opinion.

Population students. The second population in this research which communicates risk information is students. All mechanisms and processes related to receive information of

students are subordinated or related to the effects of similarity. Similarity has a major impact on how individuals make sense of information when risk information is revealed by a fellow student. One of the most important factors in information processing is personal resemblance. The higher the similarity to a person, the more relevant is the opinion of the individual for the understanding of one's own behavior, attitudes and beliefs (Salancik & Pfeffer, 1978). Moreover individuals are more likely to acquiesce to another person's opinion, if there is a perceived similarity between the two individuals. This statement is supported by Heider's explanation of unit relationships, which reveals that perceived similarities can cause positive affect. This phenomenon can be explained through the heuristic processing of information. When the person who expresses his or her opinion is noticeable similar to the information receiving person, the heuristic processing leads to a heightened compliance (Burger et al., 2004).

One of the similarity related mechanisms is conformity, as already mentioned above. The probability of individuals to conform to information is high, when they seem to resemble. Social proof or in other words informational social influence is a sort of conformity. An informational social influence can be defined as "[…] an influence to accept information […]" (Deutsch & Gerard, 1955, p. 629). When individuals are in situations in which they are unsure of the correct way to behave, they will often look to others for cues concerning the correct behavior. This occurrence is especially observable in situations of uncertainty (Cialdini & Goldstein, 2004). These findings are additionally supported by the similarity heuristic. This term describes the likelihood of individuals to identify themselves with an ambivalent event, sample or by the resemblance to the parent population (Read & Grushka-Cockayne, 2011). With respect to sense-making processes, this indicates that individuals are influenced by resembling persons in the way they interpret, search for additional information about nanotechnology in food and share this information.

Based on the existing literature about similarity and expertise, it is supposed that the following hypothesis can be received:

H1: The interaction partner has an impact on the way individuals make sense of information about the risks of nanotechnology in food.

H1a: The respondents are more secure about what nanotechnology means to them after communicating with an expert or student compared to an anonymous person.

H1b: The intention of individuals to search for additional information decreases when the interaction partner is an expert or student compared to an anonymous person.

H1c: The intention of individuals to communicate with others about the topic of nanotechnology in food is higher after receiving risk information from an expert or student compared an anonymous person.

Content of Information

Making sense of information depends on the content of the information in terms of how individuals perceive the presented information and what follow-up actions they undertake, based upon this. Factors with regard to the sense-making process are, as afore mentioned, subdivided in interpretation, searching, and sharing of information. The first step after getting the informational input is the interpretation of the information. This process is strongly influenced by the individual's prior knowledge. The judgment of the usefulness of an advice depends on the quantity and quality, as well as the kind of knowledge a person has about a certain topic. As a consequence the prior knowledge also has an impact on the processes' searching and sharing. Searching for information describes one of the following actions of individuals after being confronted with the information. If individuals are possibly insecure about the truth of the risk information or doubt the reliability of the statement, individuals subsequently start to search for other sources of information. This searching process can include asking peers, friends, family or others. Searching information on their own can occur in content-related literature such as magazines, newspapers etc. (both online for instance social media and printed media). Through interaction with other people, simultaneously sharing of information takes place by communicating the subject (Verroen et al., 2012). The diversity of the information gets enhanced as well.

Risk communication related factors refer to the evaluation and the credibility individuals attribute to the information. The evaluation of the information is strongly related to the interpretation of these. The evaluation process describes how individuals rate the

material in terms of how credible the presented information is and which personal value individuals give to the information. The evaluation is differentiated in rating the risk as positive, negative or doubting the information, whereas a positive rating refers to perceiving a low-risk-level and negative rating to the perception of a high-risk-level. Depending on the judgment of the evaluation, the personal usefulness is ascribed. Resulting on this appraisal process, the follow-up behavior is determined. These behavioral consequences describe the actions individuals undertake after being exposed to the risk information. This can refer to decide to change behavior or to be resistant to the information. In how far the behavioral consequences are definitely executed depends on individual's self-efficacy. Self-efficacy refers to the belief in one's own capacity; in how far individuals perceive that he or she is able to deal with the risk (Verroen et al., 2012).

H2: The content of reports influences the way individuals make sense of information about the risks of nanotechnology in food.

H2a: After receiving positive information about nanotechnology, there is an increased secureness about what the information personally means to the respondents compared to receiving negative or doubting the information.

H2b: The need of individuals to search for additional information about nanotechnology increases when the interaction partner is insecure about the value of nanotechnology in food, in comparison to rating nanotechnology in food as positive or negative.

H2c: The need for communicating with peers, friends or family about nanotechnology in food increases, when the interaction partner is positive or negative about the value of the topic in comparison to being insecure about the topic.

Relevance of Nanotechnology as Research Subject

As already mentioned above, the use of nanoparticles in food is a risky topic which is increasingly more focused in public. Because of the missing knowledge about this subject and

the peoples' reservation due to nanoparticles in food, there is a growing need for further making sense of the so far existing information (Siegrist et al., 2009). Therefore this subject serves as a case in this research paper to examine the processing of risk information and the related sense-making processes. By manipulating the variables interaction partner and content of information, the present study tries to determine the effects of the social environment by means of nanotechnology in food.

Based on the presented facts and the presented theoretical framework, the according hypotheses were derived, as mentioned above. It should be acknowledged that for the two populations, experts as well as students, mostly the same expectations of outcomes are appropriate. The difference is the fact that the essential processes in making sense of risk information are based on the power of authority of experts and the mechanism of similarity between students and the participants. Hereby should be kept in mind that also the content of information is an influential factor.

Conceptual Model

Following from this, the conceptual model can be derived. It displays the relationship between *interaction partner* and the *content of information*. Moreover it acknowledges that the social environment, consisting of the before mentioned variables, influences the perception of risk information and the related sense-making processes.

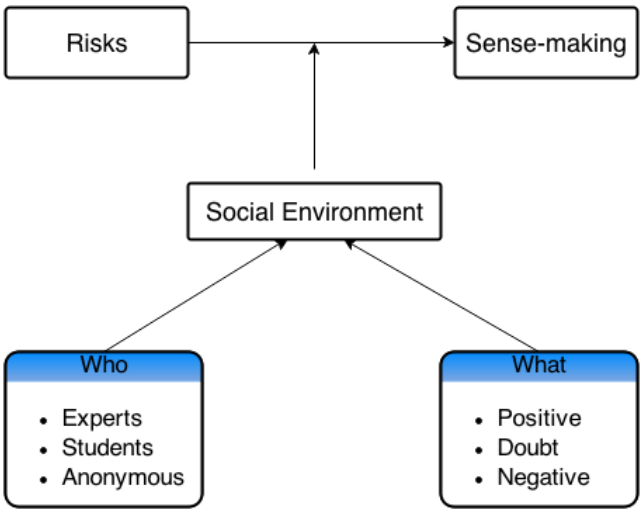

Figure 1: Conceptual Model

Method

Participants and Design

In total 65 students of the University of Twente participated in the experiment, of which 58 completed the study. A perquisite to be able to understand the content of the experiment was to be able to understand Dutch. All participants were capable of understanding Dutch and were thus able to fulfil the perquisite. The experiment was conducted in April and May 2014, in exchange for 0.5 credits (as requirement for receiving the bachelor degree). The participants were randomly assigned to nine different experimental conditions of a 3 (*interaction partner*: student vs expert vs anonymous person) x 3 (*content of information*: positive vs negative vs doubting) design. To be able to test the generated hypothesis it was necessary to identify which test was appropriate.

Table 1

Demographics of Conditions Interaction Partner and Content of Information

		Interaction partner			Content of information		
	Total	Student	Expert	Anonymous	Positive	Negative	Doubting
Gender (m/w)	22/35	7/12	8/11	7/12	7/10	7/12	8/13
Nationality (D/G)	26/30	8/11	8/10	10/9	10/7	8/10	8/13
Mean Age (SD)	22,18	22,05	22,00	22,47	22,18	22,05	22,29
	(2,79)	(2,15)	(2,24)	(3,81)	(3,19)	(2,22)	(3,04)

Note. D/G = (Dutch/German) ; SD= Standard Deviation

Procedure

First part: pre-measurement. The experiment was subdivided in two sessions. In the first part, respondents had to fill in questions related to different food products (including nanotechnology) and eating habits, and gave information about leisure time activities in an online questionnaire via ”Qualtrics”. To define the general attitude towards nanotechnology, the participants were asked to rate on seven-point-Likert scales: firstly how they were thinking about nanotechnology (1 = *very negative* and 7 = *very positive*) and secondly how important these topics were to the respondents (1 = *totally not important* and 7 = *totally*

important). The questions belonging to other topics than nanotechnology served as filler questions to hide the actual purpose of the experiment, measuring the effects of sense-making of the risks of nanotechnology in food. This should have prevented the participants from getting suspicious about the apparent intention. Finally the participants had to fill in their e-mail address to be able to send the participants the second part of the experiment three days later. The participants were guaranteed that the e-mail address is exclusively used for sending the link for the second part.

Second part: experiment. This experiment served the purpose to identify the effects of the *interaction partner*, as well as the influence of the *content of information* on the process of sense-making: the interpretation of information, searching for additional information and sharing of these. Additionally it was analyzed, how respondents rated the credibility and comprehensiveness of the responses of the apparent *interaction partner*, as well as the attitude towards nanotechnology.

The respondents received the second part of the experiment three days after finishing the first part. Each of the respondents received an individual link for the second part, spread manually through the survey tool "Qualtrics". This session consisted of a simulated chat with another participant; hereby the respondents were given the information that a student of the University of Twente or an employee of a Dutch food institute wanted to participate in the experiment. Before the respondents started the experiment, they were asked to define to which of the just mentioned groups they belong. An abstract about nanotechnology from the website of the "Rathenau Instituut" (Appendix A) was presented to the respondents to introduce the subject and to give a first slight overview. Following this, the participants were asked to give their opinion about nanotechnology in food, which occurred through talking about this topic with another participant. Subsequently the system searched for available interaction partners. While the system seemed to be connecting, the participants were requested to rate some statements about the apparent conversation partner.

To provide the anonymity of the participants, they were told that a random number was individually assigned to them. In fact there was no real conversation partner. The participants received before programmed responses, which were randomly assigned to the respondents and dependent on the particular condition of the *interaction partner*. These reports contained personal information about the interaction partner, which differed per

condition (student vs expert vs anonymous person) (Appendix B). At the end of the reports, the participants were asked to type in personal information as well. After another pretended working process of the system, the respondents received another response of the particular *interaction partner* containing information about the opinion due to nanotechnology in food. The reports, depending on the condition of the *content of information*, contained either positive or negative statements about nanotechnology or doubted the use of this nanotechnology in food (Appendix C). Following this the participants were asked to type in their opinion about the topic. The apparent conversation ended at this point.

Ensuing, the respondents again had to rate statements about the fictitious interaction partner. Furthermore questions related to the quality of the conversation and the three sense-making processes needed to be answered.

At last, the participants were asked to fill in their socio-demographic data, for instance gender and age. After answering these questions, the respondents got offered to fill in their e-mail address to receive a debriefing when the experiment is expired.

It is necessary to mention that all items, labels and reports described above in English were translated into Dutch. It should be acknowledged that it is necessary to calculate the total score of every scale to prepare the dataset for the subsequent statistical analysis.

Manipulation of Interaction Partner and Content of Information

Interaction partner. Firstly, a report containing information about the *interaction partner* was presented to the respondents. These reports differed in their content, depending on the condition. The respondents received either the information that the interaction partner was also student at the University of Twente in the student condition, the other individual was an expert of a Dutch food institute in the expert condition, or the interaction partner gave no further information, except that he or she also participated in the experiment, in the anonymous condition.

Content of information. Besides the manipulation of the *interaction partner*, there was another difference between the conditions due to the content of the responses; either the *interaction partner* was positive or negative about the risks or doubts the credibility. For instance, in case that the *interaction partner* was positive about the use of nanotechnology in food, the following response was presented to the participants: *"I think there are more*

advantages of nanotechnology in food than disadvantages. It can produce better products which are delicious and also healthy. Oh yes, and even additives which can stop vitamins or medicine in food. Sure nanoparticles can be transferred into your blood, where they can accumulate or cause damage in your cells. However I think that we do not need to worry about this. The advantages are very powerful! What do you think?" The respondents were asked to type in their own opinion about this topic, to ensure that an interaction with another individual appears to actually take place.

To further support the successfulness of the manipulation of the aforementioned variables *interaction partner* and *content of information*, it was necessary to make use of credible elements of an online conversation. Such elements were for example an initial waiting sequence to search for possible interaction partners, a working process of the chat system to send and receive messages, and an automatic transfer to the next part of the conversation. These processes were visualized by different "loading icons". The authenticity of the interaction was additionally enforced by in the reports included typing errors and counter questions, which were also pre-programmed and automatically presented to each participant.

Measures

Manipulation check. Two items were included in order to identify whether the manipulation of *interaction partner* and *content of information* was successful. Respectively one item was used to measure the effects of the manipulated variables. In order to determine the effectiveness of the manipulated variable *interaction partner*, respondents had to rate whether: "*Participant 23 is... a student*, *expert* or *I don't know"* by means of the variable *perceived interaction partner.* To measure whether the manipulation of the *content of information* worked, the respondents had to rate whether "*Participant 23 is...positive about nanotechnology in food, doubts the use of nanotechnology in food* or *is negative about nanotechnology in food."*

Interpretation of risk information. Five questions were included to identify what the information personally meant to the respondents, for example: "*It is not clear what the information about nanotechnology means to me*" and "*I'm not sure what the information of*

nanotechnology in food means to my personal situation". The statements had to be answered on seven-point-Likert scales (1 = *totally not agreeing* and 7 = *totally agreeing*, α= .84).

Searching for additional information. In order to measure the degree as to which participants intended to search additional information about nanotechnology, the following four items needed to be answered on seven-point-Likert scales (1 = *totally not agreeing* and 7 = *totally agreeing*, α= .92): *"It is likely that I'm going to search information about nanotechnology in food by myself", "I think that I'm going to search information about nanotechnology in food the next days", "I feel the need to search information about the use of nanotechnology in food by myself"* and *"After finishing this questionnaire, I'm going to search information about nanotechnology in food.*

Sharing of risk information. Four items were included to measure the intention to spread information about the risks of nanotechnology in food, for instance: "*I'm likely to share the information with my friends or family"* and *"I think I'm going to talk about nanotechnology in food the next days"*. The statements were scored on seven-point-Likert scales (1 = *totally not agreeing* and 7 = *totally agreeing*, *α*= .89).

Due to the small sample size of the target group, an analysis of the interaction of the dependent variables *interpretation, searching* and *sharing*, and the *interaction partner*, as well as the *content of information* was excluded from the measures.

Results

Manipulation check

Perceived interaction partner. To identify whether the manipulation of the *interaction partner* worked, a non-parametric Chi^2-tests was performed in order to investigate the effects of *interaction partner* and *perceived interaction partner*. The association between *interaction partner* and *perceived interaction partner* was statistically significant, $\chi^2(4) = 31.64$; $p < 0.05$. As analysis showed, participants were able to identify with which *interaction partner* they had a conversation. The distribution of the data has been demonstrated in Table 2.

Table 2

Frequencies of Perceived Interaction Partner per Condition

	Perceived interaction partner			
Interaction partner	Student UT	Expert	Anonymous	Total
Student	15	1	4	20
Expert	3	13	3	19
Anonymous	5	3	11	19
Total	23	17	18	58

Note. Student UT = Is a student of the University of Twente ; Expert = Is an expert of a food institute

Perceived content of information. To identify whether the manipulation of the *content of information* worked, a non-parametric Chi^2-tests was performed in order to investigate the effects of *content of information* and *perceived content of information*. The association between *content of information* and *perceived content of information* was statistically significant, $\chi^2(4) = 51.01$; $p < 0.05$. As further analysis showed, participants perceived the reports containing a negative content as having a doubting connotation. As the distribution of the data in Table 3 has demonstrated, participants identified the negative reports in the same manner as having a doubting content.

Table 3

Frequencies of Perceived Content of Information per Condition

	Perceived content of information			
Content of information	Positive attitude	Doubting attitude	Negative attitude	Total
Positive	14	3	0	17
Doubting	3	18	0	21
Negative	0	10	10	20
Total	17	31	10	58

Note. Positive attitude = Is positive about the use of nanotechnology in food; Doubting attitude = Doubts about the use of nanotechnology in food ; Negative attitude = Is negative about the use of nanotechnology in food

Interpretation

In order to test the hypothesis whether respondents were more secure about what nanotechnology meant to them after communicating with an expert or student compared to an anonymous person, a One-Way ANOVA was used to investigate the effects of *interaction partner* on *interpretation.* Results yielded no statistically significant effect, $F(2, 55) = 1.85$; $p = .17$.

To check whether respondents experienced an increased secureness about what the information personally meant to the respondents, after receiving positive information about nanotechnology, compared to negative or doubting the information, a One-Way ANOVA was used to investigate the effect of *content of information* on *interpretation.* Results yielded no statistically significant effect, $F(2, 55) = 1.30$; $p = .37$.

Searching

In order to check the hypothesis whether respondents experience an increased need to search for additional information about nanotechnology when the interaction partner was insecure about the value of nanotechnology in food, in comparison to rating nanotechnology in food as positive or negative, a One-Way ANOVA was used to investigate the effects of *content of information* on *searching*. Results revealed a statistically significant effect of *searching* on *content of information*, $F(2, 55) = 3.67$; $p < 0.05$. Results indicated that participants receiving *positive,* or *negative,* reports showed a slightly higher demand for searching for additional information, than those who were given a *doubting* report, as demonstrated in table 4.

In order to test the hypothesis whether respondents experienced a decreased need to search for additional information when the interaction partner is an expert or student compared to an anonymous person, a One-Way ANOVA was used to investigate the effects of *interaction partner* on *searching.* Results yielded no statistically significant effect of the *interaction partner* on *searching*, $F(2, 55) = 1{,}84$; $p = .17$).

Sharing

In order to test the hypothesis whether respondents experienced an increased need to communicate with others about the topic after receiving risk information from an expert or

student compared an anonymous person, a One-Way ANOVA was used to investigate the effects of *interaction partner* on *sharing.* It turned out that there is no statistically significant effects of *interaction partner* on *sharing,* $F(2, 55) = 2.80$; $p = .25$. In order to test the hypothesis whether respondents experienced an increased need for communicating with peers, friends or family about nanotechnology in food when the interaction partner was positive or negative about the value of the topic in comparison to being insecure about the topic, a One-Way ANOVA was used to investigate the effects of *content of information* on *sharing.* Results yielded no statistically significant effect of *content of information on sharing*, $F(2,55) = 1.65$; $p = .20$.

No further analysis of the interaction was conducted, due to the insufficient sample size of the target group. It was not tested whether there was a normal distribution, because it was relied on the robustness of the test value F.

The means and standard deviations of the dependent variables *interpretation, searching* and *sharing* and *interaction partner*, as well as *content of information* were shown in table 4.

Table 4

Mean Scores and Standard Deviations for Content of Information and Interaction Partner per Condition

		Interaction partner				Content of information		
	Total	Student	Expert	Anonymous	Total	Positive	Negative	Doubting
1.Mean	3.81	3.95	4.05	3.41	3.81	3.59	4.09	3.71
(SD)	(1.12)	(1.23)	(1.02)	(1.02)	(1.06)	(1.06)	(1.15)	(1.14)
2.Mean	3.69	3.34	3.28	4.14	3.69	4.20	3.91	3.06
(SD)	(1.42)	(1.47)	(1.35)	(1.39)	(1.42)	(1.38)	(1.47)	(1.24)
3.Mean	4.18	3.79	4.24	4.54	4.18	4.34	4.50	3.75
(SD)	(1.40)	(1.49)	(1.46)	(1.21)	(1.40)	(1.49)	(1.19)	(1.40)

Note. 1.Mean = Mean of Variable Interpretation ; 2.Mean = Mean of Variable Searching ; 3.Mean = Mean of Variable Sharing ; SD = Standard Deviation

Discussion

This paper aimed to explore how individuals process information, more specifically, how people make sense of food risk information. As previous literature showed, there was a deficiency in the knowledge of people regarding the use of nanotechnology in food. Therefore the way of processing risk information was examined by means of this example. Additionally it was analyzed to which extent the social environment had an influence on information processing. By manipulating the variables *interaction partner* and *content of information*, the current study tried to gain insight to which extent the social environment had an influence on the sense-making variables *interpretation, searching* and *sharing* of information.

Existing research concerning the impact of the social environment examined the topic of information processing mainly with regard to the social influences on individuals in general. Research in this area provided information about accompanied behavioral changes, as well as the beliefs, attitudes and knowledge of individuals. Research of Magee & Galinsky (2009) and Bonaccio & Dalal (2006) pointed out that authorities, with subscribed expertise and social status have strong impact on individuals. Further research of Salancik & Pfeffer (1978) and Deutsch & Gerard (1955) added similarity and related processes such as conformity as influential factors of social environment. Even when literature globally provided an adequate amount of information, there was little knowledge about processing information with the emphasis on the risks of nanotechnology in food. This research tried to enrich the existing literature with new insights in the field information processing.

The results of the current study demonstrated that the *content of information* influenced individual's demand for searching for information. Results indicated that participants receiving positive or negative information yielded a higher need to search information than individuals which were given reports including doubts with regard to nanotechnology in food. Even when analysis revealed an impact of the *content of information* on *searching*, the findings were contrary to hypothesis 2b, which stated that the need of individuals to search for additional information about nanotechnology increased when the interaction partner was insecure about the value of nanotechnology in food, in comparison to rating nanotechnology in food as positive or negative. A possible explanation could be related to the fears of nanotechnology in food. As research of Böl (2012) indicated, a lack of

knowledge about the use of nanoparticles in food resulted in an increased worry about potential risks. Receiving explicit positive or negative information about the risks of nanotechnology possibly could have led to a heightened concern of participants about the topic and thus animated them to build up or deepen their knowledge based on fear about nanotechnology in food. Even when the reports of the positive condition were intended to lower the risk perception, the reports still had a negative connotation, as an extract of a report of the positive condition shows: "[…] s*ure nanoparticles can be transferred into your blood, where they can accumulate or cause damage in your cells* […]*"*(Appendix C).

Further analysis demonstrated that the way people were ascribing a personal value to nanotechnology and the intention to search additional information about the topic was not influenced by the *content of information.* The findings disconfirmed the hypotheses 2a and 2c, which assumed the influence of the *content of information* on *interpretation* and *sharing* of information.

A possible explanation could be related to the confirmation bias. Due to the fact that respondents were probably aware of participating in a psychological experiment and knew that it was intended to measure a psychological occurrence, this possibly could have been influenced the way respondents answered the questions. This statement was in favor of the fact that the manipulation of the *content of information* experiment was properly constructed and simultaneously a justification why the respondents missed to ascribe the correct content to the reports. To assure that this factor did not impair the conduction of the experiment, this aspect of research can easily be tested, by conducting a pre-measurement of including the variable *content of information* and subsequently be improved and before starting further research.

In order to give a possible explanation for finding no support for the hypothesis 2c, the literature of Cialdini & Goldstein (2004) and Milgram (1963) presented two different controvertible frameworks. The first study, which stated that ambiguous information increased the need to communicate with others about the gained input, disconfirmed the hypothesis that the need for communicating with others about nanotechnology in food increased, when the interaction partner is positive or negative about the value of information. Therefore, the study presented a possible explanation for finding no effects of the *content of information* on *sharing*. Contrary to the results of this research were the findings of Milgram

(1963). The outcome of his study indicated that the opinion of an expert yielded the participant's adaption to his or her opinion. Adapting to the opinion of an expert could be understood in terms of conforming to an explicit *content of information,* in this case positive or negative information about nanotechnology in food. Thus the respondents' adaption supported the hypothesis 2c.

Furthermore the *interaction partner* had no impact on the sense-making processes; neither on *interpretation* of information, nor on *searching* for additional information about nanotechnology, nor on *spreading.* This contradicted the hypotheses 1a, 1b and 1c, which assumed that the interaction partner influenced the sense-making processes.

Based on the fact that there was no support found for the influence of the *content of information* on the sense-making processes *interpretation* and *sharing,* an explanation could possibly be received from the analysis of the manipulated variables. Results indicated that the negative condition was not perceived as such, as data showed that respondents perceived the negative reports as having a doubting connotation.

Another possible explanation of failing to support the impact of the *interaction partner* and the *content of information* on *interpretation* could be related to the knowledge of the participants about the nanotechnology. As already mentioned, research of Siegrist et al. (2009), revealed that there was not much known about nanotechnology in food in general. Even when the experiment presented some information about this topic, the facts were quite concise. It is possible that the information was not enough to improve the knowledge of participants in order to get a clear idea about what nanotechnology meant to them. Another explanation could be received from considering the egocentric bias, which states that individuals tend to overestimate their own opinions (Bonaccio & Dalal, 2006). Subsequently participants probably could have ignored information given about nanotechnology, regardless of the *content of the information* or the *interaction partner*.

The decision to exclude the analysis of the interaction of the dependent variables *interpretation, searching* and *sharing* and the *interaction partner* and *content of information* from the analysis resulted in the small sample size of the target group, which constituted 58 individuals. Even if the results of an interaction analysis would have revealed an interaction effect, the insufficient size of the target group could possibly have caused wrong assumptions.

The fact that most of the results just missed statically significance could have been related to the small sample size, as well. Raudenbush & Xiao-Feng (2001) indicated that adding more respondents would have heightened the power of analysis, thus the possibility to find an effect of the intervention would have increased, if an effect existed. Using the table of Krejcie & Morgan (1970) to determine the appropriate sample size for a target group of 9000 individuals, in this case students of the University of Twente, the necessary sample size should have consisted of 368 individuals. The retrieved sample size was based on the current number of enrolled students at the University of Twente, which was 9161 students at the time the experiment was conducted (University of Twente, 2014, June 22). Since the table of Krejcie & Morgan (1970) only presented a sample size for the given population of 9000 individuals, the total amount of students was rounded down to 9000. Furthermore the voluntary response bias might have had an impact on the availability of the experiment for the target group. Only those who had access to the link of the experiment were able to participate. This mostly concerned those, who had access to the experimenter tool SONA system. The small sample sizes reduced the possibility to find an effect, given the case that there was one.

Since many of the respondents missed to fill in the second part of the experiment, the completeness of the dataset of several respondents was not given. Possible reasons for the incompleteness could have been related to distribution problems caused by the survey program “Qualtrics”. Some respondents might have failed to receive the link to the second part of the experiment related to the fact that the e-mail might have been transferred to the spam folder of the e-mail account. Additionally there was another error with regard to filling in the second part of the experiment. After getting feedback of some respondents, it ensued that after starting the second part without completing it, the respondents were not able to start again with the experiment.

Limitations of Research

As stated in the discussion part of the current study, the upcoming limitations were derived. Neither an impact was detected for *interaction partner* on *interpretation*, *searching* and *sharing*, nor for the *content of information* on *interpretation* and *sharing*. The only support was found for the impact of *content information* on *searching*. Mostly finding no support for the hypotheses can be considered as a limitation of the current research.

Related to finding no proof for the hypotheses was the small sample size of the target group. In addition to that, the decision to exclude the measurement of interaction from the analysis was substantiated in the before mentioned small sample size.

Additional limitations were linked to the survey tool "Qualtrics". Due to the fact that there were several distribution problems, this contributed to the small sample size, as well. The access to the experiment was just available for a restricted group of students of the University of Twente. The necessary condition for participating in the study was the availability of the link.

Furthermore, it should be acknowledged that the effects drawn from the experiment cannot be generalized, due to the fact that the target group of this experiment is restricted to students of the University of Twente, only. Therefore it could not have been provided that the same results can account for other populations.

Strong Points and Implications for Future Research

The conducted reliability analysis of scale items of the dependent variables revealed a very high Cronbach's alpha for every scale. This indicated that the items used in the experiment measure validly the intended underlying construct. It was therefore assured that the results obtained from the different scales were sufficient evidence for approving or disproving the hypothesis. Because of the fact, that the items were used for the first time in the current study, the high Cronbach's alpha can be considered as a strong point of this research.

Nevertheless, it should be kept in mind that this is an explorative study and the first steps in doing research about information processing with the focus on the risks of nanotechnology in food. Due to the fact that there was not much knowledge about this topic, it was likely that the structure, as well as the conduction of the experiment showed some lapses. Additionally, it should be mentioned that the analysis of this paper was restricted to the main aspects of information processing and the influence of the social environment.

Possible implications for further research are improving the structure and the procedure of the conducted experiment. For instance the accuracy of the results could have been improved by providing a real conversation, guided by a real conversation partner instead of presenting pre-programmed responses. Comments of respondents received from the

experiment, as well as from personal communication showed, that this point is a possible influential factor in the credibility of the experiment. Feedback indicated, that some of the respondents noticed that there actually was no real conversation. This could have been prevented by conducting a laboratory experiment including the before mentioned factors. Based on the results of the analysis, a revising of the negative *content of information* text is necessary to be able to produce an efficient effect of the manipulation. Findings of prior research of Nickerson (1998), indicated that the knowledge of the respondents was possibly an influential factor, which should be included in future research to get a more precise understanding of the relationship between this variable and the process of sense-making. Moreover a broadening of the target group might have led to an additional improvement of the experiment. The expansion of the population would have provided more accuracy of the sample representing the population and therefore created the possibility to generalize the results (MacCallum et al., 1999).

The findings of this paper provided a good scientific foundation for future research. The results of the analysis gave cues about how the social environment had an influence on individuals and which additional factors could have had an impact on the process of sense-making. Even with a restricted target group and the fact that some aspects need to be reconsidered and improved; this experiment formed a good foundation to do further research. It is necessary to revise aspects with regard to the limitations of the present research, to set up subsequent research and being better able to give an answer to the question: *"What is the relevance of opinions of others in making sense of food risk information?"* Further research could more specifically modify variables such as attitude and the knowledge of participants about the use of nanotechnology in food, to get a more specific insight in the way individual deal with information and how they process it.

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Appendix A

Appendix B

Deelnemer 23 is ook online en stuurt je het volgende bericht:

"Hallo,
Ik ben, net als jij, student aan de Universiteit Twente. Kennelijk is het de bedoeling dta wij gaan praten over nanotechnologie in voeding. Wie ben jij?"

Deelnemer 23 is ook online en stuurt je het volgende bericht:

"Hallo,
Ik werk als voedingsadviseur en weet dus veel over voeding. Kennelijk is het de bedoeling dta wij gaan praten over nanotechnologie in voeding. Wie ben jij?"

Deelnemer 23 is ook online en stuurt je het volgende bericht:

"Hallo,
Ik ben deelnemer 23 en doe mee aan dit onderzoek. Kennelijk is het de bedoeling dta wij gaan praten over nanotechnologie in voeding. Wie ben jij?"

Appendix C

Deelnemer 23 heeft je het volgende bericht gestuurd:

"Ik denk dat er meer voordelen aan nano in voeding zitten dan nadelen. Het kan namelijk zorgen voor betere prodicten die lekkre zijn en toch gezond. Oh ja en zelfs toevoegingen die vitamines of medicijnen in eten kunnen stoppen of zo. Wel kunnen nanodeeltjes in je bloed komen. en daar dan dna stuk amken of zich ophopen in je cellen. Toch denk ik dat we ons hier geen zorgen over moeten maken. De voordelen zijn doorslaggevend!

Wat denk jij?"

Deelnemer 23 heeft je het volgende bericht gestuurd:

"Ik denk dat er meer nadelen aan nano in voeding zitten dan voordelen. Het kan wel zorgen voor betere prodicten die lekkre zijn en toch gezond. Oh ja en zelfs toevoegingen die vitamines of medicijnen in eten kunnen stoppen of zo. Maar nanodeeltjes kunnen ook in je bloed komen. en daar dan dna stuk amken of zich ophopen in je cellen. Daarom denk ik dat we ons hier zorgen over moeten maken. De nadelen zijn doorslaggevend!

Wat denk jij?"

Deelnemer 23 heeft je het volgende bericht gestuurd:

"Ik denk dat er zowel voor- als nadelen aan nano in voeding zitten. Enerzijds kan het zorgen voor betere prodicten die lekkre zijn en toch gezond. Oh ja en zelfs toevoegingen die vitamines of medicijnen in eten kunnen stoppen of zo. Anderzijds kunnen nanodeeltjes in je bloed komen. en daar dan dna stuk amken of zich ophopen in je cellen. Ik twijfel dus of we ons hier zorgen over moeten maken. Er zijn voordelen, maar ook nadelen.

Wat denk jij?"