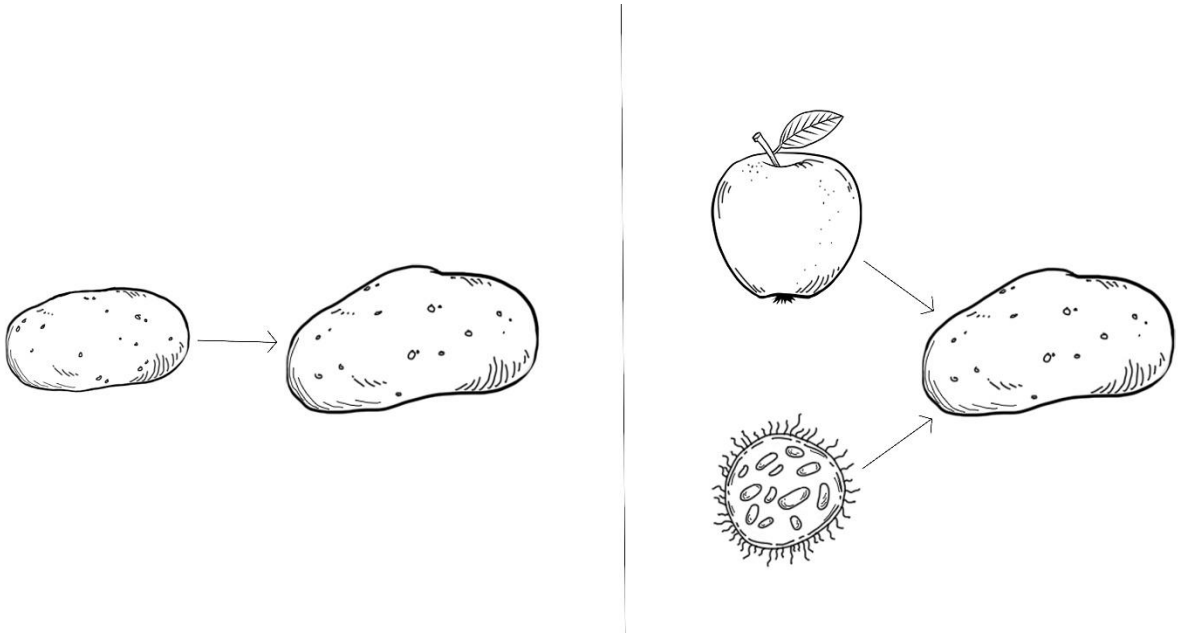
The effect of cisgenic/transgenic product information on the attitude towards GM food



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Abstract

Societal rejection towards innovative agri-food technologies, such as GM food, have hindered implementation, exploitation, and commercialisation of GM food technologies. This could be seen as a loss, since GM foods do have economic/agronomic benefits, and can have positive effects on the environmental and human health. The current research investigated whether cisgenic or transgenic plant product information could influence the attitude of European consumers towards genetically modified foods. An online internet survey was conducted wherein n = 164 Dutch consumers participated. Subsequently, to case manipulation, it was shown that the attitude towards GM food became more positively than before case manipulation. This change, however, could not be specifically attributed to any of the independent variables (a cisgenic or transgenic product, gain/loss reduction, and source of information). Surprisingly it was not shown that a transgenic product evoked higher perceived unnaturalness than a cisgenic product. The current research, therefore, contributes to the existing literature about European consumer perception of cisgenic and transgenic products since it addresses the possibly different effects of narrowly and broadly used semantics. Furthermore, it was shown that there was a discrepancy between 'knowing' to be more familiar with transgenesis and 'feeling' to be more familiar with cisgenesis. Taken together, the current research seems to indicate that European consumers do not differentiate that much between cisgenic and transgenic products as is often proposed in existing literature. These findings shed doubt on the usefulness of communicating unfamiliar terms such as 'cisgenesis' or 'cisgenic products' in communication messages, and hence on the effectiveness of using cisgenic information to influence the attitude of European consumers towards genetically modified foods.

Keywords: *genetically modified foods, cisgenesis, transgenesis, perceived unnaturalness, attitude towards genetically modified food.*

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Preface

Writing this thesis has been a fascinating experience for me. Since my Bachelor was on HBO (practical university level), reading scientific papers, writing research proposals, or doing statistics is not something that I have been acquainted with so much. Every phase of this thesis felt like a journey on its own. It was regularly only in hindsight that I could fully comprehend the feedback my supervisor provided me in the previous phase. This period has without a doubt been one of the most meaningful experiences of my academic career.

For a considerable amount of time, I have been fascinated by the effects of nutrition on human health, and consumer perception of innovative foods, and perceived risks/benefits. I have doubted for a long time whether I should focus my thesis on nanotechnology, genetically modified (GM) foods, algae, or something like 3D food printing. It was during the previous summer that I read Hamburgers in Paradise from Louise Fresco, and became more fascinated about genetically modified foods, and in particular by cisgenic and transgenic crops. In her book, she illustrates the drawbacks and vast potential of GM foods. She also addresses that politicians and the lay public do not seem to differentiate between different GM techniques, such as cisgenesis and transgenesis, while there might be reasons to do so. This sparked my interest and guided me towards my current thesis topic.

This way I would also like to express my gratitude to my supervisor dr. Arnout R. H. Fischer, for his patience, and skilful guidance throughout my thesis. For his ability to correct my sometimes flawed assumptions and to enhance my ability to think critically. Also, I would like to thank my second reader dr. Ynte van Dam for his critical analysis of my conceptual model, and his useful feedback which helped me to enhance my conceptual model. Lastly, I would also like to thank Kajsa Olsson for designing my front page cisgenic/transgenic potato, and always be there to listen to my stories about genetically modified foods.

1. Introduction

Ever since the introduction of genetically modified (GM) crops around 1990, the topic has been surrounded by a lot of public controversies (James & Krattiger, 1996). GM crops are plants used for agricultural objectives, into which genes have been inserted, or from which the genes are altered through the use of genetic engineering (Qaim, 2009). While GM food-related applications encountered a lot of controversies, GM production methods and medical applications have been encountered with considerably less concern (Bredahl, Grunert, & Frewer, 1998). When faced with severe illness, people are less likely to question the origin of medicine, because the perceived benefits of the medicine are high (Gaskell et al., 2000). Resulting in higher acceptance for GM medical applications, which are perceived as more useful and less-risky, than for GM food applications, which are associated with more risk and fewer benefits (Costa-Font, Gil, & Traill, 2008).

In spite of the broader acceptance for medical and GM production-applications (Frewer, 2017), decades later, in 2017 the use of GM food-related applications remains a highly controversial subject (Ludlow, Smyth, & Falck-Zepeda, 2013; Delwaide et al., 2015). Several factors, such as: the perception of unnaturalness, ethical concerns (Frewer et al., 2013), risks of GM food to the environment and public health (Mielby, Sandøe, & Lassen, 2013a), have guided public controversy and negative societal response towards GM foods. Resulting in worldwide consumer aversion towards GM foods, and willingness-to-pay (WTP) a premium for GM-free foods over GM food (Lusk, Jamal, Kurlander, Roucan, & Taulman, 2005; Wunderlich & Gatto, 2015). In Europe, the aversion towards GM food, and the WTP for GM-free foods is higher than in other continents such as North-America and Asia (Lusk et al., 2005; Delwaide et al., 2015). Frewer and colleagues (2013) have summarized several explanations for the higher aversion towards GM food in Europe, such as: greater negative press coverage; the lower trust of European citizens in regulating institutions responsible for the environmental protection of food production; higher availability of GM foods in North-America; and more frequent and more impactful food scares in Europe than in North-America. Societal rejection towards innovative agri-food technologies, such as GM food, have hindered implementation, exploitation, and commercialisation of GM food technologies (Frewer, 2017). From a societal and commercial perspective, this could be seen as a loss, since GM foods do have economic, agronomic benefits (Klümper & Qaim, 2014), and can have positive effects on the environmental and human health (Qaim, 2009).

In the perception of GM foods, consumers differentiate in the acceptance of animal-based and plant-based applications (Frewer et al., 2013). Overall, the worldwide perception of animal-related GM applications are more negatively associated, and less acceptable than plant-related GM applications are (Costa-Font et al., 2008; Frewer, 2017). Some authors have indicated that this is because GM animals are perceived to be more ethically intolerable than GM plants are (Knight, 2007; Frewer, Coles, Houdebine, & Kleter, 2014). Also, perceptions of unnaturalness, which is an important

determinant in the acceptance of GM foods, seems to be more determining in the case of GM animals than in the case of GM plants (Frewer et al., 2014).

There are also indications that consumers differ in their judgments of perceived (un)naturalness between different kinds of GM plant breeding techniques, such as cisgenesis and transgenesis (Schouten, Krens, & Jacobsen, 2006; Holme, Wendt, & Holm, 2013). Cisgenesis plant breeding techniques, by definition, only uses genes from the plant itself, or that of close (sexually compatible) related plants (Schouten et al., 2006). On the contrary, transgenic plant breeding techniques involve gene transfer from alien species, which are sexually incompatible with the receiving plant breed (Jacobsen & Schouten, 2008). Even though these definitions are widely used by other authors (Holme et al., 2013; Mielby et al., 2013a; Delwaide et al., 2015), some, such as de Cock et al. (2006), have criticised them. The authors criticised the demarcation between cisgenesis and transgenesis because close (sexually compatible) is too inadequately broad and ambiguous. It could thus be argued that this definition might cause measurements problems, because of the absence of an authoritative interpretation of sexually compatible species (Mielby et al., 2013a). The precise definition of borders of species, however, is not necessarily needed to make assessments of perceptions of unnaturalness, which is the primary focus of the current research. The distinction between cisgenic and transgenic products is relevant for research, namely, because cisgenesis does not trespass borders of species, while transgenesis does (Mielby et al., 2013).

Regarding the health consequences of cisgenic and transgenic plant breeding techniques, several studies have discussed the risks and benefits (de Cock et al., 2006; Schouten et al., 2006; Russell and Sparrow, 2008). Some authors such as Schouten et al. (2006), have argued that cisgenesis is safer than transgenesis because no changes in the fitness of the plant would occur, that could not happen through traditional breeding or the natural gene flow. It should be noted, however, that this point of view is not unequivocally shared by all experts (de Cock et al., 2006; Russell & Sparrow, 2008). These authors argue that the risks associated with cisgenesis and transgenesis are much closer related since it is not the origin of inserted genes that causes environmental risks, but the change in phenotype that does. Which authors are entirely right is up to discussion. Both half is more likely, but, measuring this is out of the scope of the current study. For this research, the focus will be on consumers' preferences and perceptions of the unnaturalness of cisgenic and transgenic products.

Since Europe's population is among the most aversive towards GM food (Frewer et al., 2013), it is interesting to look more narrowly into their support and perceived unnaturalness of GM food and perception of cisgenic and transgenic products. The Eurobarometer series from 1991 to 2010 provided some insight into how European consumers' attitudes towards GM food have formed and changed over time (Gaskell et al., 2010; Delwaide et al., 2015). Overall, taking into account some fluctuations, the Eurobarometer surveys seem to indicate that European citizens became more aversive towards GM food over time. European citizens did also differ in their perception of cisgenic and transgenic products. Cisgenic apples were considered to be safer, perceived as more natural, less damaging to the

environment and overall to be more useful/promising than transgenic apples. More than half of the Europeans (55%), therefore, supported cisgenesis apples, while 33% supported transgenesis apples, and only 27% supports GM food in general. Even though the majority (57%) of participants still finds cisgenic apples unnatural, this is much lower than the perceptions of unnaturalness for transgenic apples (78%), and the perception of GM food in general (76%) (Gaskell et al., 2010). Thus, it could be concluded that the support and perceived unnaturalness of GM food in Europe is much closer related to transgenic apples than to cisgenic apples. This conclusion might indicate that European consumers form their attitude towards GM food rather as their attitude towards transgenic products than towards cisgenic products.

To summarise the introduction, it has been argued that consumer attitude and acceptance of GM technology are based on its purpose of use (Costa-Font et al., 2008). The perception of GM food as being unnatural seems to be a less relevant factor for medicine, which purpose of use is seen to be more useful and less risky than for food (Siegrist, Hartmann, & Sütterlin, 2016). Also, within the perception of GM food, GM animal-related applications are less acceptable than plant-related GM applications are (Costa-Font et al., 2008; Frewer et al., 2013; Frewer, 2017). More specifically, consumers differentiate in the purpose of use between cisgenic and transgenic plant products (Gaskell., 2010). It could thus be argued that consumers' attitude varies from GM organism and the field of research in which a certain GM application is applied (Mielby, Sandøe, & Lassen, 2013b; Connor & Siegrist, 2016). Also, the specific GM techniques used to create a GM product seems to influence consumer attitude towards GM food.

Extensive research has focused on perceived (un)naturalness, the purpose of use, and the risk/benefit perception of different kinds of GM food-related applications (Costa-Font et al., 2008; Frewer et al., 2013). In contrast, there has been very little research specifically focused on cisgenic products (Wagner et al., 2014). More specifically, there is a gap of knowledge in the understanding of the effect of cisgenic or transgenic plant product information and the formation of an attitude towards GM food. Therefore, the following research question is formed:

> *What is the effect of cisgenic or transgenic plant product information on the attitude of European consumers towards genetically modified foods?*

2. Literature background

Extensive research has been conducted into consumer perception, attitude and acceptance of GM food or related applications (Bredahl et al., 1998; Bredahl, 2001; Cook, Kerr, & Moore, 2002; Connor & Siegrist, 2010). An overview of outcomes that are relevant for future research is presented. Also, an explanation why some variables that seemed logical to include in the conceptual framework, but have been left out, is given.

One regularly used model to explain behavioural intentions of consumers is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). Numerous authors have applied and slightly extended the TPB to a GM food context (Bredahl et al., 1998; Bredahl, 2001; Cook et al., 2002). These studies have shown that attitude, subjective norm and perceived behavioural control, positively influence purchase intentions of GM food, with attitude having the most substantial influence (Cook et al., 2002; Spence & Townsend, 2006). Since attitude towards GM food has the strongest impact on intentions towards GM food, focussing on this variable seems interesting as a starting point for the current research.

Public awareness and knowledge about GMO's can be of valuable insight because it could influence consumers' opinions, attitudes, and behaviours (Wunderlich & Gatto, 2015). Several authors have indicated, however, that the general consumer knowledge about GM food is low, and their ability to differentiate between different GM techniques is low as well (Mielby et al., 2013b; Lucht, 2015). Some authors have therefore suggested that increasing consumer knowledge about GM technology will increase acceptance of GM technology (Hallman, Hebden, Aquino, Cuite, & Lang, 2003; Sturgis & Allum, 2004; Costa-Font et al., 2008). Several authors, however, did not find a relationship between knowledge and increased acceptance of GM technology (Bredahl, 1999; Frewer & Scholderer, 2003). The effects of knowledge on the acceptance of GM technology, therefore, remains controversial (Connor & Siegrist, 2010). Furthermore, some authors such as Costa-Font et al. (2008) have stressed the importance of distinguishing between subjective and objective knowledge, and suggest that increased objective knowledge will result in increased consumer acceptance of GM food. A review of studies towards objective knowledge and consumer acceptance of GM food, however, showed that results are inconsistent (Connor & Siegrist, 2010). The authors indicate that it is unclear what exactly causes these inconsistencies, but, name differences in definitions of objective knowledge, and the low reliability of the used scales as possible reasons. Since the results of objective knowledge are inconsistent; this variable has not been incorporated into the conceptual framework. Another aspect of knowledge, namely how it relates to trust, seems to be more promising.

If consumers experience to have limited knowledge about a particular innovative food technology (e.g. GM food), to make decisions, they have to rely on experts whom they consider to be trustworthy (Siegrist & Cvetkovich, 2000; Connor & Siegrist, 2010). The effect of trust in a particular stakeholder (expert), and the subsequent acceptance of the information provided by the stakeholder will, therefore, be further elaborated on in the conceptual model.

3. Theoretical framework

3.1. Attitude towards GM food

In summary, societal rejection towards GM food has hindered implementation, exploitation, and commercialisation of GM food technologies (Frewer, 2017). Consumer acceptance of GM food is needed to make GM food commercialisation a success (Frewer et al., 2011). It is therefore valuable to understand how attitude formation towards GM food can be influenced since this could enhance consumer acceptance of GM food. Attitude has been defined by Eagly and Chaiken (1993, p. 1) as: "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavor." In the context of this research, the general attitude towards GM food is defined as; the psychological tendency that is expressed by evaluating GM food with some degree of favour or disfavour, resulting in acceptance or rejection of GM food as potential food choice.

3.2. Attitude towards cisgenic or transgenic product

Specifying the above-mentioned definition for attitude used by Eagly and Chaiken (1993, p. 1), on the attitude towards a cisgenic, or transgenic product, the following definition is created: the psychological tendency that is expressed by evaluating a cisgenic or transgenic plant product with some degree of favour or disfavour, resulting in acceptance or rejection of a cisgenic or transgenic plant product as potential food choice.

It has been argued that attitude formation towards GM food is formed by two different processes, namely, the top-down approach and the bottom-up approach (Grunert, Bredahl, & Scholderer, 2003). The top-down approach asserts that attitude formation towards GM food is based on more general and abstract attitudes towards technology and nature. The authors argue that these attitudes are deeply rooted and therefore cannot be easily changed. Following the top-down attitude formation, it has been argued that consumers use their strong negative attitude towards GM food, to reject GM food in general, instead of case-by-case evaluation of GM food products (Bredahl, 2001). In addition to the above-mentioned top-down attitude formation approach, it has also been argued that simultaneously with the top-down approach, there is the bottom-up attitude formation approach (Grunert et al., 2003).

According to Grunert and colleagues (2003), the bottom-up approach asserts that attitude formation towards GM foods is formed as an evaluation of the weighted average of the perceived characteristics of GM food. Following the bottom-up approach, the attitude towards GM foods could, therefore, be changed, by influencing the perceived characteristics upon which GM food is evaluated. It has been argued that essential characteristics of products may not be used in judgements because they cannot be placed into a frame of reference (Slovic, Finucane, Peters, & MacGregor, 2002). Moreover, research of Hsee (1996), has shown that the provision of new information about comparable products can influence characteristics on which both products are evaluated. Consistently

with this concept, the evaluability principle asserts that provision of new information about a comparable product can affect the evaluation of the characteristics of the product (Slovic et al., 2002). Providing consumers with details about a cisgenic or transgenic product, therefore, could create an alternative reference point upon which the characteristics of GM food is evaluated. The overall attitude towards GM food could thus be positively or negatively influenced, based on the new attributes on which a joint evaluation of either a cisgenic or transgenic product and GM food is evaluated. It is therefore hypothesised that:

H1: the attitude towards a cisgenic, or transgenic product will positively, or negatively influence the attitude towards GM food.

3.3. Risk and benefit perception

Several authors have indicated that among the most determining factors of consumer acceptance of GM foods are the perceived risks and benefits (Frewer et al., 2013; Bearth & Siegrist, 2016). Risk and benefit perception associated with GM foods are slightly increasing over time, which could suggest an increased public awareness of GM foods (Frewer et al., 2013).

In consumer research, risk perception has been defined as: "risk in terms of the consumers' perception of the uncertainty and adverse consequences of buying a product (or service)" (Dowling & Staelin, 1994, p. 119). In a meta-study related to risk perception of innovative food technologies, Bearth and Siegrist (2016) found five categories which influence risk perception. Namely: physical, moral or informational, psychological, environmental, and societal or economic risks. For the current research, risk perception is defined as: perceived negative and uncertain consequences (taking into account all afore-mentioned categories from Bearth and Siegrist), resulting from consuming cisgenic or transgenic food.

Several authors have indicated that the general public has higher and different risk perception of GM food-related applications than most of the experts do (Costa-Font et al., 2008; Siegrist et al., 2016). Furthermore, several studies demonstrated the negative influence of risk perception on the acceptance of biotechnology and GM food (Siegrist, 2000; Costa-Font & Gil, 2009; Connor & Siegrist, 2010). Consistently with these studies, it is therefore hypothesised that:

H2: perceived risks with a cisgenic or a transgenic product will negatively influence the attitude towards the cisgenic or transgenic product.

On the contrary, several studies have shown the positive effect of benefit perception on the attitude towards GM food (Costa-Font et al., 2008; Frewer et al., 2013). It has been argued that most studies towards consumer acceptance of GM food have focused on first-generation GM crops, which

primarily include farmers and GM producers-related benefits (González, Johnson, & Qaim, 2009; Connor & Siegrist, 2016). Several authors, however, have indicated that second-generation GM crops, which include consumer-related benefits such as enhanced nutritional value and health benefits, are evaluated more positively than first-generation crops (Qaim, 2009; Connor & Siegrist, 2016).

In a meta-study related to innovative food technologies, Bearth and Siegrist (2016) found four categories which influence benefit perception. Namely: personal, societal and economic, environmental and processing or qualitative benefits. For the current research, benefit perception is defined as: perceived positive outcomes (taking into account all afore-mentioned categories from Bearth and Siegrist), resulting from consuming cisgenic or transgenic food. Consistent with previous research that has shown the positive effect of benefit perception on the attitude towards GM food (Siegrist, 2000; Siegrist, Cvetkovich, & Roth 2000), it is hypothesised that:

H3: perceived benefits of a cisgenic or a transgenic product will positively influence the attitude towards the cisgenic or transgenic product.

It has been argued that risk and benefit perception of technologies are inversely related (Alhakami & Slovic, 1994). Meaning, the higher the perceived benefits, the lower the perceived risks, and the higher the perceived risks, the lower the perceived benefits. This process is guided by the affect heuristic (Slovic et al., 2002), which means that general affect changes risk and benefit perception. In the case of innovative food technologies, several authors have argued that consumer acceptance is more dependent on benefit perception than risk perceptions (Frewer et al., 2011). Specified to the GM food context, it has also been shown that benefit perceptions which are seen as important, can reduce risk perceptions (Siegrist, 2000; Frewer et al., 2011). Consistently with these findings, it is therefore hypothesised that:

H4: perceived benefits of a cisgenic or a transgenic product, will reduce risk perception of a cisgenic or transgenic product.

3.4. Perceived unnaturalness

Research suggests that the consumer acceptance of GM food is strongly dependent on perceptions of (un)naturalness (Mielby et al., 2013a; Siegrist et al., 2016). Associations with naturalness, are perceived to be almost entirely positive (Rozin, 2005). Europeans have a strong tendency to define naturalness in terms of the absence of artificial substances and human intervention (Rozin, Fischler, & Shields-Argelès, 2012). The authors, however, argue that GM foods are perceived as a form of processing, in particular, tampering with nature, which is seen as unnatural and hence negative.

Mielby et al. (2013a), created five lines of reasoning from which perceptions of naturalness, or unnaturalness, of a cisgenic or transgenic crop are justified. These arguments are based on the perception of: human interferences, mixing different species, modifying features of organisms, creating imbalances in nature, and (un)familiarity with certain GM crops. For the current research, perceived unnaturalness is defined and measured as the sum of all five categories created by Mielby et al. (2013a), to measure perceived unnaturalness.

It has been argued that cisgenic crops meet some of the consumers' moral concerns and hence are more acceptable than transgenic crops are (Mielby et al., 2013a). Moreover, Siegrist et al. (2016) have shown that consumers' perceived unnaturalness of GM crops increased perceived risks of GM food. Consistently with these findings, it is therefore hypothesised that:

H5: perceived unnaturalness of a cisgenic, or transgenic product will increase perceived risks of the cisgenic or transgenic product.

A similar, but slightly different relationship between perceived unnaturalness and perceived benefits of GM crops has been found (Siegrist et al., 2016; Siegrist & Sütterlin, 2016). The authors show that consumers perceived the same benefits for a farmer, to be lower if the farmer used GM crops than if the farmer used conventional breeding. The authors argue therefore that perceived unnaturalness and the affect associated with the GM food mediates and discounts the benefits of GM food. Consistently with these findings, it is thus hypothesised that:

H6: perceived unnaturalness of a cisgenic, or transgenic product will decrease perceived benefits of the cisgenic or transgenic product.

3.5. Cisgenic or transgenic product information

To make informed choices about the consumption of food, consumers need to consider both risks and benefits of the food (van Dijk, Fischer, & Frewer, 2011). Verdurme and Viaene (2003) found that it is exactly this kind of information, the potential health consequences (i.e. risks and benefits related to the consumption of GM food), that consumers are most interested in. Communication of risk/benefit information may influence risk/benefit perception (van Dijk et al., 2011). For the current research, risk/benefit information of a cisgenic or transgenic product will contain either a gain or a loss reduction, which will be elaborated on in the next sub-chapter.

In the research of Mielby et al. (2013a) it was shown that consumers' perceived (un)naturalness of cisgenic products made these products less risky and invasive than transgenic products. Moreover, it has been shown that people prefer plant breeding of sexually compatible plants over that of animal-to-plant transfer (Knight, 2009), and sexually incompatible species (Lusk &

Rozan, 2006; Mielby et al., 2013b). This is mainly because people tend to perceive cisgenesis to be less unnatural than transgenesis (Gaskell et al., 2010). Consistently with these findings, it is therefore hypothesised that:

H7: presentation of a product with transgenic product information will evoke higher perceived unnaturalness than the presentation of a product with cisgenic information will.

3.6. Gain or loss reduction

In addition to the provision of information about the cisgenic or transgenic product, consumers will also be provided with information related to a gain (i.e. is defined as enhanced nutritional value), or a loss reduction (i.e. is defined as a reduction in pesticide use, and subsequent residues of pesticides on the potato) of the cisgenic or transgenic crop. The inclusion of this additional independent variable into the conceptual model is based on the assumptions of Prospect theory. The theory states that the carriers of utility are losses and gains, which are reference dependent on the current or previous situation (Kahneman, 2003). Based on the assumptions of the Prospect theory, Tversky and Kahneman (1992) created a fourfold pattern of how risk attitudes are formed: in situations of high probability, people are risk aversive for gains and risk seeking for losses; in situations of low probability, people are risk seeking for gains and risk aversive for losses. Moreover, Tversky and Kahneman (1992) argue that people, in general, are loss averse and that gains and losses should be weighted differently.

Consistent with the certainty effect, it has been argued that consumers perceive the risks of GM food to be almost certain, and hence consumers' response is to avoid them (Nelson, 2001). Moreover, consumers perceived uncertain risk consequences to health and environment, results in an evaluation of uncertain future losses and present benefits for producers and manufacturers of a GM food product. Consumers tend to weigh uncertain future losses higher than current benefits, and hence in particular when benefits are low or not visible, consumers will weigh perceived potential future losses over the gain of the perceived benefits (Nelson, 2001).

Consistently with findings mentioned above, it is therefore assumed that in the case of enhanced nutritional value (gain), consumers will be less willing to engage in perceived risk-seeking behaviour (e.g. consumption of GM food), than in the case of reduction of pesticide use (reduction of a perceived health loss). It is therefore hypothesised that:

H8: presentation of a cisgenic or transgenic product that avoids losses will lead to lower perceived risks than the presentation of a product that creates a gain.

H9: presentation of a cisgenic or transgenic product that creates a gain will lead to lower perceived benefits than the presentation of a product that avoids losses.

3.7. Trust

Research suggests that trust is a key determinant in the acceptance of GM food (Frewer, Scholderer, & Bredahl, 2003; Gutteling, Hanssen, van der Veer, & Seydel, 2006). Moreover, it has been argued that trust allows consumers to make choices in the absence of knowledge about a certain topic (Gutteling et al., 2006). Also, consumers use trust in assessing credibility and accessibility of GM food-related sources (Costa-Font et al., 2008). A closely related topic, social trust, has been defined as: "people's willingness to rely on experts and institutions in the management of risks and technologies" (Frewer et al., 2003, p. 2). For the current research, trust is defined as: consumers' willingness to rely on experts and institutions in the management of GM food product information.

Trust is doubted when the communicator is perceived to be incompetent, not credible, or behaving only out of self-interest (Gaskell et al., 2010). Moreover, consumers are more willing to trust sources, or experts that have similar values as perceived to be related to themselves (Cook et al., 2002). It has been argued that the acceptance of GM food-related messages is dependent on the level of trust which receivers have in the information source (Verdurme & Viaene, 2003). Consistently with these findings, it is therefore hypothesised that:

> *H10: the level of trust in the source will influence the relation between the information of a cisgenic, or a transgenic product, and the perceived unnaturalness of the product.*

3.8. Stakeholder

Costa-Font et al. (2008) argue that consumer trust is higher for sources (stakeholders) that are perceived to be involved in protecting the well-being of the consumer and the environment. The authors indicate that trust in consumer organisations and environmental non-governmental organisations (NGO's) therefore is the highest. Also, the authors argue that the trust in the biotech sector and the European Union is lower. Consistently with the finding of Costa-Font et al. (2008), Eurobarometer surveys report that medical doctors and consumer organizations are rated among the highest trusted; average trust is being placed into environmental groups and media such as newspapers and magazines; the least trust is being placed in the European Union, the government and the biotech industry (Gaskell et al., 2010).

For the current research, the following stakeholders are selected: an environmental NGO (i.e. Greenpeace), as a higher trusted stakeholder and a biotech company (i.e. Syngenta), as lower trusted stakeholder. Consistently with the findings mentioned above of Costa-Font et al. (2008), and Gaskell et al. (2010), it is expected that consumers' level of trust will be dependent on the kind of stakeholder.

3.9. Pro-environmental personal norms

When consumers experience green consumerism to be closely related to the self-identity, environmental concerns are used as a motivation to avoid the purchase of GM food (Cook et al., 2002). A theory that takes into account altruistic (pro-environmentalism) behaviour, is the norm activation theory (Schwartz, 1977). Central to this theory is the idea that altruistic behaviour is influenced by the feelings of moral obligation to act accordingly to one's personal norms (Honkanen, Verplanken, & Olsen, 2006). Personal norms have been defined by Schwartz as: "self-expectations that are based on internalized values" (as cited in Harland, Staats, & Wilke, 1999, p. 2507). For the current research, pro-environmental personal norms have been defined as the definition used by Annika, Nordlund and Garvil (2003, p. 341): the consumers' "perceived moral obligation to act and protect the environment, based on general and environmental values".

It has been argued that a pro-environmental attitude influences risk perception of new technologies, such as gene technology (Siegrist, 1998). Moreover, Costa-Font et al. (2008) argue that individual values, such as environmentalism, condition risk and benefit perceptions of GM food. This could explain why some studies have found that pro-environmental personal norms reduced acceptance of GM technology (Siegrist 1998), and enhanced rejection of GM foods (Tanner & Wölfing Kast, 2003). Moreover, it has been argued that consumers use morality as a value to express concerns or threats about the use of bioengineering to the environment (Durant & Legge, 2006). Specifying this to cisgenic and transgenic crops, it has been shown that cisgenic crops meet some of the consumers' perceptions of unnaturalness and moral concerns, and hence are more acceptable than transgenic crops are (Mielby et al., 2013a). Combining the elements mentioned above, it is hypothesised that:

> *H11: consumers' pro-environmental personal norms will strengthen the relationship between perceived unnaturalness and perceived risks of a cisgenic or transgenic product.*

> *H12: consumers' pro-environmental personal norms will strengthen the relationship between perceived unnaturalness and perceived benefits of a cisgenic or transgenic product.*

3.10. Conceptual framework

Summarizing all hypotheses mentioned above results in Figure 1.

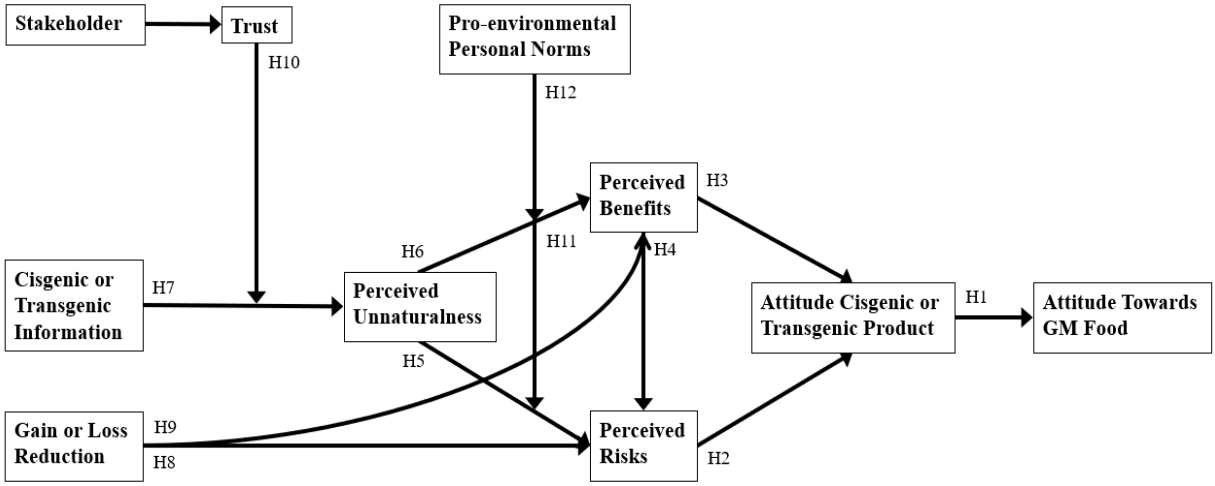

Figure 1. Conceptual framework attitude towards GM food.

4. Methodology

4.1. Participants and design

The goal of the current research is to answer the following research question:

> *What is the effect of cisgenic or transgenic plant product information on the attitude of European consumers towards genetically modified foods?*

As a starting point to answer this research question, one member-state of Europe, the Netherlands, has been selected as the target population. Therefore, the sample selected for this research consisted merely of Dutch consumers. The research design of the current research was a randomised experiment. The experiment had a 2 x 2 x 2 design: with the product (i.e. a cisgenic or a transgenic crop) as the first independent variable; a gain (i.e. enhanced nutritional value) or a loss reduction (i.e. reduced pesticide use) as second independent variable; the stakeholder (i.e. an NGO (Greenpeace) or a biotech company (Syngenta)) as the third independent variable. As data collection method, an online internet survey was used. For the online internet survey, the online survey software of Qualtrics was used. To ensure a reasonable level of statistical power and therefore enhance the probability of correctly rejecting or accepting a hypothesis, each combination of product, gain or loss reduction, and source consisted of at least 20 participants.

4.2. Manipulation

In this section, the cases that were provided to the Dutch consumers are described, exactly as how they were presented to the participants. In the real survey, the only difference was that underlined words were no longer underlined. The cisgenic or transgenic apple cases used in the Eurobarometer survey (Gaskell et al., 2010) (see Appendix A), were used as example cases, to create the cisgenic and transgenic cases used for the current research.

It has been argued that risk/benefit perception and attitude towards potatoes are rather neutral (van Dijk, Fischer, de Jonge, Rowe, & Frewer, 2012). For the current research, potatoes were, therefore, suited as case manipulation object. For both cases, potatoes have been selected as an example product to be either enhanced with cisgenic GM techniques or transgenic GM techniques. In addition to the product, each participant was provided with two additional manipulations, related to the gain or loss reduction, and to the source of information. Two example cases are presented in the current section (see Appendix B for all eight manipulation cases).

Cisgenic potato with enhanced nutritional value, source Greenpeace:

In a recent newsletter from Greenpeace, a worldwide operating environmental organization, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes nutritional value has been enhanced by the use of genetic engineering. The potato, therefore, has enhanced values of vitamin A and C. The technique used to enhance the nutritional value of the potato only used genes from the gene pool of the potato cultivar or that of crossable potatoes, and put these into the potato.

Transgenic potato with reduced pesticide use, source Syngenta:

In a recent newsletter from Syngenta, a worldwide operating biotech company, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes disease resistance has been enhanced by the use of genetic engineering. Pesticide use and subsequent residues of pesticides on the potato, therefore, are reduced to a minimum. The technique used to enhance the disease resistance of the potato used genes from the gene pool of not crossable plants, or bacterium, and put these into the potato.

4.3. Measurement

It has been argued that analyses of perceived unnaturalness are regularly conducted in general terms, and hence fail to explain what characteristic of unnaturalness people refer to when answering questions about unnaturalness (Mielby et al., 2013a). For the current research, perceived unnaturalness was therefore measured on five different items, which is based on the five different lines of reasoning created by Mielby et al. (2013a), used to characterise cisgenic or transgenic crops as to be more or less unnatural. The items included: human interference versus no human interference; mixing different species versus not mixing different species; modifying features of organisms versus not modifying features of organisms; creates imbalances in nature versus not creating imbalances in nature; familiarity with the technique versus no familiarity with the technique. To measure perceived unnaturalness, the items were measured on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). Perceptions of unnaturalness were measured by the use of the following questions:

To what extent do you disagree or agree with the following statements?

This technique is a form of human interference.

This technique is a form of mixing different species.

This technique is a form of modifying features of organisms.

This technique creates imbalances in nature.

I am familiar with this kind of technique.

Perceived risks were measured on five items, which is based on the risk categories found by Bearth and Siegrist (2016), to be most important for innovative food technologies, such as GM food. The items included: physical risk versus no physical risk; psychological risk versus no psychological risk; moral concerns versus no moral concerns; environmental concerns versus no environmental concerns; societal/economic risk versus no social/economic risk. The items of perceived risks were measured on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). Risk perception was measured by the use of the following questions:

To what extent do you disagree or agree the following statements:

This technique creates physical risks for me.
This technique makes me anxious.
I have moral concerns with this technique.
This technique creates risks to the environment.
This technique creates societal or economic risks.

Perceived benefits were measured on four items, which is based on the benefit categories found by Bearth and Siegrist (2016), to be most important for innovative food technologies, such as GM food. The items included: physical benefits versus no physical benefits; processing benefits versus no processing benefits; environmental benefits versus no environmental benefits; societal/economic benefits versus no societal/economic benefits. The items of perceived benefits were measured on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). Benefit perception was measured by the use of the following questions:

To what extent do you disagree or agree with the following statements:

This technique creates physical benefits for me.
This technique creates production or processing benefits.
This technique creates benefits for the environment.
This technique creates societal or economic benefits.

Attitude towards a cisgenic or transgenic product was measured on a three item, 7-point semantic differential scale used by Bredahl (2001). The items included: bad technique versus good technique; foolish technique versus wise technique; against technique versus for technique. Attitude towards a cisgenic or transgenic product was measured by the use of the following questions:

To what extent do you disagree or agree with the following statements:

Applying this kind of technique to enhance the nutritional value/disease resistance of a potato is…

To be answered on a 7-point semantic differential scale, range from: ‘extremely bad’ to ‘extremely good’

To be answered on a 7-point semantic differential scale, range from: ‘extremely foolish’ to ‘extremely wise’

Applying this kind of technique to enhance the nutritional value/disease resistance of a potato is something that I am…

To be answered on a 7-point semantic differential scale, range from: ‘strongly against’ to ‘strongly for’

Attitude towards GM food was measured by the use of a prior attitude measurement and a post attitude measurement. For both measurements, different multi-item semantic-differential measurement scales were used. This method was used, because it has been argued that the use of different prior and post attitude scales, reduce biases (Frewer, Scholderer, & Bredahl, 2003), and potential repetition or reactivity effect (van Dijk et al., 2012). The prior attitude measurement towards GM food was measured as a pre-test, before interventions. The prior attitude measurement of attitude towards GM food was based on the four-item semantic differential scale used by van Dijk et al. (2012) to measure prior attitudes. The items included: bad versus good; unfavourable versus favourable; undesirable versus desirable; inappropriate versus appropriate. The items were measured on a 7-point semantic differential scale. The following questions were used to measure prior attitude towards GM food:

What do you generally think about genetically modified foods:

For me genetically modified foods are…

To be answered on a 7-point semantic differential scale, range from: ‘very bad’ to ‘very good’

To be answered on a 7-point semantic differential scale, range from: ‘very unfavourable’ to ‘very favourable’

Genetically modified foods are something I find…

To be answered on a 7-point semantic differential scale, range from: ‘very undesirable to ‘very desirable’

To be answered on a 7-point semantic differential scale, range from: ‘very inappropriate’ to ‘very appropriate’

The post attitude measurement of attitude towards GM food was based on the four-item semantic differential scale used by van Dijk et al. (2012) to measure post attitudes. The items included: disliking versus liking; disagreeing versus agreeing; unsatisfactory versus satisfactory; negative versus positive. The items were measured on a 7-point semantic differential scale. The following questions were used to measure post attitude towards GM food:

What do you generally think about genetically modified foods:

Genetically modified foods are something I…

To be answered on a 7-point semantic differential scale, range from: ‘strongly dislike’ to ‘strongly like’

To be answered on a 7-point semantic differential scale, range from: ‘strongly disagree with’ to ‘strongly agree with’

For me genetically modified foods are…

To be answered on a 7-point semantic differential scale, range from: ‘strongly unsatisfactory’ to ‘strongly satisfactory’

To be answered on a 7-point semantic differential scale, range from: ‘very negative’ to ‘very positive’

Trust was measured by the usage of four items, which is based on the factors of trust found in the research of Lang and Hallman (2005). The items included: trust in competence stakeholder versus no trust in competence stakeholder; trust in stakeholder to be transparent versus no trust in stakeholder to be transparent; trust in stakeholder to do good for society versus no trust in stakeholder to do good for society; trust in source to tell the truth versus no trust in source to tell the truth. The 5-point Likert scales used by Lang and Hallman (2005) to measure trust, was adapted to a 7-point Likert scale. The items of trust were, therefore, measured on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). To measure trust, the following questions were used:

To what extent do you disagree or agree with the following statements:

I feel confident in the competencies of the source.

The source of this information is useful for information about GM foods.

The source of this information will do what is right for society.

The source of this information will tell the truth about GM foods.

Pro-environmental personal norms were measured by the usage of four items, which is based on the scales used by Tanner and Wölfing Kast (2003), to measure personal environmental norms. The items of pro-environmental personal norms were measured on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree). Pro-environmental personal norms were measured by the use of the following questions:

To what extent do you disagree or agree with the following statement?

Everybody has a responsibility to contribute to environmental preservation by avoiding packaged food products.

Everybody should make a contribution to promoting green food production by buying only green products.

Consumers have the right to buy exotic fruits.

I feel morally obligated to refrain from eating the meat of animals kept inhumanely.

4.4. Demographic and background variables

After all variables of the conceptual model had been measured, demographic and background variables were measured. The following items were measured: age, gender, highest completed educational background and knowledge about cisgenesis and transgenesis. To measure these items, the following questions were asked:

What is your age? (number: 16-99)

What is your gender? (range: male/female/other)

What is your highest level of school or degree that you have completed? (range: primary school, VMBO, HAVO, VWO, MBO, HBO, WO)

Are you familiar with cisgenesis (range: yes/no)

Are you familiar with transgenesis (range: yes/no)

Measurements of the current research were conducted in Dutch. A Dutch version of the survey has therefore been added (see Appendix D).

4.5. Procedure

Participants of the current research started the online survey with an introductory paragraph related to the purpose of the survey; namely, to measure public opinion of Dutch consumers towards food products which qualities have been enhanced. In this introductory paragraph, it was also stated that participants would remain anonymously and that their answers will be treated confidentially. Before case manipulation, all participants of the current research started with the pre-test (i.e. to measure prior attitude towards GM food).

Afterwards, each participant was randomly subdivided into one of the eight groups. Half of the groups were provided with a cisgenic potato and half of the groups with a transgenic potato. Half of the groups were provided with a case in which the nutritional value of the potato has been enhanced, and half of the groups were provided with a case in which the pesticide use on the potato has been reduced. In addition, half of the groups were provided with an environmental NGO (i.e. Greenpeace) as source of information, and half of the groups were provided with a biotech company (i.e. Syngenta) as the source of information.

Each participant was provided with the same order of questions. In descending order, the questions asked were: perceived unnaturalness, perceived risks, perceived benefits, attitude towards a cisgenic or transgenic product, trust in the source of information, pro-environmental personal norms and post attitude towards GM food. After the experiment had ended participants were asked to provide background and demographic information (i.e. age, gender, educational level, and knowledge about cisgenesis and transgenesis).

5. Results

5.1. Descriptive statistics and reliability

From the pilot surveys we conducted, it came forward that the survey took about 5-10 minutes to complete. To enhance internal validity of the research results, surveys completed in less than 60 seconds are considered to be unobjective, and hence five surveys completed in less 60 seconds have been left out of the data analysis. Also, one survey was removed because of a very unlikely response pattern of only ones throughout the survey. After removal of unobjective completed surveys, $n = 164$ participants were used for data analysis, of which $n = 145$ surveys were completed at full. The experimental design of the research included a 2 (cisgenic/transgenic product) x 2 (gain/loss reduction) x 2 (NGO/biotech company) design. Table 1 represents the randomization of the experiment.

Table 1

Randomization Experiment

Experimental condition	**participants**
Cisgenic potato	$n = 83$
Transgenic potato	$n = 81$
Enhanced nutritional value	$n = 83$
Reduced pesticide usage	$n = 81$
Greenpeace as source	$n = 82$
Syngenta as source	$n = 82$

Before further data analysis and hypothesis testing, all variables included from the conceptual model are tested on their Cronbach's Alpha value. This value is used as an indicator, to estimate if the underlying items (questions) measure the same construct (variable). In table 2 Reliability measurement, for each measured variable, the number of items and Cronbach's Alpha value will be presented. Whenever the Cronbach's Alpha is below .7, to enhance the internal consistency of a variable, items might be deleted. For the variables wherein items have been removed, or a Cronbach's Alpha of lower than .7 is used, additional elaboration is provided.

Table 2

Reliability Measurement

Measured concept	**Items**	**Cronbach's Alpha**	**Cronbach's Alpha after deleted item**
Prior attitude towards GM food	4	$\alpha = .974$	
Perceived unnaturalness	5	$\alpha = .303$	$\alpha = .558$
Perceived risk	5	$\alpha = .833$	
Perceived benefits	4	$\alpha = .779$	
Attitude towards GM product	3	$\alpha = .932$	
Post attitude towards GM food	4	$\alpha = .975$	
Pro-environmental personal norms	4	$\alpha = .571$	$\alpha = .724$
Trust	4	$\alpha = .811$	

The initial Cronbach's Alpha of perceived unnaturalness (α = .303**)** was very low. One of the questions measuring perceived unnaturalness, the acquaintance with the techniques used to manipulate the potato, was reverse coded. This might have caused the low Cronbach's Alpha. Removal of this question led to a substantial enhancement of the Cronbach's Alpha (α = .558). Even though this Cronbach's Alpha value is still below .7, no further items have been deleted, since factor analysis and reliability analysis indicated that removal of other items would only increase the Cronbach's Alpha very slightly (Δ α = .019).

The initial Cronbach's Alpha of pro-environmental personal norms (α = .571) was low. One of the questions measuring pro-environmental personal norms, whether consumers think that buying exotic fruit is tolerated, was reverse coded. This might have caused the low Cronbach's Alpha. When testing with the full scale, we did not find any relevant differences compared to testing with the removal of the reverse coded question. Thus, showing that the results are robust, to retain information, the item has been left in the construct of pro-environmental personal norms.

From the participants that filled in the questions about the control variables, the following statements can be made: The age of the participants is between 17 and 73 years old (*M* = 28.15, *SD* = 13.56). Of the participants, 48.3 % is male and 51.7% of the participants if female. The educational background of the participants is summarized in table 3 For further data analysis, the educational background will be recoded as VMBO = low educational level; HAVO, MBO and VWO = medium educational level; HBO and WO = high educational level.

Table 3

Educational Background

Highest achieved level	*n*	%	Low education	Medium education	High education
VMBO	4	2.8	2.8%, *n* = 4		
HAVO	13	8.9			
VWO	22	15.2			
MBO	14	9.7		33.8%, *n* = 49	
HBO	36	24.8			
WO	56	38.6			63.4%, *n* = 92

The following statements can be made about the knowledge of the participants about cisgenic or transgenic plant breeding techniques: is familiar with cisgenic (*n* = 29, % = 19.9), is not familiar with cisgenic (*n* = 117, % = 80.1), is familiar with transgenic (*n* = 37, % 25.2), is not familiar with transgenic (*n* = 110, % = 74.8).

A bivariate correlation analysis was conducted, to analyse the relationship between the control variables and the variables in the conceptual model. Results are summarised in Table 4. of the Appendix E. If control variables are significantly correlated to several variables used in the conceptual model, they will be used for further analysis. Age is significantly correlated to pro-environmental

personal norms (p <.05, r = .24). Gender is significantly correlated to risk perception (p <.01, r = .27), benefit perception (p <.01, r = -.22), attitude towards a cisgenic or transgenic product (p <.01, r = -.22), prior attitude towards GM food (p <.01, r = -.26), post attitude towards GM food (p <.05, r = -.20), and pro-environmental personal norms (p <.01, r = .31). The educational background is significantly correlated (p <.01, r = .24) to pro-environmental personal norms, and perceived unnaturalness (p <.05, r = -.18). Knowledge about cisgenic plant breeding techniques is not significantly correlated to any variables in the model. Knowledge about transgenic plant breeding techniques is significantly correlated (p <.05, r = -.20) to prior attitude towards GM food. Since gender and educational background are significantly correlated to several variables in the conceptual model, these variables were used as control variables for further data analysis.

5.2. Hypothesis testing

To test the hypothesis of the conceptual framework, several (multiple) linear regressions have been conducted. The findings of these analyses are summarised on the next page in table 5 Regression models predicting post attitude GM food, attitude cisgenic or transgenic product, risk perception, benefit perception, and perceived unnaturalness. All model assumptions of linear regression: normality, homoscedasticity (constant variance), linearity, independence, and absence of multicollinearity have been met.

Table 5

Regression Models Predicting Post Attitude GM Food, Attitude Cisgenic or Transgenic Product, Risk Perception, Benefit Perception, and Perceived Unnaturalness (Only Hypothesised Relations are Shown)

Variable	Post attitude GM food			Attitude cis/trans product			Risk perception			Benefit perception			Perceived unnaturalness		
	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI
Gain or loss reduction (0 loss reduction, 1 enhanced)							-0.11	-0.683	[-0.42, 0.21]	-0.20	-1.154	[-0.54. 0.14]			
Cisgenic or transgenic product (0 cis, 1 trans)													0.12	1.571	[-0.03, 0.27]
Attitude cis/trans product	0.97**	26.318	[0.89, 1.04]												
Risk perception				-0.33**	-4.853	[-0.47, -0.20]									
Benefit perception				0.62**	7.798	[0.46, 0.78]	-0.67**	-8.682	[-0.83, -0.52]						
Perceived unnaturalness							0.30**	3.454	[0.13, 0.46]	-0.11	-1.212	[-0.30, 0.07]			
Pro-environmental personal norms							0.05	0.547	[-0.13, 0.22]	-0.10	-1.012	[-0.29, 0.09]			
Naturalness*norms							0.02	0.174	[-0.13, 0.16]	-0.01	-0.131	[-0.17, 0.15]			
Trust													-0.10	-1.201	[-0.25, 0.06]
Cis/trans product*trust													0.04	0.469	[-0.12, 0.19]
Gender (1 male, 2 female)	0.02	0.23	[-0.16, 0.20]	-0.06	-0.42	[-0.32, 0.21]	0.28	1.699	[-0.05, 0.60]	-0.37*	-2.073	[-0.72, -0.02]	0.12	0.782	[-0.19, 0.43]
Education (1 low, 2 medium, 3 high)	<0.01	0.04	[-0.16, 0.16]	0.12	1.04	[-0.11, 0.36]	0.12	0.808	[-0.18, 0.60]	<0.01	-0.030	[-0.33, 0.32]	-0.36*	-2.486	[-0.64, -0.07]
	$F(3, 141) = 242.489$, $p < .001$ $R^2 = .84$			$F(4, 140) = 55.770$, $p < .001$ $R^2 = .61$			$F(7, 137) = 16.609$, $p < .001$ $R^2 = .46$			$F(6, 138) = 2.045$, $p = .064$ $R^2 = .08$			$F(5, 139) = 2.015$, $p = .08$ $R^2 = .07$		

Note. * = $p < .05$, ** = $p < .01$

Attitude GM food

A multiple linear regression analysis to predict attitude towards GM food was conducted, with gender and educational background as the covariates, and, attitude towards a cisgenic or transgenic product as the predictor variable. The covariates, gender ($t(141) = 0.232$, $p = .817$), and educational background ($t(141) = 0.041$, $p = .968$) had no significant effect on the attitude towards GM food. It was shown that the attitude towards a cisgenic or transgenic product is a significant predictor of the attitude towards GM food ($\beta = 0.970$, $t(141) = 26.318$, $p < .001$). These findings are in line with hypothesis 1, hence hypothesis 1 is confirmed.

Attitude cisgenic or transgenic product

A multiple linear regression analysis to predict attitude towards a cisgenic or transgenic product was conducted, with gender and educational background as the covariates, and, risk perception and benefit perception as the predictor variables. The effect of the covariates gender ($t(140) = -0.421$, $p = .674$) and educational background ($t(140) = 1.036$, $p = .302$) was not significant. Furthermore, it was shown that risk perception of a cisgenic or transgenic product significantly predicted the attitude towards a cisgenic or transgenic product ($\beta = -0.330$, $t(140) = -4.853$, $p < .001$). This indicates that risks perception of a cisgenic or a transgenic product negatively influences the attitude towards the cisgenic or transgenic product. These findings are consistent with hypothesis 2; hypothesis 2 is thus confirmed. Also, it was shown that benefit perception of a cisgenic or transgenic product is a significant predictor of the attitude towards a cisgenic or transgenic product ($\beta = 0.619$, $t(140) = 7.798$, $p < .001$). This indicates that benefit perception of a cisgenic or a transgenic product positively influences the attitude towards the cisgenic or transgenic product. Providing support for hypothesis 3, thus hypothesis 3 is accepted.

Risk perception

To predict risk perception, a multiple linear regression, with gender and educational background as the covariates; and, benefit perception, gain or loss reduction, perceived unnaturalness, pro-environmental personal norms, and the interaction effect of perceived unnaturalness and pro-environmental personal norms as predictor variables was conducted. The effect of gender ($t(137) = 1.699$, $p = .092$) and educational background ($t(140) = 0.808$, $p = .420$) was non-significant. Benefit perception significantly predicted risk perception ($\beta = -0.672$, $t(137) = -8.682$, $p < .001$). This indicates that the risk perception of a cisgenic or transgenic product is reduced by the benefit perception of a cisgenic or transgenic product. Providing support for hypothesis 4, hence hypothesis 4 is confirmed. Also, it was not shown that a gain or loss reduction was a predictor of risk perception ($t(137) = -0.683$, $p = .496$). This indicates that it not has been shown that a loss reduction (reduced pesticide usage and subsequent residues on the potato) lead to lower perceived risks than a gain (e.g. enhanced nutritional value of the potato). These findings do not provide support for hypothesis 8; hence hypothesis 8 is not

accepted. In addition, it was shown that perceived unnaturalness was a significant predictor of risk perception (β = 0.295, $t(137) = 3.454$, $p < .001$). This indicates that perceptions of unnaturalness of a cisgenic, or a transgenic product, increases perceived risks of a cisgenic or transgenic product. These findings provide support for hypothesis 5; hence hypothesis 5 is accepted. We found no effect of pro-environmental personal norms on the risk perception of a cisgenic or transgenic product ($t(137) = 0.547$, $p = .586$). Moreover, the interaction effect of perceived unnaturalness and pro-environmental personal norms on risk perception was not significant ($t(137) = 0.174$, $p = .862$). It has therefore not been shown that pro-environmental personal norms strengthen the influence of perceived unnaturalness on perceived risks. These findings do not provide support for hypothesis 11; thus hypothesis 11 cannot be accepted.

Benefit perception

A multiple linear regression analysis to predict benefit perception was conducted, with gender and educational background as covariates; and, gain or loss reduction, perceived unnaturalness, pro-environmental personal norms, and the interaction of perceived unnaturalness and pro-environmental personal norms as predictor variables. It was shown that gender significantly predicted benefit perception (β = -.369, $t(138) = 2.073$, $p < .05$). This indicates that benefit perception of a cisgenic or transgenic product is lower for women than for men. The effect of educational background on benefit perception was not significant ($t(138) = -0.030$, $p = .976$). The effect of a gain or a loss reduction on risk perception was not significant ($t(138) = -1.154$, $p = .251$). This indicates that a gain (e.g. enhanced nutritional value of a potato), does not lead to lower perceived benefit perception than a loss reduction (reduced pesticide usage and subsequent residues on the potato). Providing no support for hypothesis 9, thus hypothesis 9 cannot be accepted. In addition, we also did not found support for the effect of perceived unnaturalness ($t(138) = -1.212$, $p = .228$), and pro-environmental personal norms ($t(138) = -1.012$, $p = .313$) on benefit perception. Moreover, the interaction effect of perceived unnaturalness and pro-environmental personal norms on benefit perception was also not significant ($t(138) = -0.131$, $p = .896$). The data seems therefore not to indicate that perceived unnaturalness reduced benefit perception, neither that this relationship is moderated by pro-environmental personal norms. Providing no support for hypothesis 6, and hypothesis 12; hence hypothesis 6 and 12 cannot be accepted.

Perceived unnaturalness

A multiple linear regression analysis to predict perceived unnaturalness, with gender and educational background as the covariates; and a cisgenic or transgenic product, trust in the source of information, and the interaction effect of a cisgenic or transgenic product and the trust in the source of information as predictor variables was conducted. The effect of gender on perceived unnaturalness was not significant ($t(139) = 0.782$, $p = .436$). It was shown that educational background is a significant predictor of perceived unnaturalness ($t(139) = -2.486$, $p < .05$). This seems to indicate that

the higher the educational level is, the less a cisgenic or transgenic product is perceived to be unnatural. To further test this assumption, the interaction effect of educational background and a cisgenic or transgenic product on perceived unnaturalness was tested. This effect, however, was not significant ($t(140) = -1.547$, $p=.124$). It could therefore not be concluded that the different educational background had a significant effect on the relationship between a cisgenic or transgenic product and perceived unnaturalness. Also, we did not found a significant effect of a cisgenic or a transgenic product on perceived unnaturalness ($t(139) = 1.571$, $p = .118$). It has therefore not been shown that transgenic products evoke higher perceived unnaturalness than cisgenic products. Providing no support for hypothesis 7, and thus hypothesis 7 is rejected. It also was not shown that that trust in the different stakeholders (e.g. Greenpeace and Syngenta) had a significant effect on perceived unnaturalness ($t(139) = -1.201$, $p = .232$). Moreover, it was not shown that the interaction effect of a cisgenic or transgenic product and the trust in the different stakeholders influenced the relation between a cisgenic, or a transgenic product, and perceived unnaturalness ($t(139) = 0.469$, $p = .640$). Providing no support for hypothesis 10, hence hypothesis 10 cannot be accepted.

5.3. Other outcomes

A paired sample t-test indicated that for all experimental conditions, prior attitude measurement was significantly ($t(150)= -3.752$, $p < .001$) more negative associated ($M = 4.14$, $SD = 1.49$), than post attitude measurement was ($M = 4.45$, $SD = 1.28$).

A three-way ANOVA with gender and educational background as the covariates; all experimental (cis/trans product, gain/loss reduction, and source of information), the interaction effect of product and gain/loss reduction, product and source, and, gain/loss reduction and source, as the independent variables; and attitudinal change (post attitude GM food - prior attitude GM food) as the dependent variable was conducted. The effect of the control variables gender ($F(1, 136) = 2.347$, $p = .128$), and educational background ($F(1, 136)= 0.271$, $p = .603$), on attitudinal change was not significant. None of the experimental conditions, a cisgenic or transgenic product ($F(1, 136) = 0.009$, $p < .926$), gain or loss reduction ($F(1, 136) = 0.899$, $p = .345$), and trust in source of the information ($F(1, 136) = 0.175$, $p = .676$) had a significant effect on attitudinal change. Furthermore, none of the interaction effects, product and gain/loss reduction ($F(1, 136) = 0.521$, $p = .472$), product and source ($F(1, 136) = 0.152$, $p = .697$), and gain/loss reduction and source ($F(1, 136) = 0.271$, $p = .604$) was significant. Thus, even though the attitude towards GM food became more positive subsequently to case manipulation, this cannot be specifically attributed to any of the independent variables or their interaction effects.

To assure that the attitude towards a cisgenic or transgenic product is a one-directional predictor of the attitude towards GM food, prior and post attitude measurements were included in the research design. A multiple linear regression to predict attitudinal change (post – prior attitude), with gender and educational background as covariates, product attitude towards a cisgenic or transgenic

product as the independent variable and attitudinal change as the dependent variable was conducted. The effect of gender on attitudinal change was significant (β= .346, (t(141) = 1.994, p<.05). Thus, subsequently to case manipulation attitudinal change was higher for women than for men. Even though marginal, the difference between the non-significant effect of gender in the three-way ANOVA (previous paragraph), and the significant effect of gender in the current multiple linear regression indicates some level of multicollinearity in the three-way ANOVA. The effect of educational background on attitudinal change was not significant (t(141) = -0.685, p=.494). Furthermore, the effect of the attitude towards a cisgenic or transgenic product on the attitudinal change in prior and post attitude towards GM food showed a trend in the expected direction (t(141) = 1.917, p=.057).

The means of the independent variables, a cisgenic or transgenic product, and a gain or loss are presented for mediators and dependent variables in Figure 2 and 3.

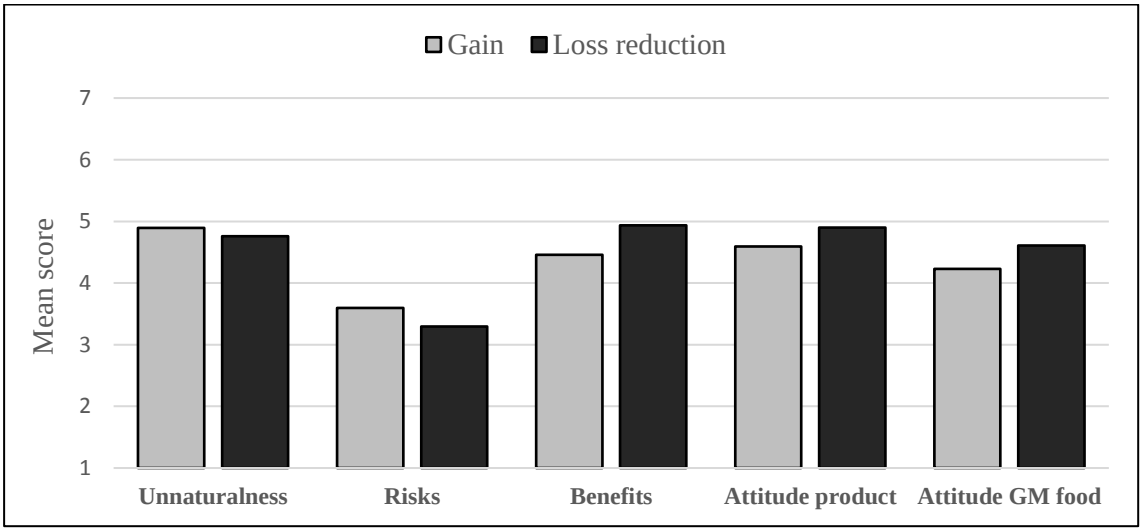

Figure 2. Means of evaluative measures cisgenic product and gain/loss reduction on mediators and dependent variable.

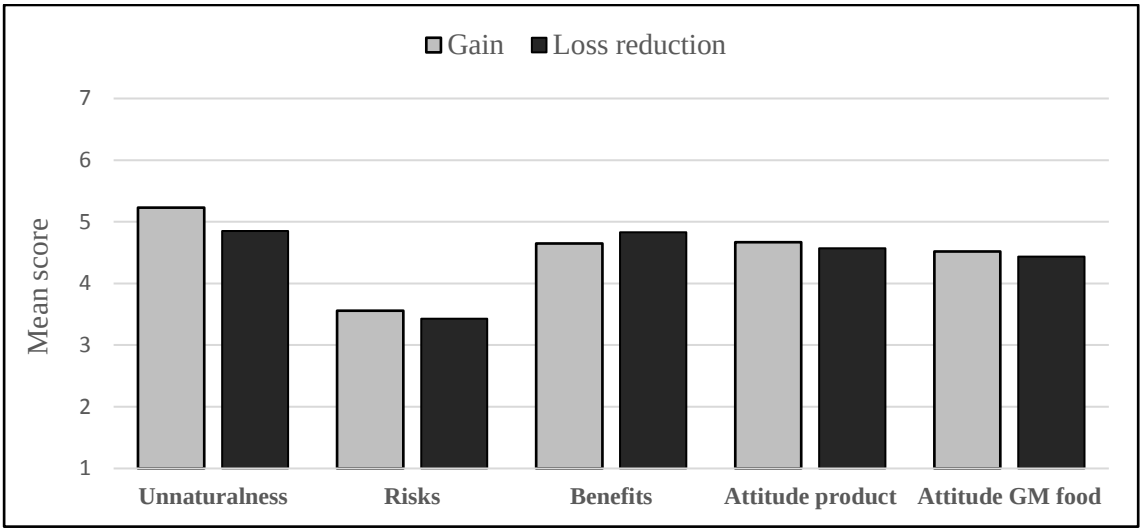

Figure 3. Means of evaluative measures transgenic product and gain/loss reduction on mediators and dependent variable.

For a potato that has been altered with a *cisgenic* plant breeding technique (Figure 2), there is almost no observable difference in perceived unnaturalness between a gain (enhanced nutritional value) or loss reduction (reduced pesticide usage). From the other variables, it can be observed, that a cisgenic potato with reduced pesticide use led to fewer perceived risks, higher perceived benefits, a more positive attitude towards the cisgenic potato, and a more positive attitude towards GM food, than a potato with enhanced nutritional value. For a potato that has been altered with a *transgenic* plant breeding technique (Figure 3), it is observable that a potato with enhanced nutritional value led to higher perceived unnaturalness than a potato whose pesticide usage has been reduced. For perceived risks, perceived benefits, the attitude towards a transgenic product, and the attitude towards GM food, the differences between enhanced nutritional value and reduced pesticide usage are almost non-observable.

After removal of one item, the Cronbach's Alpha of perceived unnaturalness remained low ($\alpha = .558$). Since the Cronbach's Alpha value remains low, and perceived unnaturalness is a broad and somewhat vague concept, it could be argued that perceived unnaturalness might be a multi-dimensional construct, rather than a one-dimensional construct. Hence, it is valuable to further analyse the items under perceived unnaturalness as constructs independently. A MANCOVA analysis to predict all items under perceived unnaturalness (e.g. human interference, crossing borders of species, modifying features of organisms, tampering with nature, and being acquainted with the technique) was conducted. Gender and educational background were included as covariates and a cisgenic or transgenic product as the predictor variable. The results of the MANCOVA analysis are summarised in table 6 (p. 29) MANCOVA predicting items perceived unnaturalness.

For the concepts: human interference in nature ($t(141) = 0.550$, $p=.583$), crossing borders of species ($t(141) = 0.681$, $p=.497$), and tampering with nature ($t(141) = 0.823$, $p=.412$), there was no a significant difference between cisgenic and transgenic potato. For these items, the effects of the covariates gender and educational background were also non-significant (see table 6 for effects).

We found that there was a significant difference between a cisgenic and transgenic potato on the concept of modifying features of organisms ($\beta= .487$, ($t(141) = 2.256$, $p<.05$). This indicates that perceptions of modifying features of organisms were higher for potatoes that have been altered with transgenic plant breeding techniques, than potatoes that have been altered with cisgenic plant breeding techniques. The effect of the covariate gender was non-significant ($t(141) = -0.356$, $p=.723$), but, the covariate educational background was a significant predictor of perceived modifying features of organisms ($\beta= -.411$, $t(141) = -2.058$, $p<.05$). Meaning that a higher educational background leads to lower perceived modifying features of organisms.

Also, we found that there was a significant difference between a cisgenic or transgenic potato on the concept of being acquainted with the technique used to alter the potatoes genes ($\beta= -.840$, $t(141) = -2.681$, $p<.01$). This indicates that Dutch consumers felt to be less acquainted with the

technique used to create a transgenic potato, than the technique used to create a cisgenic potato. This is remarkable since the control variables seemed to indicate the exact opposite. Namely, 25.2% of Dutch consumers were familiar with the term transgenesis breeding techniques, while only 19.9% indicated to be familiar with the term cisgenesis breeding techniques. Thus, even though Dutch consumers were more familiar with the term transgenesis than cisgenesis, a technique that used genes from the gene pool of the same potato cultivar or that of crossable potatoes felt more familiar, than a technique that used genes from the gene pool of not crossable plants, or bacterium. The covariates gender and educational background had no significant effect on being acquainted with the technique used to alter the potato (see table 6 for effects).

The discrepancy between 'knowing' and 'feeling' in the previous paragraph, might have hindered the influence of the level of trust in the source of information, on the acceptance of the GM food message. Moreover, it has been argued that trust has an impact on perceived risks and benefits (Siegrist, 2000). The effect of trust was therefore also tested as moderator on the relationship between gain/loss reduction and perceived risks, and, perceived benefits. The multiple linear regression models used to predict risk perception, and, to predict benefit perception, were thus extended with the variables trust, and the interaction effect of gain/loss reduction and trust. The interaction effect of gain/loss reduction and trust was a significant predictor of risk perception ($\beta = .163$, ($t(135) = 2.029$, $p < .05$). The interaction effect of gain/loss reduction and trust on benefit perception, however, was not significant ($t(136) = -0.452$, $p = .652$).

Table 6

MANCOVA Predicting Items Perceived Unnaturalness

Variable	Human interference			Crossing borders species			Modifying features organisms			Tampering with nature			Acquaintance with technique		
	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI	β	t	95 % CI
Cisgenic or transgenic product (0 cis, 1 trans)	0.14	0.550	[-0.37, 0.65]	0.16	0.681	[-0.31, 0.64]	0.49*	2.256	[0.06, 0.91]	0.20	0.823	[-0.28, 0.69]	-0.84**	-2.681	[-0.22, -1.46]
Gender (1 male, 2 female)	0.01	0.047	[-0.50, 0.52]	0.21	0.871	[-0.27, 0.68]	-0.08	-0.356	[-0.51, 0.35]	0.34	1.392	[-0.14, 0.83]	0.41	1.287	[-0.22, 1.03]
Education (1 low, 2 medium, 3 high)	-0.30	-1.279	[-0.77, 0.17]	-0.29	-1.311	[-0.73, 0.15]	-0.41*	-2.058	[-0.81, -0.02]	-0.32	-1.423	[-0.77, 0.13]	0.10	0.359	[-0.47, 0.68]
	$F(3, 141) = 0.641$,			$F(3, 141) = 0.922$,			$F(3, 141) = 3.134$,			$F(3, 141) = 1.453$,			$F(3, 141) = 3.118$,		
	$p < .590$			$p < .432$			$p < .028$			$p = .230$			$p = .028$		
	$R^2 = .01$			$R^2 = .02$			$R^2 = .06$			$R^2 = .03$			$R^2 = .06$		

Note. * = $p < .05$, ** = $p < .01$

6. General discussion

This study aimed to investigate the effect of cisgenic or transgenic plant product information on the attitude of European consumers towards genetically modified foods. As a starting point for the current research, the Netherlands was taken as the target population. The results of the hypothesised relations are summarised in Figure 4.

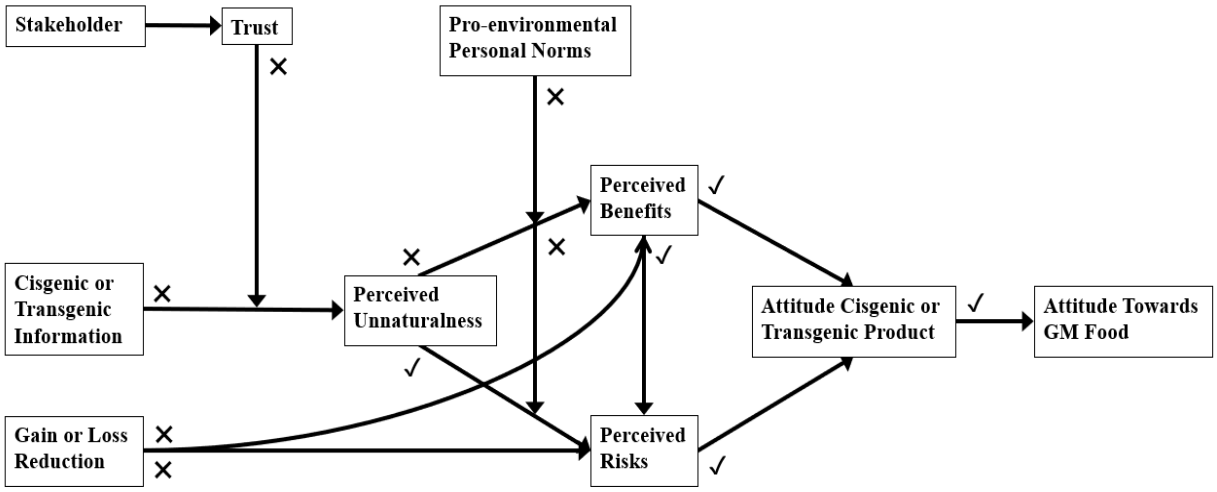

Figure 4. Outcomes conceptual framework.

The current research showed that the attitude towards a cisgenic or transgenic product was a highly significant predictor of the attitude towards GM food (H1). To make sure that the attitude towards a cisgenic or transgenic product is a one-directional predictor of the attitude towards GM food, prior and post attitude measurements towards GM food were included in the analysis. It has not been conclusively shown that the effect of the attitude towards a cisgenic or transgenic product has a significant effect on the attitudinal change (post – prior attitude). Thus, even though there are some indications that the trend is in the expected direction, we cannot entirely exclude that the initial attitude towards GM food influences the attitude towards a cisgenic or transgenic product.

Also, it was shown that risk perception of a cisgenic or transgenic product negatively influenced the attitude towards a cisgenic or transgenic product (H2). This is consistent with the findings of other studies, such as Siegrist (2000), Costa-Font and Gil (2009), Connor and Siegrist (2010). Moreover, it was shown that benefit perception of a cisgenic or transgenic product positively influenced the attitude towards a cisgenic or transgenic product (H3). This is consistent with the findings of Siegrist (2000), Siegrist et al. (2000), Costa-Font and Gil (2009). These results (H2 and H3), are in line with the existing literature that addresses the importance of perceived risks and benefits on consumer acceptance of innovative food technologies, such as, GM food products (Siegrist, 2000; Bearth & Siegrist, 2016).

Current research also indicates that benefit perception of a cisgenic or transgenic product reduced risk perception of a cisgenic or transgenic product (H4). This is in line with research of

(Frewer et al., 2011) wherein it is argued that perceived benefits that are seen as important can reduce risk perception, and hence enhance consumer acceptance of GM food.

It was not shown that presentation of a potato with transgenic information evoked higher perceived unnaturalness than a potato with cisgenic information did (H7). At first sight, this might seem remarkable, since Gaskell et al. (2010), and others (Wagner et al., 2014; Delwaide et al., 2015; Rousselière & Rousselière, 2017) that remodelled the data used by Gaskell and colleagues, found large significant differences in perceived unnaturalness between cisgenic and transgenic products. This contrast, however, can be explained by the different semantics used to describe cisgenic and transgenic plant breeding techniques. In the current research, we tried to define the cisgenic, and transgenic product as a realistic representation of the current used cisgenic and transgenic plant breeding techniques. Respectively, we used the narrow definitions: this technique used genes – from the gene pool of the potato cultivar or that of crossable potato cultivar – from the gene pool of not crossable plants, or bacterium – and put these into the potato. In contrast, Gaskell and colleagues (2010), respectively used the broad definitions, artificially introduce – a gene that exists naturally in wild/crab apples – a resistance gene from another species such as a bacterium or animal – into an apple tree.

While we explicitly prevented the usage of the word animals since this evokes strong consumer' reactions, it seems that Gaskell and colleagues (2010) explicitly avoid the usage of the word non-crossable plants to elicit stronger consumer' reactions. The current research, therefore, contributes to the existing literature about European consumer perception of cisgenic and transgenic products since it addresses the importance/difference of narrowly and broadly used semantics. As the current study illustrated, when definitions used for cisgenic and transgenic products are more narrowly defined, it might be that the difference in perceived unnaturalness is not as extreme, as is found by Gaskell and colleagues (2010). Future research on cisgenic or transgenic products, should, therefore, take carefully into account the semantics used to define cisgenic and transgenic plant breeding techniques and products. This implies a thorough consideration whether the research aims to measure a more realistic representation of current used cisgenic and transgenic GM breeding techniques or the usage of more theoretical extremes.

Furthermore, it has been argued that analyses of unnaturalness conducted in general terms fail to explain what characteristic of unnaturalness people refer to when answering questions about unnaturalness (Mielby et al., 2013a). For the current research, to measure the variable perceived unnaturalness, five lines of reasoning why a cisgenic or transgenic product is to be considered unnatural, created by Mielby et al. (2013a), have been transformed into five different items. Factor analysis indicated that these items did not all fit correctly together under the construct perceived unnaturalness. In particular, familiarity did not fit correctly with the other four items, and hence might be more a construct on itself than an item of perceived unnaturalness. Moreover, it could be argued that human interference in nature, and crossing borders of species, might be a version of tampering

with nature. While modifying features of organisms seems to be more related to the technique used to alter the organisms, than tampering with nature. *On the one hand,* this might indicate a limitation of the currently used scale to measure perceived unnaturalness. *On the other hand,* this might indicate that perceived unnaturalness is a more-dimensional construct. Future research should, therefore, explore the multi-dimensionality of perceived unnaturalness, and the effect of different items under perceived unnaturalness on the attitude towards GM food. In the current research, a first attempt to explore the multi-dimensionality of perceived unnaturalness is conducted. Further analysing the items under perceived unnaturalness, as constructs independently led to some surprising results.

Firstly, we did not find that the technique used to alter a transgenic product led to significantly higher perceived crossing borders of species, than the technique used to alter a cisgenic product. This is remarkable since other research (Mielby et al., 2013a; Wagner et al., 2014) indicates this to be the key argument why cisgenic is perceived to be less unnatural than transgenic is. This difference might be explained by differences in semantics used to explain the techniques to alter a cisgenic or transgenic product. The concept of crossing borders of species, might thus not be perceived to be much different for crossable plants, and, not-crossable plants or bacterium.

Secondly, we found that perceptions of modifying features of organisms were significantly higher for potatoes that have been altered with transgenic plant breeding techniques, than potatoes that have been altered with cisgenic plant breeding techniques. Focus group interviews of Mielby et al. (2013a), however, indicated that consumers did not argue cisgenic products to be less unnatural than transgenic products, based on the argumentation of modifying features of organisms. Current research thus adds to the existing literature; when asked explicitly, consumers do differ in their perception of modifying features between cisgenic and transgenic products.

Thirdly, it was shown that Dutch consumers felt less acquainted with the technique used to create a cisgenic product, than with the technique used to create a transgenic product. The knowledge of Dutch consumers about the techniques, however, indicated that Dutch consumers are more familiar with the term transgenesis than cisgenesis. These contractionary findings suggest that there is a discrepancy between 'feeling' more familiar with products altered with cisgenic breeding techniques, and 'knowing' to be more familiar with the term transgenesis. This seems to indicate that people interpret transgenesis as the familiar GMO technique, but thus also as the more acceptable variant, namely, as crossing between the gene pool of the potato, or that of crossable potato cultivar. We will discuss the practical implications of this finding in the section practical implications.

It was not shown that the level of trust in the source of information moderated the relation between a cisgenic, or a transgenic product, and the perceived unnaturalness of the product (H10). Other authors, such as Costa-Font et al. (2008), have shown that there are differences in the levels of trust in an NGO and biotech company. Moreover, it was argued that the level of trust in the different stakeholders would influence the acceptability of a GM-food related message (Verdurme & Viaene, 2003). These effects, however, were not shown in the current research. To avoid unwanted carry-over effects, we did not want to pick too extreme examples of biotech companies, such as Monsanto and Bayer. Therefore Syngenta was chosen as a more mild biotech company. For the NGO, Greenpeace was selected since this is a familiar and established NGO on the GM food topic. The combination of a more mild perceived biotech company, and a more extreme NGO, however, did not lead to significant differences in trust. In hindsight, it could be argued that it would have been more interesting to take a more radical perceived biotech company and a more mild NGO. For future research that wants to use trust in the stakeholder as a variable, it is thus advised to pick a more extreme example of a biotech company and a more mild example of an NGO.

Since previous research indicated that trust has an impact on perceived risks and benefits (Siegrist, 2000), the effect of trust in the source of information was also tested on the relation between gain/loss reduction and perceived risks, and, benefits. It was shown that trust in the source of information moderated the relation between gain/loss reduction and perceived risks, but did not affect the relation between gain/loss reduction and perceived benefits. The influence of trust on the acceptability of a GM-food related message (Verdurme & Viaene, 2003) seems thus to matter for risk perception, but not for benefit perception. This indicates that the trust in the source of information, to some degree, seems to act as an assurance of risks, or lack of risks, associated with the GM product.

It was shown that perceived unnaturalness of a cisgenic, or a transgenic product increased perceived risks of a cisgenic or transgenic product (H5). This is consistent with research from Siegrist et al. (2016). It was, however, not shown that perceived unnaturalness of a cisgenic, or a transgenic product decreased perceived benefits of a cisgenic or transgenic product (H6). This is in contrast with the findings of Siegrist et al. (2016). The different benefits provided to the consumers might explain these contradictory results. The current research focussed on consumer-related benefits, such as enhanced nutritional value and reduced pesticide residues on the potato. On the contrary, the study of Siegrist et al. (2016) focussed on the farmer and producer-related benefits, such as financial gains and enhanced yield. The authors acknowledged this limitation in their research and indicated the need for future research to replicate their study with consumer-related benefits. The current research contributes to their findings; the discounting effects of perceived unnaturalness on producer-related benefits cannot be directly extrapolated to consumer-related benefits. It should be noted, however, that the current research measured perceived benefits on a more broadly range (health, environment,

producers, society) than exclusively consumer-related benefits. The need of Siegrist et al. (2016) to extrapolate their research to consumer-related benefits, remains thus, partly, intact.

It was not shown that the effect of perceived unnaturalness on perceived risk (H11), or perceived benefits (H12), was moderated by consumers' pro-environmental personal norms. This was not expected, since Costa-Font et al. (2008) have argued that individual values, such as environmentalism, condition risk and benefit perceptions of GM foods. Moreover, it was argued that that cisgenic crops meet some of the consumers' perceptions of unnaturalness and moral concerns and hence are more acceptable than transgenic crops. It seemed thus logical to include pro-environmental personal norms as moderator on the relation between perceived unnaturalness and risk/benefit perception. Since other studies have shown that pro-environmental personal norms reduced acceptance of GM technology (Siegrist, 1998), and enhanced rejection of GM foods (Tanner & Wölfing Kast, 2003), it is likely that pro-environmental personal norms influence the acceptation of GM food somewhere, or somehow in the proposed conceptual model. A current limitation of the study is that we have not shown where this is, or can entirely exclude that the effect of pro-environmental personal norms plays a role. Future research should therefore further explore the influence of pro-environmental personal norms on the acceptation of GM food.

It was not shown that a cisgenic or transgenic product that reduced losses led to lower perceived risks than a product that created a gain (H8), nor that a gain led to lower perceived benefits than a product that reduced losses (H9). This is in contradiction with some assumptions of prospect theory (Tversky & Kahneman, 1992). These contradictory findings might be explained by the different gains and loss reductions used. While Tversky and Kahneman focus on monetary examples, the current gain is defined as enhanced nutritional value and the loss reduction as a reduction in pesticide use and subsequent residues on the potato. Also, even though the differences in perceived risks/benefits were not statistically significantly different, Figure 2 illustrated that there were clear 'observable differences', favouring loss reduction for a cisgenic potato. Moreover, the current research focusses on realistic and not too extreme examples of a gain and a loss reduction. It is likely that more extreme examples of a gain/loss reduction do lead to significant differences in perceived risks/benefits. One recent example case, which illustrated a promising direction for future research on loss reduction and consumer acceptance of GM food, is the transgenic Cavendish banana with resistance to Fusarium (Dale et al., 2017). From consumers' reactions on social media, it was observed that the potential perceived loss of the most eaten banana in the Netherlands, the Cavendish banana, seemed to justify the use of a new transgenic variant. These forms of perceived big losses of a 'natural' product, which can be compensated by a GM food product, are a promising direction for future research on GM food acceptance. Or as Thaler once put it: "A good rule to remember is that people who are threatened with big losses and have a chance to break even will be unusually willing to take risks, even if they are normally quite risk averse" (Thaler, 2015, p. 84).

Theoretical implications

Taken together, there is some evidence that the 'robust' influence of perceived risks and benefits, and the attitude towards a cisgenic or transgenic product, on the attitude towards GM food matter. The evaluation part, as is proposed in existing literature, remains thus intact with the current proposed conceptual model. The role of perceived unnaturalness as mediator seems to matter for perceived risks, but not for perceived benefits. Furthermore, the current research seems to indicate that there are reasons to assume that perceived unnaturalness might well be a multi-dimensional construct. If perceived unnaturalness is a multi-dimensional construct, these constructs would likely have different influences on risk and benefit perception. Also, the proposed information components, such as a cisgenic or transgenic product, gain/loss reduction, and source of information, did not seem to influence the evaluation part of the model, and hence remains open for multiple interpretations. The moderating role of pro-environmental personal norms on perceived risks and benefits was not shown in the current model. It is likely that pro-environmental personal norms influence consumer acceptation of GM food somehow, but in what way remains unanswered with the current conceptual model.

Practical implications

The findings of the current research can be of practical relevance to enhance consumer acceptance of GM food products. For example, communication that is based on reducing perceived unnaturalness can be used to influence consumer acceptance of a GM food product. As the current model showed, reducing perceived unnaturalness will reduce uncertainty and risks associated with a particular GM food product. This can be of value to the communicator since the evaluation part of the model has shown that reduced risk perception will positively influence the attitude towards the GM product. When the communicator wants to enhance perceived benefits, reducing perceived unnaturalness is likely not the best strategy.

Another factor that cannot be directly obtained from the conceptual model, but seems noteworthy for communication messages, is the effect of gender. As previous research has shown, women perceive GM foods to have higher risks and lower benefits than men do (Frewer, Miles, & Marsh, 2002). In the current research, it came forward that the attitudinal change towards GM food was significantly higher for women than for men. This seems to indicate that women are more susceptible to GM food communication than men are. Since women have a more negative attitude towards GM food and are more susceptible to change their attitude due to information provision, it is therefore advised that GM food communication messages should focus on women, rather than on men.

Also, Dutch consumers were more familiar with the term transgenesis than cisgenesis but felt more familiar with the technique used to create a cisgenic product than the technique used to create a transgenic product. This discrepancy between 'knowing' and 'feeling', has some practical implications for the usage of the word 'cisgenic', or 'cisgenesis' as a value proposition. Namely, if consumers think that a transgenic product is a cisgenic product, and hence is a more acceptable form of GM technique,

cisgenesis loses its advantage over transgenesis. Furthermore, since consumers are less familiar with the term cisgenesis, explicit cisgenic communication messages might thus even confuse, or lead to consumer rejection as a consequence. Information provision of GM foods is a highly sensitive topic since information provision solely based on GM food benefits can also result in reduced consumer acceptance (Grunert et al., 2003). These findings shed doubt on the usefulness of communicating unfamiliar terms such as ‘cisgenesis’ or ‘cisgenic products’ in communication messages, and hence on the effectiveness of using cisgenic information to influence the attitude of European consumers towards genetically modified foods.

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Appendix

This Appendix consist of the following chapters and sub-chapters:

Appendix A: Cisgenesis/transgenesis Apple example Eurobarometer survey

Appendix B: Cisgenic or transgenic potato cases

Appendix C: Dutch version of the potato cases

Appendix D: Dutch version of the survey questions

Appendix E: Results bivariate correlation analysis background variables and variables model

Appendix A: Cisgenesis/transgenesis Apple example Eurobarometer survey

Cases Gaskell et al. (2010, p. 47) manipulation technique cisgenic and transgenic apples.

'Cisgenics was introduced in the survey with the following description:

Some European researchers think there are new ways of controlling common diseases in apples– things like scab and mildew. There are two new ways of doing this. Both mean that the apples could be grown with limited use of pesticides, and so pesticide residues on the apples would be minimal. The first way is to artificially introduce a resistance gene from another species such as a bacterium or animal into an apple tree to make it resistant to mildew and scab…. The second way is to artificially introduce a gene that exists naturally in wild/ crab apples which provides resistance to mildew and scab.'

Respondents were then asked to what extent they agreed or disagreed with a number of statements in relation to these techniques:

1. It is a promising idea (transgenic)/ it will be useful (cisgenic)
2. Eating apples produced using this technique will be safe (transgenic)/it will be risky (cisgenic)
3. It will harm the environment
4. It is fundamentally unnatural
5. It makes you feel uneasy
6. It should be encouraged.

Appendix B: Cisgenic or transgenic potato cases

Cisgenic potato with enhanced nutritional value, source Greenpeace:

In a recent newsletter from Greenpeace, a worldwide operating environmental organization, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes nutritional value has been enhanced by the use of genetic engineering. The potato, therefore, has enhanced values of vitamin A and C. The technique used to enhance the nutritional value of the potato only used genes from the gene pool of the potato cultivar or that of crossable potatoes, and put these into the potato.

Cisgenic potato with enhanced nutritional value, source Syngenta:

In a recent newsletter from Syngenta, a worldwide operating biotech company, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes nutritional value has been enhanced by the use of genetic engineering. The potato, therefore, has enhanced values of vitamin A and C. The technique used to enhance the nutritional value of the potato only used genes from the gene pool of the potato cultivar or that of crossable potatoes, and put these into the potato.

Transgenic potato with enhanced nutritional value, source Greenpeace:

In a recent newsletter from Greenpeace, a worldwide operating environmental organization, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes nutritional value has been enhanced by the use of genetic engineering. The potato, therefore, has enhanced values of vitamin A and C. The technique used to enhance the nutritional value of the potato used genes from the gene pool of not crossable plants, or bacterium, and put these into the potato.

Transgenic potato with enhanced nutritional value, source Syngenta:

In a recent newsletter from Syngenta, a worldwide operating biotech company, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes nutritional value has been enhanced by the use of genetic engineering. The potato, therefore, has enhanced values of vitamin A and C. The technique used to enhance the nutritional value of the potato used genes from the gene pool of not crossable plants, or bacterium, and put these into the potato.

Cisgenic potato with reduced pesticide use, source Greenpeace:

In a recent newsletter from Greenpeace, a worldwide operating environmental organization, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes disease resistance has been enhanced by the use of genetic engineering. Pesticide use and subsequent residues of pesticides on the potato therefore, are reduced to

a minimum. The technique used to enhance the disease resistance of the potato only used genes from the gene pool of the potato cultivar or that of crossable potatoes, and put these into the potato.

Cisgenic potato with reduced pesticide use, source Syngenta:

In a recent newsletter from Syngenta, a worldwide operating biotech company, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes disease resistance has been enhanced by the use of genetic engineering. Pesticide use and subsequent residues of pesticides on the potato therefore, are reduced to a minimum. The technique used to enhance the disease resistance of the potato only used genes from the gene pool of the potato cultivar or that of crossable potatoes, and put these into the potato.

Transgenic potato with reduced pesticide use, source Greenpeace:

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Transgenic potato with reduced pesticide use, source Syngenta:

In a recent newsletter from Syngenta, a worldwide operating biotech company, it came forward that a new potato has been invented, and soon will be introduced onto the Dutch consumer market. This new potatoes disease resistance has been enhanced by the use of genetic engineering. Pesticide use and subsequent residues of pesticides on the potato therefore, are reduced to a minimum. The technique used to enhance the disease resistance of the potato used genes from the gene pool of not crossable plants, or bacterium, and put these into the potato.

Appendix C: Dutch version of the potato cases

In this sub-section, the cases that will be provided to the Dutch consumers will be provided translated in Dutch.

Cisgenese aardappel waarvan voedingswaarden zijn verbeterd, afzender Greenpeace:

In een recente nieuwsbrief meldt Greenpeace, een wereldwijd opererende milieuorganisatie, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De voedingswaarden van de aardappel zijn verbeterd door het gebruik van genetische modificatie. De aardappel heeft hierdoor verhoogde vitamine A en C waardes. De techniek die gebruikt is om de voedingswaarden van de aardappel te vergroten heeft alleen gebruik gemaakt van genen van dit aardappelras of die van een verwant aardappelras.

Cisgenese aardappel waarvan voedingswaarden zijn verbeterd, afzender Syngenta:

In een recente nieuwsbrief meldt Syngenta, een wereldwijd opererend biotechbedrijf, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De voedingswaarden van de aardappel zijn verbeterd door het gebruik van genetische modificatie. De aardappel heeft hierdoor verhoogde vitamine A en C waardes. De techniek die gebruikt is om de voedingswaarden van de aardappel te vergroten heeft alleen gebruik gemaakt van genen uit dit aardappelras of die van een verwant aardappelras.

Transgenese aardappel waarvan voedingswaarden zijn verbeterd, afzender Greenpeace:

In een recente nieuwsbrief meldt Greenpeace, een wereldwijd opererende milieuorganisatie, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De voedingswaarden van de aardappel zijn verbeterd door het gebruik van genetische modificatie. De aardappel heeft hierdoor verhoogde vitamine A en C waardes. De techniek die gebruikt is om de voedingswaarden van de aardappel te vergroten heeft gebruik gemaakt van genen uit niet aan dit aardappelras verwante planten en bacteriën.

Transgenese aardappel waarvan voedingswaarden zijn verbeterd, afzender Syngenta:

In een recente nieuwsbrief meldt Syngenta, een wereldwijd opererend biotechbedrijf, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De voedingswaarden van de aardappel zijn verbeterd door het gebruik van genetische modificatie. De aardappel heeft hierdoor verhoogde vitamine A en C waardes. De techniek die gebruikt is om de voedingswaarden van de aardappel te vergroten heeft gebruik gemaakt van genen uit niet aan dit aardappelras verwante planten en bacteriën.

Cisgenese aardappel met verminderd pesticide gebruik, afzender Greenpeace:

In een recente nieuwsbrief meldt Greenpeace, een wereldwijd opererende milieuorganisatie, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt

geïntroduceerd. De weerstand tegen ziekte van de nieuwe aardappel is verbeterd door het gebruik van genetische modificatie. Het gebruik van pesticide en daaruit overblijvende reststoffen van de pesticide op de aardappel worden daardoor verminderd tot een minimum. De techniek die gebruikt is om de weerstand tegen ziekte van de aardappel te vergroten heeft alleen gebruik gemaakt van genen uit dit aardappelras of die van een verwant aardappelras.

Cisgenese aardappel met verminderd pesticide gebruik, afzender Syngenta:

In een recente nieuwsbrief meldt Syngenta, een wereldwijd opererend biotechbedrijf, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De weerstand tegen ziekte van de nieuwe aardappel is verbeterd door het gebruik van genetische modificatie. Het gebruik van pesticide en daaruit overblijvende reststoffen van de pesticide op de aardappel worden daardoor verminderd tot een minimum. De techniek die gebruikt is om de weerstand tegen ziekte van de aardappel te vergroten heeft alleen gebruik gemaakt van genen uit dit aardappelras of die van een verwant aardappelras.

Transgenese aardappel met verminderd pesticide gebruik, afzender Greenpeace:

In een recente nieuwsbrief meldt Greenpeace, een wereldwijd opererende milieuorganisatie, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De weerstand tegen ziekte van de nieuwe aardappel is verbeterd door het gebruik van genetische modificatie. Het gebruik van pesticide en daaruit overblijvende reststoffen van de pesticide op de aardappel worden daardoor verminderd tot een minimum. De techniek die gebruikt is om de weerstand tegen ziekte van de aardappel te vergroten heeft gebruik gemaakt van genen uit niet aan dit aardappelras verwante planten en bacteriën.

Transgenese aardappel met verminderd pesticide gebruik, afzender Syngenta:

In een recente nieuwsbrief meldt Syngenta, een wereldwijd opererend biotechbedrijf, dat er een nieuwe aardappel is uitgevonden, die binnenkort op de Nederlandse markt wordt geïntroduceerd. De weerstand tegen ziekte van de nieuwe aardappel is verbeterd door het gebruik van genetische modificatie. Het gebruik van pesticide en daaruit overblijvende reststoffen van de pesticide op de aardappel worden daardoor verminderd tot een minimum. De techniek die gebruikt is om de weerstand tegen ziekte van de aardappel te vergroten heeft gebruik gemaakt van genen uit niet aan dit aardappelras verwante planten en bacteriën.

Appendix D: Dutch version of survey questions

The survey questions will be presented in the order as how they will be presented to the Dutch consumers.

Welkom bij dit onderzoek.

Deze enquête is onderdeel van mijn Master afstudeerscriptie aan de Universiteit van Wageningen. Het onderzoek gaat over technieken die gebruikt kunnen worden om de kwaliteit van voeding te verbeteren. De enquête duurt ongeveer 10 minuten om in te vullen.

Uw antwoorden zullen volledig anoniem en vertrouwelijk behandeld worden. Dit betekent dat u nergens uw naam hoeft in te vullen, of dat uw naam aan de antwoorden gekoppeld kan worden.

P. 1. Wat denk je in het algemeen over genetisch gemodificeerd voedsel:

Genetisch gemodificeerd voedsel vind ik…

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'zeer slecht' tot zeer goed'

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'zeer ongunstig' tot 'zeer gunstig'

Genetisch gemodificeerd voedsel is iets wat ik ...

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variëren van: 'zeer ongewenst vind' tot 'zeer gewenst vind'

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variëren van: 'zeer ongeschikt vind' tot 'zeer geschikt vind'

P. 2. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Deze techniek is een vorm van menselijke inmenging in de natuur.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek is een vorm van het mengen van verschillende soorten.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek is een vorm van het verandering van eigenschappen van organismen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek zorgt voor onevenwichtigheden in de natuur.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Ik ben bekend met deze soort techniek.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

P. 3. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Deze techniek heeft fysieke risico’s voor mij.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek maakt mij angstig.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Ik heb morele zorgen over deze techniek.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek heeft risico's voor het milieu.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek heeft sociale of economische risico's voor de maatschappij.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

P. 4. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Deze techniek heeft fysieke voordelen voor mij.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek heeft productie- of verwerkingsvoordelen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek heeft voordelen voor het milieu.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Deze techniek heeft voordelen voor de maatschappij.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

P. 5. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Het toepassen van dit soort techniek om de voedingswaarde van een aardappel te verbeteren is ...

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'extreem slecht' naar 'extreem goed'

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'extreem dwaas' naar 'uiterst wijs'

Het toepassen van dit soort techniek om de voedingswaarde van een aardappel te verbeteren is iets waar ik ...

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'sterk tegen ben' naar 'sterk voor ben'

P. 6. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Genetisch gemodificeerd voedsel is iets wat ik ...

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: ‘sterk afkeur’ tot ‘sterk goedkeur’

Beantwoord op een 7-punts semantische differentiaal schaal, variërend van: zeer mee eens ben’ tot ‘zeer niet mee eens ben’

Genetisch gemodificeerd voedsel is iets waar ik…

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'sterk onbevredigend' naar 'sterk bevredigend'

Te worden beantwoord op een 7-punts semantische differentiaal schaal, variërend van: 'zeer negatief’ tot ‘zeer positief '

P. 7. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Iedereen heeft de verantwoordelijkheid bij te dragen aan het beschermen van het milieu door verpakte voedingsmiddelen te vermijden.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Iedereen zou een bijdrage moeten leveren aan het bevorderen van de productie van groene levensmiddelen door alleen groene producten te kopen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Consumenten hebben het recht om exotisch fruit te kopen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Ik voel me moreel verplicht om af te zien van het eten van vlees van dieren die in dieronvriendelijke omstandigheden worden gehouden.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

P. 8. In hoeverre ben je het oneens of eens met de volgende uitspraken?

Ik heb vertrouwen in de vaardigheden van de bron.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

De bron van deze informatie is nuttig voor informatie over genetische gemodificeerde voedingsmiddelen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

De bron van deze informatie zal doen wat goed is voor de maatschappij.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

De bron van deze informatie zal de waarheid vertellen over genetisch gemodificeerde voedingsmiddelen.

Te worden beantwoord op een 7-punts Likert schaal, variërend van: ‘totaal oneens’ tot ‘totaal eens’

Wat is je leeftijd?

(mogelijkheden 16-99 jaar)

Wat is je geslacht?

(mogelijkheden: man/vrouw/anders)

Wat is de hoogste graad of niveau van school die je hebt behaald?

(mogelijkheden: basisschool/middelbare school (opties: VMBO, HAVO, VWO, MBO, HBO WO)

Bent u bekend met de term cisgenese veredelingstechnieken?

(mogelijkheden: ja/nee)

Bent u bekend met de term transgenese veredelingstechnieken?

(mogelijkheden: ja/nee)

Appendix E: Results bivariate correlation analysis background variables and variables model

Table 4

Correlations and Significance Control Variables, and Variables Conceptual Model

Variable	M	SD	1	2	3	4	5
1. Age	28.16	13.57					
2. Gender	1.52	0.50	0.40				
3. Educational background	2.61	0.54	4.10**	0.09			
4. Cisgenic knowledge	1.80	0.40	-0.47	0.19**	-0.07		
5. Transgenic knowledge	1.75	0.44	-0.13	0.15	-0.09	0.776**	
6. Perceived unnaturalness	4.89	0.95	-0.02	0.05	-0.18*	-0.04	-0.01
7. Risk perception	3.48	1.19	0.14	0.27**	0.04	0.03	0.09
8. Benefit perception	4.71	1.04	-0.12	-0.22**	-0.02	-0.07	-0.15
9. Product attitude	4.69	1.23	-0.03	-0.22**	0.03	-0.08	-0.13
10. Prior attitude GM food	4.11	1.49	-0.07	-0.26**	0.05	-0.10	-0.20*
11. Post attitude GM food	4.45	1.28	-0.01	-0.20*	0.03	-0.03	-0.10
12. Pro-environmental personal norms	4.28	0.97	0.24**	0.31**	0.24**	-0.02	-0.01
13. Trust	4.07	0.99	-0.01	-0.05	-0.14	0.08	0.08

Note. * = p <.05, ** = p <.01