Investigating the Influence of Product Label and Product Healthiness on Food Nutrition Perception

by

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ABSTRACT

INVESTIGATING THE INFLUENCE OF PRODUCT LABEL AND PRODUCT HEALTHINESS ON FOOD NUTRITION PERCEPTION

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The overall objective of this study was to investigate whether positive or negative nutrition attributes are more determinative to consumer choice of food products. Specifically, this thesis investigated the influence of all-natural and GMO labels on the relative importance of nutrition attributes, and whether the impact of different labels on the relative importance of nutrition attributes depends on the healthiness perception of the food product. The results indicated that GMO and all-natural labels do not influence consumers' nutrition attribute preferences when the product is perceived as healthy. On the other hand, all-natural label can bring down the importance of negative nutrition attributes and GMO label would not influence nutrition attribute preference when the product is perceived as unhealthy. These findings provide important insights for food manufacturers to identify key nutritional attributes that influence the choice of food products with GMO and all-natural labels.

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LIST OF ABBREVIATIONS

DCE: Discrete Choice Experiment

GM: Genetically Modified

GMO: Genetically Modified Organisms

LRT: Log-Likelihood Ratio Test

RUT: Random Utility Theory

Chapter 1: Introduction

Food products are introduced into the market with different labels such as all-natural, organic, and GMO which may be because of policy requirements or marketing strategies. These labels will emphasize on the quality and the process through which the product is produced to differentiate between themselves and other common labels (Barham, 2002). Investigating the influence of food labels on consumers' evaluation is critical for producers and marketers since these labels are powerful means to influence consumer judgments (Besson et al., 2019; Buckland et al., 2015). Although these labels are tended to give more information about the product, they can influence consumers' judgments and decisions unconsciously through cognitive biases (Nufer & Alesi, 2018). When individuals encounter with a huge amount of information, it is possible that they do not thoroughly process and analyze each piece of information; therefore, they use mental shortcuts to make decisions easily and quickly (Nufer & Alesi, 2018).

The development of genetically modified (GM) crops and health concerns associated with consuming GM food products have increased the importance of Genetically Modified Organisms (GMO) labels (Ruth & Rumble, 2019). Although there are some benefits associated with GM products such as increased nutritional values and reduced pesticide usage, consumers still have concerns regarding consuming GM food products (Loureiro & Bugbee, 2005). People believe that GM techniques change the composition and nature of the product by injecting the food with hazardous materials like hormones and antibiotics (Health Canada, 2016). Therefore, consumers perceive GM foods as manipulative to nature and immoral, while foods that are grown naturally are seen as preserving nature and the environment (Dreezens et al., 2005).

Negative beliefs associated with GM food products may have negative influence on consumers' preferences towards GM foods (Costa-Font, Gil, & Traill, 2008). These inferences can be attributed to "health horn" effect which refers to erroneous negative inference that happens when a product is perceived to be unhealthy (Burton et al., 2015). On the other hand, although consumers avoid consuming products with a GMO label, they prefer to purchase options that are grown naturally (Hughner et al., 2007; Rozin et al., 2004; Shafie & Rennie, 2012). This preference can be explained through "health halo" effect (Burton et al., 2015). Assumption about GM (e.g., GM foods are bad – a health "horn") and natural (e.g., natural foods are good – a health "halo") food products can influence consumers' preferences and especially nutrition perception (Besson, Bouxom, & Jaubert, 2020; Lee et al., 2013; Schuldt & Schwartz, 2010; Vos et al., 2019).

Previous studies show that GM and natural food products influence consumers' nutrition perception. Consumers are concerned about nutrition attributes such as fat, cholesterol, and calorie when food products are produced through GM technology (Burton & Pearse, 2003; Grunert et al., 2001; Grunert, Bredahl, & Scholderer, 2003). In addition, they underestimate nutrition attributes such as calories or fat of organic or natural products (Schuldt & Schwarz, 2010; Wansink & Chandon, 2006). Although some research acknowledges the influence of GM horn effect and natural halo effect on product and nutrition perception, researcher have not yet investigated whether these labels influence consumers' decisions toward the relative importance of positive and negative nutrition attributes. Since GM foods are perceived to be manipulative to nature and immoral (Dreezens et al., 2005), it can be assumed that GMO label differently impacts nutrition importance in a food product compared to a food product that is produced naturally.

However, previous research provides evidence that the influence of different labels such as organic or GMO on consumers' evaluation also depends on the healthiness perception of the food product (Balasubramanium & Cole, 2002; Burton et al., 2015; Ellison et al., 2016; Lee et al., 2013; Prada, Garrido & Rodrigues, 2017; Román, Sánchez-Siles, & Siegrist, 2017; Hamzaoui Essoussi & Zahaf, 2008). It has been stated that when a food product is perceived as healthy, labeling it as conventional or organic may not cause significant difference in evaluation of the food product (Lee et al., 2013). Therefore, this thesis has examined to what extent would the impact of GMO and all-natural labels on the relative importance of nutrition attributes depend on the healthiness perception of the food product.

The findings showed that although GMO labels would not influence consumers' nutrition attribute preferences, all-natural labels affect the relative importance of nutrition attributes of the food product perceived as unhealthy by bringing down the importance of negative nutrition attributes. These findings provide much insight on the literature of GM and natural food products and whether nutrition information is more effective for healthy and unhealthy food products with GMO or all-natural label. In what follows, we presented a literature review and developed theoretical framework and research hypotheses. Then, we tested the proposed hypotheses across one study and provided a general discussion. Finally, we concluded with discussing managerial and theoretical implications of our key findings.

Chapter 2: Literature Review

2.1 Genetically Modified Foods

Genetically Engineered (GE) or Genetically Modified (GM) foods refer to foods that have been created through transgenic technologies (Arya, 2015). Specifically, GM foods produced from organisms with changed heritable traits (Government of Canada, 2020). World Health Organization (2014) defines Genetically Modified Organisms (GMOs) as:

"Organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination. It allows selected individual genes to be transferred from one organism into another, also between nonrelated species" (World Health Organization, 2014).

The use of transgenic technologies in food products usually aims for several purposes, such as modifying nutritional characteristics, increasing the nutritional content of foods, addressing dietary deficiencies, increasing crops resistant to pest, and creating the opportunity of cultivation under unfavourable growing conditions (Francis, Craig, & George, 2016). Despite the acceptance of GM crops by producers and farmers, consumers are less convinced of the benefits and are more concerned of GM technology (Lusk et al., 2002). Consumers' avoidance of GM foods may be attributed to the safety of GM products (Hossain & Onyango, 2004). People avoid consuming GM foods because they believe that genetic modification changes the composition of the product by injecting the food with hazardous materials like hormones and antibiotics (Health Canada, 2016).

2.2 Attitudes Toward GM vs. Natural Food Products

The growing body of literature show that consumers avoid consuming products with a GMO label, but prefer to purchase options made from natural ingredients (Hughner et al., 2007; Rozin et al., 2004; Shafie & Rennie, 2012). Naturalness plays a crucial role in consumers' choices of food products since consumers believe that natural foods do not contain any additives or artificial ingredients and are not made by human intervention (Siegrist, 2008; Rozin et al., 2004). Natural preferences are justified based on different reasons such as instrumental and ideational (Rozin et al., 2004; Rozin, 2006). Instrumental reasons are based on the belief that natural entities are better because they have not been damaged by human intervention, they are healthier, and also they are more environmental friendly (Rozin et al., 2004; Rozin, 2006). Ideational reasons only refer to the notion that natural is just inherently better or right (Rozin et al., 2004; Rozin, 2006). In general, consumers mostly prefer natural products because they believe that natural entities are healthier and environmental friendly than unnatural entities and simply because they are inherently better or right (Rozin et al., 2004; Rozin, 2005).

Therefore, it can be concluded that the public prefer natural entities because of the positive associations these entities generate (Rozin et al., 2004). Since nature and naturalness are associated with almost positive beliefs, natural food products are more preferred than "non-natural", "artificial" or "processed" food products (Rozin et al., 2004; Rozin, 2006). Opposed to natural entities, unnatural entities have been associated with negative traits (Rozin et al., 2004). Research has shown that one of the most critical factors for naturalness judgment is the process that the product has undertaken to be produced (Rozin et al., 2004; Rozin, 2005; Rozin, 2006).

Compare to other human intervention methods such as freezing, adding or removing components, mixing with other natural or unnatural entities, and domestication, genetic engineering techniques are the most influential factor in reducing perceived naturalness (Rozin et al., 2004). Opposed to natural products, GM food products are associated with negative beliefs that the product is destroying the nature, and ethnically wrong and unhealthy (Grunert et al., 2003; Rozin et al., 2004). Human intervention through GM technology violates a natural entity's essence and makes it unnatural (Hingston & Noseworthy, 2018). The intuitive notion that natural is inherently good and unnatural is inherently bad may result in disregarding the benefits of GM foods (Loureiro & Bugbee, 2005). In general, perceiving a food product as natural or non-natural may be an influential factor in biasing consumers' perceptions (Schuldt & Schwarz, 2010).

2.3 Halo Effect

Halo effect is one of the most recognized psychological phenomena (Nisbett & Wilson, 1977a). The halo effect happens when individuals' evaluation of one trait of an entity powerfully affects or biases the individual's perceptions of other attributes of the same entity (Lee et al., 2013). This phenomenon can be described based on the implicit personality theory stating that "nice people tend to have nice attributes and less nice people have less nice attributes" (Nisbett & Wilson, 1977a). Halo effect was first introduced by Edward Thorndike who showed that the estimates of the same person based on different numbers of characteristics such as intelligence, industry, technical skill, reliability were correlated (Thorndike, 1920). This correlation may be explained by the fact that raters were not able to evaluate different traits of the same person independently and their ratings were influenced by a strong tendency to rate individuals in general as rather good or rather bad (Thorndike, 1920).

The research shows that halo effect can be explained through cognitive dissonance (Asch, 1946 as cited in Grcic, 2008) and individuals have little awareness of the nature and existence of the cognitive processes that underlie their judgments, inferences, and the production of complex social behavior (Nisbett & Wilson, 1977b). Cognitive dissonance happens when people have inconsistent beliefs or behaviors which lead them to minimize this dissonance by seeking information that supports their previous beliefs and avoiding conflicting information that may increase dissonance (Grcic, 2008). For example, when individuals form a positive impression of another person, they try to have that impression be consistent with other impressions (Grcic, 2008). In general, people seek to obtain information that is consistent with their previous beliefs and decrease dissonance by generalizing and avoiding conflicting information (Grcic, 2008).

However, this effect works in two different directions in a way that positive information results in positive evaluation of traits, whereas, negative information results in negative assessment of traits (Gräf & Unkelbach, 2016). Positive halo effect states that individuals often over-generalize by assuming one positive trait shows the existence of other positive traits (Vos et al., 2019). Conversely, negative halo effect (horn effect) refers to the negative influence of a single undesirable characteristic on impression formation for unrelated dimensions (Zeigler-Hill et al., 2019).

In the study conducted by Nisbett & Wilson, (1977a), participants were asked to rate the favourableness of the instructor who spoke English with a European accent on attributes such as appearance, mannerisms, and accent when the instructor spoke in warm or cold manner. The results showed that these attributes were rated much more positively when participants watched the warm versus cold instructor speaking since participants' perception was influenced by a positive global attitude toward the instructor. Specifically, global evaluation of a person can strongly change evaluations of particular attributes even when there is enough information to allow for independent appraisal of attributes (Nisbett & Wilson, 1977a). This effect has been investigated across various contexts and attributes throughout the decades (Dennis, 2007; Landy & Sigall, 1974; Nufer, 2019) and also it is extended beyond human characteristics to food and health (Wansink & Chandon, 2006).

2.3.1 Health Halo Effect

Research shows attributes of the food product such as brand, claim, and label can bias consumers' perceptions about the food product (Besson et al., 2020). Consumer's perceptions of claims, symbols or labels attached to food packaging or advertisements can evoke the health halo effect which is an extension of the halo effect (Nufer & Alesi, 2019; Roe, Levy, & Derby, 1999). This effect has been found for the nutritional (Wansink & Chandon, 2006), organic (Lee et al., 2013; Schuldt & Schwartz, 2010) and also vegetarian labels (Besson et al., 2020).

Health halo happens when consumers form biased impressions of a product (e.g., healthy) from limited information (Burton et al., 2015). Roe et al. (1999) show that nutrient-content and health claims can influence individuals' information processing, which results in healthier product appraisal through halo effect. The results demonstrated that the presence of health claims will cause individuals to limit their information search and rate a product healthier based on the information present on the food package which has been attributed to halo effect. In other words, positive health halos may impact consumers' inferences about missing attributes of foods and actual consumption in such a way that consumers generalize that a food product with a health claim is healthy and they can eat more per recommended serving.

The impact of health halo effect has been investigated across various contexts and different consumption settings such as grocery stores and restaurants that advertise to offer healthy choices. For example, Wansink and Chandon (2006) examined how information present on a food label can impact consumers' estimation of the calorie amount and consumption of the food product. Participants were incoming students and their families at a university open house. After entering the display area, they were taken to one of two serving bowls of M&M's that was labeled as "low fat," or "regular" and were told that they could consume as many M&M's as desired. The study revealed that labeling a product as "low fat" increased the consumption volume as subjects underestimated the calorie density they consumed. Research also shows that positive beliefs which are associated with organic food products, which consumers often consider synonymous with natural (Román et al., 2017; Hamzaoui Essoussi & Zahaf, 2008), can produce a health halo effect and when such an effect exists, consumers' reasoning about food products is more favourable (Lee et al., 2013; Román et al., 2017; Schuldt & Schwarz, 2010).

2.3.2 Health Horn Effect

Although the halo effect was first considered in the context of positive attributes, there is also a negative halo effect which refers to the negative influence of a single undesirable characteristic on impression formation for unrelated dimensions (Zeigler-Hill et al., 2019). The horn effect, opposite to the halo effect, describes a negative bias that causes the perception of a person or objects to be influenced by a single negative trait (Burton et al., 2015). Specifically, "health horn" effect refers to negative inference that happens when a product is perceived to be unhealthy (Burton et al., 2015).

Research shows that negative beliefs associated with GM foods can produce a health horn effect and when such an effect exists, consumers' reasoning about food products is less favourable (Sundar, Kardes, & Noseworthy, 2014). These negative attitudes towards GM food products may result in decisive negative associations that overshadow potential benefits perceived (Grunert et al., 2003). Therefore, it is less likely that consumers accept GM food products to natural or healthy food products (Costa-Font et al., 2008).

2.3.3 Overcoming Health Horn Effect

Overcoming the health horn effect associated with negative labels such as GMOs is challenging (Sundar et al., 2014). Despite the avoidance of people from consuming GM food products, several studies have focused on introducing ways to improve the acceptance of GM products (Loureiro & Bugbee, 2005; Lusk et al., 2002; Savadori et al., 2004; Siegrist, 2008). GM literature has been established that consumers' acceptance of GM food products depends on the evaluation of benefits and risks associated with the product and if the benefits outweigh the risks (Loureiro & Bugbee, 2005). Providing information about the benefits of GM products such as improved nutritional value, improved taste or lower price may result in reduced perceived risk by public (Lusk et al., 2002; Magnusson & Hursti, 2002; Savadori et al., 2004; Siegrist, 2008). For instance, Magnusson and Hursti (2002) showed how consumers' attitudes toward GM foods will change among Swedish consumers by tangible benefits such as protecting the environment or producing healthier food options through GM technology. The research showed that although most of the consumers had moral and ethical doubts toward GM foods, tangible benefits may increase their willingness to pay for GM foods. A considerable number of consumers declared that they will buy GM foods if they notice that GM technology has made the food products that benefit human health (Magnusson & Hursti, 2002)

Although there are several benefits associated with GM food products, research demonstrated that increased nutritional value of GM foods is one of the highest level benefits associated with GM foods that can negate the adverse consumer reaction to GM foods (Loureiro & Bugbee, 2005). Nutritional attributes may play an important role in encouraging consumers to shift from non-GM foods to the functionally improved GM foods (Hossain & Onyango, 2004). On the other hand, some studies revealed that improved taste and functionality of GM food products will not compensate for the negative perceptions that consumers have regarding GM products (Grunert et al., 2001).

2.4 Health Horn/Halo Effect and Nutrition Perception

The influence of heath halo/horn effect has not been limited to general product evaluation and it has been investigated in different contexts such as nutrition perception (Chandon & Wansink, 2007; Sundar et al., 2014). Nutrition information is provided for food products to enable consumers to make healthier decisions (Grunert & Wills, 2007). Consumers confront with positive and negative nutrition attributes and are interested in foods that have higher amounts of positive nutrition attributes and lower amount of negative nutrition attributes (Balasubramanian & Cole, 2002). Positive attributes are nutritional traits that should be increased such as fiber, vitamin and mineral, and protein, whereas negative nutrition attributes are nutritional traits that should be decreased such as fat, cholesterol, calorie, and sodium (Balasubramanian & Cole, 2002; Oakes & Slotterback, 2001b; Provencher, Polivy, & Herman, 2009). Numerous researches have investigated the influence of health horn effect and health halo effect on nutrition perception (Buckland et al., 2015; Chandon & Wansink, 2007; Ebneter, Latner, & Nigg, 2013).

Wansink and Chandon (2006) state that when participants were asked to estimate the actual calorie content of meals, health halos lead individuals to believe that food contains lower amount of calorie content and they can consume that food in higher amount. Likewise, Chandon and Wansink (2007) demonstrated that health claims may lead to underestimation of the caloric density of foods when participants were asked to rate the amount of calorie content in foods. With four studies, the results showed that individuals are likely to underestimate the calorie content of foods in restaurants that claim to offer healthy foods than restaurants that do not make this claim. Moreover, Schuldt and Schwarz (2010) revealed that introducing a cookie as organic food product will cause individuals to evaluate it as a food product with lower amount of calories which can be eaten more compare to conventional cookies. Therefore, it seems that when positive beliefs are associated with labels such as natural or organic, consumers evaluate the food product as more healthy and underestimate the negative nutrition attributes associated with these kinds of products (Lee et al., 2013; Schuldt & Schwarz, 2010). In other words, the importance of negative nutrition attributes may decrease since consumers already expect that the way that the product is produced has reduced its negative outcomes and they may pay attention to other attributes.

Sundar and colleagues (2014) showed that GM foods produce a negative horn effect and when such an effect exists, consumers' reasoning about food products is less favourable. Participants' positive perception (positive halo) was manipulated by using "real ingredients" label and their negative perception (negative halo) was manipulated by showing "artificial ingredients", "Contains Additives", or "Genetically Modified Organism (GMO)" on the label. Conducting two studies, results revealed that negative conditions led participants to conclude that the product has higher calories and was less healthy to eat compared to control group. Grunert and colleagues (2003) have conducted a study to determine consumers' attitudes toward GM foods. Yogurt was chosen as a food product with different combinations of fat content, additives, texture and production method (Traditional vs. GM). Consumers from 4 countries were asked to choose the most and the least preferred products. Despite the fact that GM product was least preferred by consumers in most of the countries, consumers appreciated the low fat content and the lack of additives of GM yogurt (Grunert et al., 2003).

Moreover, Burton and Pearse (2003) concluded that a large number of consumers who care more about cholesterol are more likely to pay a premium to buy a bottle of beer with the benefit claim that will reduce cholesterol levels. Likewise, Grunert and colleagues (2001) found that societal relevance and personal tangible benefits compensate for risks and negative association with GM foods more than other benefits. In other words, among different combinations of GM products, those with low-calorie content that could be consumed by diabetics were more valued by consumers. Therefore, it is expected that GM food products that contain less negative nutrition attributes are more valuable for consumers. In other words, since consumers expect more negative nutrition attributes associated with GM food products, they try to reduce these negative outcomes by giving them more importance than other attributes of the product.

As the literature shows, GMO and all-natural labels may influence consumers' tendency toward nutrition attributes differently. Logically, consumers may be interested in foods with lower amount or no negative nutrition attributes and higher amount of positive nutrition attributes (Balasubramanian & Cole, 2002). However, previous research mostly investigated the influence of food labels on negative nutrition attributes and disregarded the influence of these labels on positive nutrition attributes. Hence, this study will investigate whether health halo or horn effect associated with GM and natural food products are influential factors in impacting consumers' nutrition attribute preferences and evaluate consumers' tendency for deciding based on specific nutrition attributes (positive or negative).

Assumption about GM (e.g., GM foods are bad – a health "horn") and natural (e.g., natural foods are good – a health "halo") food products can influence consumers' nutrition perception and ultimately their preferences. As the literature stated, there are positive and negative beliefs associated with GM and natural food products (Hughner et al., 2007; Rozin et al., 2004). Therefore, individuals' beliefs and expectations about these kinds of food products may result in seeking specific information by consumers which can be explained by confirmation bias theory.

2.5 Confirmation Bias

Confirmation bias is an attitude toward seeking or interpreting information in a way that confirms one's previously existing beliefs, expectations or hypotheses (Christandl, Fetchenhauer, & Hoelzl, 2011). Specifically, when individuals selectively seek information that supports their expectations and disregard disconfirming information, the consumer is subject to confirmatory bias (Nickerson, 1998).

This phenomenon has been investigated in many contexts (Lallement et al., 2019; Mandler, Won, & Kim, 2017). In the context of nutrition information seeking, Lin and colleagues (2004) reported that individuals have a tendency to disregard information that may result in cognitive dissonance between their behavior and perception of the behavior and this phenomenon has been explained by selective information avoidance tendency. The results of their study showed that the search for fat and cholesterol information on food labels is more among subjects who believe in the significance of low-fat diets and individuals who consume more fat, or cholesterol are less likely to search for this information on food labels which is inconsistent with their dietary behaviors. In other words, the likelihood of looking for negative nutrition information such as fat and cholesterol on food labels is related to dietary behaviors (Lin, Lee, & Yen, 2004).

The theory of confirmation bias regarding GM food products has also been investigated (McFadden & Lusk, 2015; Ruth & Rumble, 2019; Zhu & Xie, 2015). Zhu and Xie (2015) showed that it is possible that individuals with a high level of risk perception (moral, natural, and uncertainty) regarding GM foods selectively gather and interpret risk information and disregard benefit information about GM foods which may cause the avoidance of GM food products (Zhu & Xie, 2015). The literature shows that because of confirmation bias, it is difficult to share positive messages with consumers who have strong negative attitudes regarding GM food products (McFadden & Lusk, 2015). Consumers with extremely negative views regarding GM food products reject any message that conflicts with their beliefs (Ruth & Rumble, 2019). Yet, these studies have not explored the possibility that GMO or all-natural label using may influence the relative importance of positive and negative nutrition attributes.

Therefore, it is likely that when the product has GMO label which consumers have negative views about, they would support and confirm this hypothesis or expectations by considering the GM food product as unhealthy product and thus expecting to see more negative nutrition attributes and less positive nutrition attributes associated with GM food products. On the other hand, given that there are positive beliefs associated with natural foods (Rozin et al., 2004); it can be assumed that products with all-natural labels affect nutrition attributes preferences of food products differently compare to GMO labels. Therefore, consumers may support their favourable thought regarding the natural products by expecting to see less negative nutrition attributes and more positive nutrition attributes associated with natural food products. This can be explained by confirmation bias theory which refers to willingness to seek or interpret information in a way that supports one's previously existing beliefs, expectations or hypotheses (Christandl et al., 2011).

2.6 Product Healthiness Perception

Although previous research shows that GMO and organic label can influence consumers' nutrition perception, research demonstrates that this effect can be moderated through healthiness perception of the product category (Ellison et al., 2016; Lee et al., 2013). Products can be classified in healthy and unhealthy categories which result in different healthiness perceptions of food products (Carels, Konrad & Harper, 2007; Carels, Harper & Konrad, 2006). Different factors such as stereotypical beliefs relative to the name of the food, food description, and food-related beliefs may impact the classification of food products to healthy and unhealthy categories and consumers’ evaluation about the healthiness of food products which eventually affect their food intake, appraisal and choice (Bialkova, Sasse, & Fenko, 2016; Carels et al., 2006; Carels et al., 2007; Ebneter et al., 2013; Gravel et al., 2012; Oakes & Slotterback, 2001a; Provencher et al., 2009).

2.6.1 Product Healthiness Perception and GM/Natural Foods

The research demonstrates that healthiness perception of the food product can moderate the influence of food labels on consumers' nutrition perception and preferences (Ellison et al., 2016; Lee et al., 2013). For example, Carels and colleagues (2007) demonstrate that the influence of labels promoting certain nutritional and health benefits such as reducing fat or sugar may be biased by the product category. The authors showed that because there is an association between poor health and weight gain and good health and weight loss, when the product is perceived as healthy, the caloric content is underestimated and it was overestimated when the food product was perceived as unhealthy (Carels et al., 2007). Some research has demonstrated that unhealthy products benefit from the organic label with regard to their health or nutrition ratings (Ellison et al., 2016; Lee et al., 2013). In addition, research shows that the product category can impact the acceptability of GM products (Gamble et al., 2000).

In this regard, Lee and colleagues (2013) investigated the relationship between organic vs. non-organic label and consumer perception of healthy (yogurt) and less healthy (potato chips and cookies) food products. Participants were recruited from a local shopping mall to rate mentioned food products. The results demonstrated that participants perceived the food products with organic label healthier in total compared to their non-organic counterparts. Moreover, participants had more willingness to pay for these kinds of food products compared to non-organic food products. Nevertheless, these effects were weaker for healthy food products (yogurt) compared to less healthy food products (cookies and potato chips). The authors contemplated that there is a possibility that since yogurt is perceived as a healthy food product per se, this perception mitigate the influence of organic label; therefore, labeling it as conventional or organic may not result in significant difference (Lee et al., 2013).

Ellison and colleagues (2016) examined the influence of product type (Virtue vs. Vice) and organic label on product evaluation. The study revealed that organic products were perceived more desired on measures such as nutrition, brand attitude, and brand trust than non-organic products which are explained by the organic halo effect. However, the difference in nutrition perception between organic and non-organic vice products (cookies) was larger than the difference between organic and non-organic strawberries. More specifically, there was no significant difference between healthiness perception of organic and non-organic strawberries, whereas organic cookies were evaluated remarkably more nutritious than their non-organic peers. This issue has been explained by the notion that virtue (healthy) products are inherently perceived as more healthy and the organic label might do little to enhance consumers' appraisal of the product. It can be explained by the reason that healthy food products will mitigate the health halo effect resulted from the organic or all-natural label since the product has already been perceived as healthy and producing it organically or naturally may make little improvement. It is expected that unhealthy products may benefit more from labels that are associated with positive beliefs. When the product is perceived as healthy per se, the all-natural label will not add to the healthiness of it; however, when the product is unhealthy, the all-natural label can make it healthier.

Moreover, in the study conducted by Gamble and colleagues (2000), the authors showed that the way that a product is produced (GM technology) is more important than the quality, taste, and price of the healthy products (tomatoes) than unhealthy products (chocolate biscuits). The authors demonstrate that since the chocolate biscuits are already perceived as being unhealthy, consumers do not pay attention whether the production method is also considered as unhealthy or not (Gamble et al., 2000 as cited in Tenbu¨lt et al., 2005). This explanation may be attributed to the reason that unhealthy food products may mitigate the health horn effect resulted from applying GM technology. Therefore, this research is going to investigate whether product category healthiness perception will mitigate the labeling effect of GMO and all-natural labels on nutrition perception.

2.7 Summary of Research Findings and Literature Gap

Consumers have a strong preference for natural products and perceive foods with an organic or all-natural label to be healthier than products without the label (Parasidis, Hooker, & Simons, 2015; Rozin, Fischler, & Shields-Argelès, 2012). On the other hand, GM foods are perceived as manipulative to nature and immoral (Dreezens et al., 2005). Literature shows that these beliefs regarding GM and natural food products may result in health horn or halo effect which ultimately influences nutrition perception. However, the influence of these labels on consumers' attention to positive and negative nutrition attributes has not been investigated. Since GM foods are perceived to be manipulative to nature and immoral (Dreezens et al., 2005), it can be assumed that GMO label differently impacts nutrition preferences in a food product compared to a food product that is produced naturally. Therefore, the first objective of this study is to investigate whether GMO and all-natural labels influence the relative importance of positive and negative nutrition attributes on consumer product decision (Gap #1).

Furthermore, studies have demonstrated that the influence of GMO and organic labels also depends on the food product category and the healthiness perception that consumers already have about the food product (Ellison et al., 2016; Gamble et al., 2000; Lee et al., 2013). It has been stated that when the food product is already perceived as healthy, the influence of organic label on healthy product is less than unhealthy product (Ellison et al., 2016). In addition, consumers are not sensitive to the way that the product is produced (GM technology) when the product is already perceived as unhealthy (Gamble et al., 2000). Therefore, the second objective of this study is to investigate the degree to which the influence of GMO and all-natural labels on the relative importance of nutrition attributes depends on the product healthiness perception (Gap #2).

Chapter 3: Conceptual Framework

3.1 Research Questions

Literature has established that GM and natural food products influence consumers' preferences and evaluations through health horn or halo effect which ultimately can influence their nutrition perception (Besson et al., 2020; Lee et al., 2013; Schuldt & Schwartz, 2010; Vos et al., 2019). Consumers perceive GM foods as manipulative to nature and immoral, while natural foods are seen as preserving nature and the environment (Dreezens et al., 2005). GM foods are generally perceived to be unhealthy because they have been created in a way that does not occur naturally (World Health Organisation, 2014). It has been argued that this negative perception of GM food stems from consumers' assumption that genetically modified technology decreases the naturalness of the food product, which in turn makes the food product unhealthier (Rozin et al., 2004). The most significant belief about natural foods is naturalness whereas GM food is manipulative to nature and altered by human hands (Grunert et al., 2003; Rozin et al., 2004). Assumption about GM (e.g., GM foods are bad – a health "horn") and natural (e.g., natural foods are good – a health "halo") food products can influence consumers' nutrition preferences.

Given that research has not examined the influence of all-natural and GMO labels on the relative importance of nutrition attributes, the first question that this thesis aims to address is:

***Research Question 1:* Whether food product label, GMO and all-natural, influences the relative importance of positive and negative nutrition attributes on consumer product decision?**

Moreover, based on the literature the influence of GMO and all-natural labels may also depend on the food product category and the healthiness perception that consumers already have about the food product (Ellison et al., 2016; Gamble et al., 2000; Lee et al., 2013). For example, when a food product is already perceived as being a healthy food option, the influence of organic label on consumers' nutrition perception for a healthy product is weaker compared to less healthy food product (Lee et al., 2013). Moreover, consumers are not sensitive to the way that the product is produced (GM technology) when the product is already perceived as unhealthy (Gamble et al., 2000). Given that food product healthiness perception may influence the impact of all-natural and GMO labels, the second question this thesis aims to answer is:

***Research Question 2:* To what extent would the impact of GMO and all-natural labels on the relative importance of nutrition attributes depend on the healthiness perception of the food product under consideration?**

Therefore, the overall objectives of this research project are to determine whether GMO and all-natural labels influence the relative importance of nutrition attributes differently and how food product healthiness perception influence this relationship.

3.2 Hypotheses

As literature shows, GM and natural food products influence nutrition perception of food products and improved nutrition attributes are preferable for consumers; however, they have not differentiated between different nutrition attributes and whether these labels influence the relative importance of positive and negative nutrition attributes differently. Since consumers confront with positive nutrition attributes (such as fiber, vitamin and mineral, and protein) and negative nutrition attributes (such as fat, cholesterol, calorie, and sodium) (Oakes & Slotterback, 2001b; Provencher et al., 2009), it is possible that GMO and all-natural labels influence consumers' preferences for positive and negative nutrition attributes differently.

Nutrition formation of products will be affected based on the notion that how perceivers hold favourable/unfavourable attitudes toward the way that a product is processed (Schuldt & Schwarz, 2010). As previous research showed, negative beliefs associated with GM foods may result in health horn effect (Sundar et al., 2014). It can be assumed that the presence of one negative trait (i.e. presence of GMO labels) increase paying attention to other negative traits (e.g. negative nutrition attributes) with less attention to positive nutrition attributes.

Based on confirmation bias theory, it is difficult to influence consumers who have strong negative attitudes toward GM food products by positive messages (McFadden & Lusk, 2015). Therefore, consumers may expect to spend more attention to confirming information (negative nutrition attributes) and less attention to disconfirming information (positive nutrition attribute) of the food product with GMO label. This can be explained by confirmation bias theory which is an attitude toward seeking or interpreting information in a way that confirms one's previously existing beliefs, expectations or hypotheses (Christandl et al., 2011).

Most of the research shows that when consumers are informed that the product was produced through GM technology, they conclude that the product has higher amount of calories (Sundar et al., 2014); on the other hand, consumers valued GM food products that could reduce the cholesterol level and had lower amount of fat and calories (Burton & Pearse, 2003; Grunert et al., 2001; Grunert et al., 2003).This may be because of the reason that consumers are more concerned about the negative nutrition attributes of GM food products which can be the influence of health horn effect. Therefore, when it comes to choose based on negative and positive nutrition attributes, it is expected that consumers make decision based on the negative nutrition attributes because they are more concerned about it rather than positive ones. That is, GMO label may bring down the importance of positive nutrition attributes and increase the importance of negative nutrition attributes of GM food products.

On the other hand, since associated beliefs about GM foods are different from natural food products which results in different effects (health horn vs. health halo), it can be assumed that products with all-natural labels influence consumers' preferences toward positive and negative nutrition attributes differently. Opposed to GM food products, natural foods are associated with more positive beliefs and less unfavourable attributes (Chandon & Wansink, 2007; Rozin et al., 2004), which results in health halo effect (Lee et al., 2013; Schuldt & Schwartz, 2010).

In addition, previous studies show that consumers consider organic or natural products as healthier and underestimate negative nutrition attributes such as calories and fat (Schuldt & Schwarz, 2010; Wansink & Chandon, 2006). This may be because of the reason that consumers are less concerned with the negative nutrition attributes of natural food products which can be the influence of health halo effect. In other words, the importance of negative nutrition attributes of natural food products may decrease and the importance of positive nutrition attributes of natural food products may increase since consumers already expect that the way that the product is produced has reduced its negative outcomes and they may pay more attention to other attributes. Therefore, when it comes to choose based on negative and positive nutrition attributes, it is expected that consumers decide based on the positive nutrition attributes to satisfy their expectation of all-natural label.

In conclusion, we assume that GMO label increase the importance of negative nutrition attributes and bring down the importance of positive nutrition attributes compared to no-label condition. Conversely, we assume that all-natural label increases the importance of positive nutrition attributes and bring down the importance of negative nutrition compared to no-label condition.

However, studies have demonstrated that the influence of GM and organic food products on nutrition perception also depends on the food product category and the healthiness perception that consumers already have about the food product (Ellison et al., 2016; Gamble et al., 2000; Lee et al., 2013). Specifically, the healthiness perception of the food product that carries the GMO or organic label may be a significant factor in nutrition perception (Lee et al., 2013). It has been stated that when the food product is already perceived as healthy, the influence of organic label on healthy product is less than unhealthy product (Ellison et al., 2016). Also, the influence of a positive claim on food products' evaluation will be more significant for unhealthy products (Lee et al., 2013) because in this situation, the positive claim such as an all-natural label may be perceived as a way to increase the healthiness of the unhealthy food product.

Therefore, when the food product is perceived as healthy, we would not expect all-natural label influence the importance of difference nutrition attributes. The reason is that high healthiness perception mitigates the health halo effect produced by an all-natural label. However, we would expect that GMO label brings down the importance of positive nutrition attribute and increase the importance of negative nutrition attribute of healthy food products compared to no-label condition.

Respectively, when the food product is perceived as unhealthy, we would not expect GMO label influence the importance of difference nutrition attributes. The reason is that since the GM food product has already been perceived as unhealthy, unhealthiness perception regarding the food product may mitigate the health horn effect created by GMO label. However, we would expect that all-natural label bring down the importance of negative nutrition attributes and increase the importance of positive nutrition attributes of unhealthy food products compared to no-label condition. In order to determine whether GMO/all-natural label is boosting up or lowering down the weight of positive and negative nutrition attributes, we compared these labels against no-label condition.

Hypotheses are as follow:

H_1: Food healthiness perception moderates the impact of product label on the relative importance of nutrition attribute valence on consumer food decision, such that:

- **H_{1a}:** With unhealthy food products, positive nutrition attributes are more determinative to consumer food choice for products with all-natural label than products without ingredient label.
- **H_{1b}:** With unhealthy food products, negative nutrition attributes are less determinative to consumer food choice for food products with all-natural label than products without ingredient label.
- **H_{1c}:** With healthy food products, positive nutrition attributes are less determinative to consumer food choice for food products with GMO label than products without ingredient label.
- **H_{1d}:** With healthy food products, negative nutrition attributes are more determinative to consumer food choice for food products with GMO label than products without ingredient label.

Chapter 4: Methodology

4.1 Pretest

4.1.1 Objective

A pretest was conducted before designing the main study to determine the stimuli (food product) to use in the main study. For achieving this objective, we tried to identify a neutral food product (neither healthy nor unhealthy) that participants are familiar with and manipulate it in healthy and unhealthy condition. By choosing a neutral food product and manipulating it in healthy and unhealthy conditions, we could control the undesired effects resulted from the difference between food products. In addition, we could make sure that participants are familiar with the food product; therefore, they can evaluate the nutrition attributes carefully.

4.1.2 Participants

In total, 71 undergraduate students (56% female) were recruited through the Department of Marketing & Consumer Studies SONA pool at the University of Guelph to participate in this pretest. Participants conducted the survey online through Qualtrics. There were no age or gender restrictions.

4.1.3 Design

In total, 6 food products were used in the study. The food products used in the study consisted of apple juice, rice crispy, pasta, cottage cheese, bread, and Japanese noodle. The selection of food products was based on previous research and also more familiar food products (Lemmens et al., 2010; Rozin, Kurzer, & Cohen, 2002).

Healthiness perception of 6 food products ("How healthy each one of the food products seems to be?") was evaluated on 7-point scales ranging from 1 (Absolutely unhealthy) to 7 (Absolutely healthy; Hagen, Krishna, & McFerran, 2017). Familiarity with 6 food products ("How familiar are you with each one of the food products?") was evaluated on 7-point scales ranging from 1 (Not at all familiar) to 7 (Extremely familiar; Park & Lessig, 1981).

4.1.4 Procedure

First, participants were asked to read a consent form and agree to participate in the study. Next, participants viewed 6 food products in random order to rate the perceived healthiness of each product. Then, participants were required to answer a question measuring their familiarity with each food product. We expected to identify a neutral food product (neither healthy nor unhealthy) that participants are familiar with in order to manipulate it in healthy and unhealthy condition.

4.1.5 Results

One-Sample T-Test was used in SPSS to compare the mean of the scores for healthiness for each food product (with %95 confidence interval) to the midpoint of the scale (4). Therefore, the null hypothesis is that the mean of the sample is equal to 4 which means that food products with the mean of 4 are neither healthy nor unhealthy.

Compared to the midpoint of the scale (4), four products out of six products were perceived as neither healthy nor unhealthy: had p-value greater than 0.05: rice crispy ($M = 3.7, SD = 1.52; p = .10$), Japanese noodle($M = 3.94, SD = 1.21; p = .7$), pasta ($M = 4.03, SD = 1.16; p = .84$), and bread ($M = 4.14, SD = 1.25; p = .34$). Therefore, the null hypothesis cannot be rejected for these four food products and the mean of healthiness for them is not significantly different from 4. In addition, analysis of familiarity showed that participants are more familiar with bread ($M = 6.32,\ SD = .97;\ p < .05$) and pasta ($M = 5.97,\ SD = 1.3;\ p < .05$) (see Appendix 1 for pretest results).

4.1.6 Discussion

The purpose of the pretest was to identify a neutral product that participants are more familiar with for using in the main study. Four products had been evaluated as neutral; however, participants were more familiar with bread and pasta. Since bread can be considered with different combination of ingredients which may impact the evaluation of nutrition attributes, pasta was selected as a neutral food product.

4.2 Main Study

4.2.1 Objective

The objective of the main study was to investigate whether GMO or all-natural label influences the relative importance of nutrition attributes on consumer product decision. Moreover, we investigated whether product category healthiness perception will influence this relationship.

4.2.2 Participants

In total, 315 undergraduate students were recruited through the Department of Marketing & Consumer Studies SONA pool at the University of Guelph to participate in the study. Participants conducted the survey online through Qualtrics in the lab. The minimum sample size required ($n > 65$) was calculated by following discrete choice experiment's sample size formula:

$$n > \frac{z^2 q}{rpa^2}$$

The assumptions were: $z = 1.96$, the value from the normal distribution at appropriate confidence interval; $p = 0.33$, the proportion of times product is selected (3 alternatives); $q = 0.67$, the proportion of times a product will not be selected $(1 - p)$; $r = 12$, the number of choice sets in the experiment; $a = 0.1$, the allowable sampling error (in accordance with p).

4.2.3 Design

The main study consisted of a 3 (label: GMO vs. all-natural vs. no-label) x 2^7 (choice task: 6 attributes with two levels for each nutrition attributes and price with two levels) mixed design. Participants were presented with a food product that is labeled either made from genetically modified ingredients, natural ingredients or no-label condition. GMO and all-natural labels were manipulated by written statement that explains the way that the ingredients of the food product are being produced. In the natural condition, it was stated that the food product is being made from ingredients that have been grown using a natural farming practice. On the other hand, in the GMO condition, participants were informed that the food product is being made from ingredients that have been genetically modified through gene splicing technology. We used a no-label group (product without label) to see whether the difference between consumers' preferences is related to the health horn/halo effect. After reading the information, participants were provided a nutrition facts table about the food product.

The type of positive and negative nutrition attributes and their levels were obtained from the same products in the market. For pasta, the nutritional information about positive nutrition attributes such as protein, iron, and fiber and also negative nutrition attributes such as energy density (kcal/100 g), saturated fat, and sodium was obtained per serving size (85 gr). These nutrition attributes were commonly used for dry pasta in the market. Although these positive and negative nutrition attributes have been used in previous research, the perceived positivity or negativity of these attributes was measured during the main study. For the nutritional attributes, the higher and lower levels were calculated by adding and subtracting an equal value from the mean amount of that nutrition for pasta in the market.

The nutrition attributes and price and their levels have been summarized in the following table:

Table 1: Nutrition attributes and levels

	Attributes	**Levels (Per 1 cup)**	
		1	**2**
Pasta	Fiber	10%	14%
	Iron	6%	10%
	Protein	12%	16%
	Sodium	1%	5%
	Saturated Fat	2%	6%
	Calories	13%	17%
	Price per 5 cup	1.49	1.99

To account for the effect of food product healthiness perception, we did the experiment in healthy and unhealthy conditions. We selected one food product and manipulated the perceived healthiness by using different pictures and written scenarios for main study (Jones, McVie, & Noble, 2008). Therefore, two different scenarios were developed for healthy and unhealthy conditions. In the healthy condition, a photo of different vegetables and fruits with pasta in the photo was used. In addition, a written statement was presented following the photo to reinforce the healthiness of the situation as follows:

“Sahar is a global food manufacturing company that produces and sells dry pasta and vegetable based snacks such as dried fruit and veggie and fruit chips.”

Moreover, some description of the product and the way that the product is produced was explained.

In the ‘unhealthy’ condition, a photo of different snacks such as crunchy and chocolate bar with pasta within the photo was used. In addition, a written statement with inherently unhealthy words following the photo was presented to influence the perceptions of the participants as follows:

“Sahar is a global food manufacturing company that produces and sells dry pasta and snacks including crunchy cheese, corn chips, potato chips, salty pretzel, and popcorns.”

Participants were randomly assigned to one of the 3 experimental conditions 3(label: GMO vs. all-natural vs. no-label) for healthy or unhealthy conditions and they were asked to view information about the new food product and complete different choice sets by making a choice among 3 different product options that differ on the percentage amount of nutrition repeatedly. Therefore, the choice task of each product was nested within label manipulation, resulting in a 3 (label: GMO vs. all-natural vs. no-label) x 2^7 (choice task: 6 nutrition attributes and price with two levels for each nutrition attributes and also price) mixed design. A manipulation check question about ingredient type and each serving size of the pasta was added to make sure that participants are engaged in the task. Participants were asked “What is the serving size of each cup of dry pasta?” and “What type of wheat was used to make dry pasta?”

A total of 6 scenarios were used in this study (see Appendix 2 for pictures and written scenarios used in the main study). Choice sets were randomly assigned to participants (see Appendix 3 for an example of choice set featuring sample nutrition fact stimuli).

4.2.4 Procedure

The experiment was conducted through lab experiment using Qualtrics. First, participants were asked to read a consent form and agree to participate in the study. Participants were told that the purpose of the study was to explore consumer preferences for a new product that will be introduced to the market. Then, they were randomly assigned to one of six conditions. In each condition, they were emphasized to read the descriptions of the food product that the company is launching and got to know the nutrition facts and the levels of each attribute. There was a timer built into Qualtrics to ensure that the participants stayed on the description page for 30 seconds before being able to proceed to the next page.

Then, they were provided with 12 choice sets randomly. In each choice set, participants were asked to consider three different dry pasta options under the guise that the company would like to understand how consumers rely on nutritional facts to make purchase decisions. In this way, we could hold brand, size, and flavor constant, and thus get a true estimation of nutrition preference. For each of the 12 choice sets, participants were asked to indicate “which dry pasta option would you be most likely to choose?”

Specifically, in each choice set, they were asked to compare and evaluate three options of the food product that differ on price and the percentage amount of nutritional elements and choose the one they like most by clicking the option that corresponds to it. Participants were then asked to determine their thought on the nutrition elements. Nutrition attribute valence of each nutrition ("How do you think of each nutritional element?") was measured by three items on 7-point scales ranging from 1 (bad) to 7 (good), 1 (unhealthy) to 7 (healthy), and 1 (the less amount the better) to 7 (the more amount the better). Subsequently, participants were asked to answer a series of questions about health consciousness and nutrition involvement and also demographic questions. Finally, participants read a debriefing form which showed the true nature of the study and asked to provide their consent again.

4.2.5 Data Analysis

Discrete Choice Experiment (DCE) was used to determine individuals' preference for different nutrition attributes and explore how the preference change for different labels and product categories. DCEs widely used in marketing research to evaluate consumers' preferences of different nutrition attributes by designing choice options that consumers may face in real environment (Crouch et al., 2009). The DCE consisted of 12 choice sets (12 choice combinations) with 3 product alternatives, with experimentally designed attribute levels.

Random utility theory (RUT) (McFadden, 1974), what discrete choice experiment is based on, postulates that each individual may have latent preferences (specified by observed and unobserved components) associated with all alternatives being considered. Individuals maximize utility by selecting their most preferred alternative. Multinomial logit model (MNL) which is one of the best known discrete choice models was used to estimate the attribute preference coefficients. This model assumes that the unobserved component is independent and identically distributed across alternatives and individuals. According to MNL model, the latent utility of alternative *i*, derived by *n*th respondent can be expressed as:

$$U_{ni} = \beta' X_{ni} + \varepsilon_{ni}$$

Where U_{ni} is the latent utility of alternative i, judged by the *n*th respondent; X_{ni} is the vector of attributes of alternative i; β is a vector of parameters representing the preference for each attribute and ε_{ni} is the stochastic or random part of the utility of alternative *i* derived by the *n*th respondent. Also, the probability of choosing alternative *i* all over the J alternatives presented may be written as:

$$P_{ni} = \frac{\exp(\beta' X_{ni})}{\sum_{j-1}^{J} \exp(\beta' X_{ni})}$$

Since we decided to look at the mean preference or utility for positive and negative nutrition attributes for dry pasta in all different conditions (GMO, all-natural, and no-label), we used the WALD statistic to test whether the shift in preference for the combined nutrition attributes was statistically different from zero.

In this research, there were six nutritional elements presented to participants for dry pasta (three positive and three negative nutrition elements). Therefore, the key theoretical contrasts were to explore the combined preference for the positive nutrition and the combined preference for the negative ones across the three ingredient conditions (GMO, all-natural and no-label) for healthy and unhealthy conditions.

We were required to indicate whether healthiness perception and labels shift consumer's combined preferences for nutrition attributes. Therefore, we examined whether there is a significant difference in the relative importance of positive and negative nutrition attributes of dry pasta among the experimental conditions (GMO and all-natural) and no-label condition (a condition that there are no cues that indicate a particular ingredient they should focus on) for healthy and unhealthy dry pasta. Based on the literature review, we expected that the unhealthiness perception mitigate the health horn effect of the GMO label. As a result, for the unhealthy condition, our expectation was that the combined preference for the positive nutrition attributes be the same between GMO and no-label conditions. In addition, we expected that the combined preference for the negative nutrition attributes be the same between GMO and no-label conditions. In addition, we expected to see different combined preference for the positive nutrition attributes for all-natural and no-label condition and also different combined preference for negative nutrition attributes for all-natural and no-label condition.

On the other hand, for the healthy condition, we expected that the healthiness perception mitigate the health halo effect of the all-natural label. Therefore, our expectation was that the combined preference for the positive nutrition attributes be the same for all-natural and no-label conditions and also combined preference for negative nutrition attributes be the same for all-natural and no-label conditions. In addition, we expected to see different combined preference for the positive nutrition attributes for GMO and no-label condition and also different combined preference for the negative nutrition attributes for GMO and no-label condition. Therefore, we used Wald test to examine whether the utility difference between the two main nutrition attributes (positive and negative) in both GMO and no-label conditions are statistically different from the utility difference in the all-natural condition for unhealthy food product. On the other hand, we investigated whether the utility difference between the two main nutrition attributes (positive and negative) in both all-natural and no-label conditions are statistically different from the utility difference in the GMO condition for healthy food product. The study's expectation has been summarized in the following table:

Table 2: Expectation of the nutrition preferences

Food Product Category	Relative Importance of Nutrition Attributes
Unhealthy	Negative (All-natural) < Negative (No-label) Positive (All-natural) > Positive (No-label)
Healthy	Negative (GMO) > Negative (No-label) Positive (GMO) < Positive (No-label)

Given that we chose to examine the relative importance of three positive and three negative nutrition attributes, we could investigate different contrasts for different conditions. For example, if we wanted to investigate whether the combined preference for the negative nutrition for GMO conditions is higher in comparison to the natural condition, we could consider the key restriction coefficients for the negative nutrition, R(1 1 1 -1 -1 -1). The three 1s are for the combined preference of the negative nutrition in the GMO ingredient condition, and the three -1s are for the combined preference of the negative nutrition in the natural ingredient condition. The null hypothesis is simply, R|β|=<0.

We used Wald test to determine whether the utility differences between different nutrition attributes in GMO, all-natural, and no-label conditions are statistically different. The test statistic can be expressed as:

$$W = (R|\hat{\beta}| - r)'[R\,\mathbf{VCOV}(\hat{\beta})R'\,]^{-1}(R|\hat{\beta}| - r) \sim X_q^2$$

In this equation, R is q x k matrix of restrictions, q is the number of restrictions (here q=1), k is number of parameters in the restriction, **VCOV** is variance - covariance matrix of $\hat{\beta}$ and r in our study is expecting to be not significantly different from zero.

4.2.6 Results

The discrete choice experiment was analyzed using R Studio. By using discrete choice experiment we were able to identify which attributes influence consumers' choice of food products more or less when they are produced with different ingredients.

4.2.6.1 Participants

A total of 315 (47% female, M_{age} = 20) subjects were collected of which 308 responses were used. Seven responses were excluded from analyses because of the incomplete answers. Out of the 308 participants, 67% of the participants were under 20 years of age, 29% were between the ages of 20 and 24, and the 4% remaining was above the age of 24. In addition, analysis of familiarity showed that participants are familiar with dry pasta ($M = 5.21, SD = 1.57; p < .001$). 86 % of the participants in all-natural condition specified that the pasta was made from natural ingredients, 92% specified that the pasta was made from genetically modified ingredients in GMO condition; therefore, we removed those participants that answered the question wrong. Also, 89% of participants guessed the serving size of each cup of dry pasta correctly which means most of the participants answered the questions with awareness of the serving size of each cup of dry pasta.

4.2.6.2 Factor Analysis and Results of Nutrition Attribute Valence

To ensure that all of the scales used for positivity and negativity of nutrition attributes were properly represented by the items used to measure them, a factor analysis was conducted before evaluating the nutrition attribute valence. The results of the factor analysis with varimax rotation showed that nutrition attribute valence can be measured through three items for each nutrition attribute (See Appendix 4).

In addition, internal reliability of the factors was evaluated through Cronbach's alpha. The results of Cronbach's alpha for different nutrition attributes were as follows Fiber ($\alpha = 0.85$), Iron ($\alpha = 0.83$), Protein ($\alpha = 0.78$), Saturated fat ($\alpha = 0.93$), Sodium ($\alpha = 0.92$), and Calories ($\alpha = 0.86$). Since the reliability of factors is acceptable (Cronbach, 1951), we calculated the composite scores for each factor based on the means of the items that had their primary loadings on that factor for using in the following analyses.

One-Sample T-Test was used to compare the mean of the scores for nutrition valence of each nutrition attribute (with %95 confidence interval) to the midpoint of the scale (4). Compared to the midpoint of the scale (4), fiber ($M = 5.9$, $SD = 0.81$; $p < .001$), iron ($M = 5.92$, $SD = 0.85$; $p < .001$), and protein ($M = 6.24$, $SD = 0.7$; $p < .001$) were identified as positive nutrition attributes. Moreover, saturated fat ($M = 2.44$, $SD = 1.26$; $p < .001$) and sodium ($M = 2.88$, $SD = 1.29$; $p < .001$) were identified as negative nutrition attributes. However, calorie was considered as neutral nutrition attribute ($M = 4.1$, $SD = 1.24$; $p = .17$); therefore, we eliminated this nutrition attribute from the analyses (See Appendix 5 for nutrition attribute valence). Since we wanted to calculate the combined preference for positive and negative nutrition attributes and we had 2 negative and three positive nutrition attributes (because of the elimination of calories), we decided to eliminate one of the positive nutrition attributes from the analyses which was done based on the results of the estimates of the MNL model which has been discussed in the upcoming sections.

4.2.6.3 Goodness of Fit Model

The Goodness of fit of models with all nutrition attributes as well as price and also all nutrition attributes without calories and price was compared through Log-Likelihood Ratio Test (LRT) of the two models for six conditions. Since we wanted to disregard price and calories from analyses, we examined and compared two models for each condition. First, we examined Model 1 which considered all nutrition attributes except calories and the price. Model 2 examined, included all positive and negative nutrition attributes and price.

For the unhealthy-no label condition, we compared the log likelihoods of model 1, Log L = -580.28 parameters. = 5 and model 2, Log L = -554.88, parameters. = 7. The results revealed LRT (2) = 50.82, $p<0.05$. For the healthy-no label condition, we compared the log likelihoods of model 1, Log L = -599.26 parameters. = 5 and model 2, Log L = -551.22, parameters. = 7. The results revealed LRT (2) = 96.07, $p<0.05$.

For the unhealthy-GMO condition, we compared the log likelihoods of model 1, Log L = -480.21 parameters. = 5 and model 2, Log L = -436.00, parameters. = 7. The results revealed LRT (2) = 88.42, $p<0.05$. For the healthy-GMO condition, we compared the log likelihoods of model 1, Log L = -506.98 parameters. = 5 and model 2, Log L = -482.93, parameters. = 7. The results revealed LRT (2) = 48.1, $p<0.05$.

For the unhealthy-natural condition, we compared the log likelihoods of model 1, Log L = -575.52 parameters. = 5 and model 2, Log L = -534.99, parameters. = 7. The results revealed LRT (2) = 81.06, $p<0.05$. For the healthy-natural condition, we compared the log likelihoods of model 1, Log L = -524.53 parameters. = 5 and model 2, Log L = -487.76, parameters. = 7. The results revealed LRT (2) = 73.56, $p<0.05$. As expected, model 2 better predicted the choice of the participants than model 1 in all conditions. Therefore, Model 2 was selected to proceed with.

4.2.6.4 Hypothesis Findings

For examining the hypotheses, the GMO, all-natural, and no-label conditions were estimated using a MNL model. The results of coefficients for nutrition attributes in different conditions have been summarized in Table 3. As the results show, all the estimates had expected signs and were highly significant except fiber in unhealthy-no label condition (See Appendix 6 for the results of variance-covariance matrix). Given that the coefficient of fiber was not significant in no-label condition for unhealthy food products, we decided to eliminate fiber from the analyses.

Table 3: Estimates of MNL model for all conditions

Dry Pasta		**GMO Condition**			**All-natural Condition**			**No-label Condition**		
		β	**SE (β)**	**P-value**	**β**	**SE (β)**	**P-value**	**β**	**SE (β)**	**P-value**
Healthy	Fiber 14%	0.252	0.053	0.000	0.307	0.052	0.000	0.284	0.049	0.000
	Iron 10%	0.289	0.058	0.000	0.339	0.060	0.000	0.165	0.056	0.003
	Protein 16%	0.489	0.054	0.000	0.294	0.052	0.000	0.419	0.049	0.000
	Sodium 5%	-0.206	0.051	0.000	-0.265	0.051	0.000	-0.313	0.048	0.000
	Saturated Fat 6%	-0.410	0.055	0.000	-0.375	0.054	0.000	-0.391	0.051	0.000
	Calories 17%	-0.248	0.054	0.000	-0.272	0.054	0.000	-0.230	0.050	0.000
	Price per 5 cups $1.99	-0.243	0.053	0.000	-0.326	0.051	0.000	-0.388	0.050	0.000
Unhealthy	Fiber 14%	0.187	0.055	0.001	0.196	0.049	0.000	0.067	0.048	0.160
	Iron 10%	0.194	0.065	0.003	0.212	0.056	0.000	0.180	0.055	0.001
	Protein 16%	0.451	0.056	0.000	0.268	0.050	0.000	0.256	0.048	0.000
	Sodium 5%	-0.436	0.054	0.000	-0.229	0.048	0.000	-0.362	0.047	0.000
	Saturated Fat 6%	-0.488	0.059	0.000	-0.306	0.050	0.000	-0.466	0.050	0.000
	Calories 17%	-0.280	0.059	0.000	-0.321	0.051	0.000	-0.244	0.052	0.000
	Price per 5 cups $1.99	-0.406	0.057	0.000	-0.278	0.049	0.000	-0.228	0.049	0.000

Based on the hypothetical development, for the unhealthy product, we expect the same combined preferences for negative nutrition attributes and the same combined preferences for positive nutrition attributes between the GMO and no-label conditions since we assumed that unhealthiness perception may mitigate the influence of GMO label. Using Wald statistics, we tested equation 1 and 2 below for examining combined preference for positive and negative nutrition attributes, respectively:

Equation 1: $(\beta_{GMO\_Iron} + \beta_{GMO\_Protein}) - (\beta_{No\text{-}label\_Iron} + \beta_{No\text{-}label\_Protein}) = 0$

Equation 2: $(\beta_{GMO\_SaturatedFat} + \beta_{GMO\_Sodium}) - (\beta_{No\text{-}label\_SaturatedFat} + \beta_{No\text{-}label\_Sodium}) = 0$

First, for testing equation 1, we used the coefficients for positive nutrition attributes for GMO and no-label conditions for unhealthy food products (Table 3). First, we calculated the amount of $\beta_{GMO\_Iron} + \beta_{GMO\_Protein}$ (0.65) and $\beta_{No\text{-}label\_Iron} + \beta_{No\text{-}label\_Protein}$ (0.44). By taking the difference between the two sums, Wald statistics would determine whether this amount is different from zero or not. The results of the Wald test revealed that the difference is not significantly different from zero $R|\beta|=0.21$; $W= 3.05$, $p = .08$. In other words, for the unhealthy dry pasta, Wald statistics demonstrated that the combined preference for the positive nutrition attributes was the same for the product made from genetically modified ingredients and no-label condition.

For testing equation 2, we used the coefficients for negative nutrition attributes of GMO and no-label conditions for unhealthy food products (Table 3). First, we calculated the amount of $\beta_{GMO\_SaturatedFat} + \beta_{GMO\_Sodium}$ (-0.92) and $\beta_{No\text{-}label\_SaturatedFat} + \beta_{No\text{-}label\_Sodium}$ (-0.83). By taking the difference between the two sums, Wald statistics would determine whether this amount is different from zero or not. The results of the Wald test revealed that the difference is not significantly different from zero $R|\beta|=0.1$; $W= 0.73$, $p = .39$. In other words, for the unhealthy dry pasta, the Wald statistics demonstrated that the combined preference for the negative nutrition attributes was the same for the product made from genetically modified ingredients and no-label condition.

Based on H_{1a} and H_{1b}, for the unhealthy product, we would expect more combined preferences for positive nutrition attributes and less combined preferences for negative nutrition attributes of all-natural condition compared to no-label condition since consumers try to avoid seeking disconfirming information and obtain confirming information. Using Wald statistics, we tested hypotheses by equation 3 and 4 for testing combined preference for positive and negative nutrition attributes.

Equation 3: $(\beta_{\text{All-natural\_Iron}} + \beta_{\text{All-natural\_Protein}}) - (\beta_{\text{No-label\_Iron}} + \beta_{\text{No-label\_Protein}}) = 0$

Equation 4: $(\beta_{\text{All-natural\_SaturatedFat}} + \beta_{\text{All-natural\_Sodium}}) - (\beta_{\text{No-label\_SaturatedFat}} + \beta_{\text{No-label\_Sodium}}) = 0$

First, for testing H_{1a}, we used the coefficients for positive nutrition attributes for all-natural and no-label conditions of unhealthy food products (Table 3) and equation 3 for calculating the amount of $\beta_{\text{All-natural \_Iron}} + \beta_{\text{All-natural \_Protein}}$ (0.48) and $\beta_{\text{No-label\_Iron}} + \beta_{\text{No-label\_Protein}}$ (0.43). By taking the difference between the two sums, Wald statistics would determine whether this amount is different and more than zero. The results of the Wald test revealed that the difference is not significantly different from zero $R|\beta|=0.04$; $W= 0.16$, $p = .69$ which rejects our hypothesis. In other words, for the unhealthy dry pasta, the results demonstrated that the combined preference for the positive nutrition attributes was the same for the product made from naturally grown ingredients and no-label condition.

For testing H_{1b}, we used the coefficients for negative nutrition attributes of all-natural and no-label conditions for unhealthy food product (Table 3) and equation 4. First, we calculated the amount of $\beta_{\text{All-natural\_SaturatedFat}} + \beta_{\text{All-natural\_Sodium}}$ (-0.54) and $_{\text{No-label\_SaturatedFat}} + \beta_{\text{No-label\_Sodium}}$ (-0.83). By taking the difference of the two sums, Wald statistics would determine whether this amount is different and less than zero. The results of the Wald test revealed that the difference is significantly different and less than zero $R|\beta|=-0.29$; $W= 8.00$, $p < .005$ which supports our hypothesis. In other words, for the unhealthy dry pasta, the results demonstrated that the combined preference for the negative nutrition attributes was lower for the food product made from naturally grown ingredients than the no-label condition.

Based on the theoretical development, for the healthy product, we expected the same combined preferences for negative nutrition attributes and the same combined preferences for positive nutrition attributes between the all-natural and no-label conditions since we assumed that high healthiness perception may mitigate the influence of all-natural label. Using Wald statistics, we tested equation 3 and 4 for testing combined preference for positive and negative nutrition attributes between all-natural and no-label conditions:

First, for testing equation 3, we used the coefficients for positive nutrition attributes for all-natural and no-label conditions of healthy food product (Table 3) for calculating the amount of $\beta_{\text{All-natural\_Iron}} + \beta_{\text{All-natural\_Protein}}$ (0.63) and $\beta_{\text{No-label\_Iron}} + \beta_{\text{No-Label\_Protein}}$ (0.58). By taking the difference between the two sums, Wald statistics would determine whether this amount is different from zero or not. The results of the Wald test revealed that the difference is not significantly different from zero $R|\beta|=0.05$; $W= 0.18$, $p = .67$. In other words, for the healthy dry pasta, the results demonstrated that the combined preference for the positive nutrition attributes was the same for the product made from naturally grown ingredients and no-label condition.

For testing equation 4, we used the coefficients for negative nutrition attributes of all-natural and no-label conditions for healthy food products (Table 3). First, we calculated the amount of $\beta_{\text{All-natural\_SaturatedFat}} + \beta_{\text{All-natural\_Sodium}}$ (-0.64) and $\beta_{\text{No-Label\_SaturatedFat}} + \beta_{\text{No-Label\_Sodium}}$ (-0.70). By taking the difference between the two sums, Wald statistics would determine whether this amount is different from zero or not. The results of the Wald test revealed that the difference is not significantly different from zero $R|\beta|=-0.06$; $W= 0.36$, $p = .55$. In other words, for the healthy dry pasta, the results demonstrated that the combined preference for the negative nutrition attributes was the same for the product made from naturally grown ingredients and no-label condition.

Based on H_{1c} and H_{1d}, for the healthy product, we expected less combined preferences for positive nutrition attributes and more combined preferences for negative nutrition attributes of GMO condition compared to no-label condition since consumers try to avoid seeking disconfirming information and obtain confirming information. Using Wald statistics, we tested hypotheses by equation 1 and 2 for testing combined preference for positive and negative nutrition attributes between GMO and no-label conditions:

For testing H_{1C}, we used the coefficients for positive nutrition attributes for GMO and no-label conditions for healthy food product (Table 3) then using equation 1, we calculated the amount of $\beta_{\text{GMO\_Iron}} + \beta_{\text{GMO\_Protein}}$ (0.78) and $\beta_{\text{No-label\_Iron}} + \beta_{\text{No-Label\_Protein}}$ (0.58) . By taking the difference between the two sums, Wald statistics would determine whether this amount is different and less than zero or not. The results of the Wald test revealed that the difference is not significantly different from zero R|β|= 0.19; W= 2.75, p = .10 which reject our hypothesis. In other words, for the healthy dry pasta, the results demonstrated that the combined preference for the positive nutrition attributes was the same for the product made from genetically modified ingredients and no-label condition.

For testing H_{1d}, we used the coefficients for negative nutrition attributes for GMO and no-label conditions for healthy food products (Table 3) and equation 2. First, we calculated the amount of $\beta_{GMO\_SaturatedFat} + \beta_{GMO\_Sodium}$ (-0.62) and $\beta_{No\text{-}Label\_SaturatedFat} + \beta_{No\text{-}Label\_Sodium}$ (-0.70). By taking the difference between the two sums, Wald statistics would determine whether this amount is different and more than zero or not. The results of the Wald test revealed that the difference is not significantly different from zero R|β|=-0.09; W= 0.66, p = .42 which reject our hypothesis. In other words, for the healthy dry pasta, the results demonstrated that the combined preference for the negative nutrition attributes was the same for the product made from genetically modified ingredients and no-label condition.

4.3 Post Hoc study

4.3.1 Objective

A post hoc was conducted after the main study to evaluate the manipulation of healthiness and unhealthiness of the food product. The purpose of conducting a post hoc instead of manipulation check during the main study was that the descriptions of the scenarios were aimed to manipulate healthiness and unhealthiness of the food product and also the GMO and all-natural conditions. Therefore, it was possible that these two manipulations interfere and we couldn’t evaluate the healthiness and unhealthiness perception of the food product.

4.3.2 Participants

In total, 41 undergraduate students (49% female) were recruited through the Department of Marketing & Consumer Studies SONA pool at the University of Guelph to participate in the post hoc. Participants conducted the survey online through Qualtrics in the lab. There were no age or gender restrictions.

4.3.3 Design

A within subject experiment was conducted to evaluate the healthiness perception of the food product. Therefore, participants read the description of a new food product (dry pasta) that a food manufacture is going to produce in two different conditions (healthy and unhealthy). In both conditions, they were shown the same picture and written statement that had been used in the main study which emphasized on the healthy and unhealthy aspects of the food product. Healthiness of food product ("How healthy dry pasta seems to be?") was evaluated on 7-point scales ranging from 1 (Absolutely unhealthy) to 7 (Absolutely healthy) (Hagen, Krishna, & McFerran, 2017).

4.3.4 Procedure

First, participants were asked to read a consent form and agree to participate in the study. Next, participants viewed a new food product in healthy and unhealthy conditions in random order to choose the degree of healthiness or unhealthiness for that product.

4.3.5 Results

Paired-Samples T-Test was used in SPSS to compares the means of the scores for healthiness for dry pasta (with %95 confidence interval) in two healthy and unhealthy conditions.

Therefore, the null hypothesis is that the paired population means are equal which means that there is no difference between participants' healthiness perceptions of two different conditions.

Comparing the means of different conditions, the results showed that there is a significant difference between healthiness perception of dry pasta in healthy and unhealthy conditions ($p < 0.05$). Specifically, the dry pasta tested was perceived as healthier in healthy condition (M = 5.15, SD = .22) than in the unhealthy condition (M = 3.56, SD = .2), which confirmed the effectiveness of the ‘‘healthy’’ and “unhealthy” manipulation. Therefore, the null hypothesis can be rejected (see Appendix 7 for healthiness and unhealthiness manipulation results).

4.4 Additional Analysis

The objective of this study was to investigate the impact of GMO and all-natural labels, compared to no label, on the relative importance of differently valance nutrition attributes on food choice. In addition to that, we also compared the importance of positive and negative nutrition attributes within each type of product label. First of all, individuals cared more about negative nutrition attributes with unhealthy food products when no ingredient label is indicated ($R|\beta|$=-0.39; W= 11.63, $p < .05$). This finding is in line with prior literature that documents the negativity effect of negative information on consumer choice (Balasubramanian & Cole, 2002). Similarly, we also found that when the food product was perceived as unhealthy, individuals cared more about negative nutrition attributes than positive ones with GMO label ($R|\beta|$= -0.27; W= 4.02, $p < .05$). However, the presence of the all-natural label decreases the importance of negative nutrition attributes and the relative importance of positive and negative nutrition attributes is the same within the all-natural condition ($R|\beta|$= -0.05; W= .23, $p = .64$). This might be because consumers expect natural ingredients make unhealthy food products slightly healthier, and thus they disregard negative nutrition attributes to confirm their expectations.

In addition to nutritional attribute influences, prior literature suggests that nutrition involvement and consumer health consciousness may also impact food product decision (Chandon & Wansink, 2007). On the other hand, some other research shows that nutrition involvement does not reduce the biasing effects of positive beliefs regarding claims and labels on nutrition perception (Chandon & Wansink, 2007). Therefore, we tried to measure nutrition involvement and health consciousness and evaluate whether there is any interaction between these variables and nutrition thoughts. Nutrition involvement was measured by four items and respondents were asked to indicate their agreement with these statements: "I actively seek out nutrition information when buying foods."; "I pay close attention to nutrition information about food products."; "It is important to me that nutrition information is available for food products.", and "I understand nutrition information about food products." (Chandon & Wansink, 2007). Additionally, health consciousness was measured by four items and respondents were asked to indicate their agreement with these statements: "I follow a healthful diet."; "Eating healthy food is important to me."; "I follow a balanced diet.", and "I am currently dieting to lose weight". Participants rated how much these statements apply to them on a 7-point Likert-scale ranging from "strongly disagree" (1) to "strongly agree" (6).

To ensure that all of the scales used for health consciousness and nutrition involvement were properly represented by the items used to measure them, a factor analysis was conducted. Factor analysis with varimax rotation conducted to identify the proper items for each factor. Of the 8 items examined, 1 item was eliminated ("I am currently dieting to lose weight") because of low primary loading below (<0.5) (Appendix 8). Therefore, nutrition involvement (4 items) and health consciousness (3 items) factors identified.

In addition, internal reliability of the factors was evaluated through Cronbach's alpha. The reliability of nutrition involvement and health consciousness were satisfying, respectively with a Cronbach's alpha of (α=0.88) and (α=0.84). Subsequently, we calculated the composite scores for each factor based on the means of the items that had their primary loadings on that factor for using in the following analyses. The result of the interaction between nutrition attributes and nutrition involvement and also interaction between nutrition attributes and health consciousness was significant and had meaningful signs for some of the nutrition attributes. The results show that when the GM food product was perceived as healthy, the interaction between protein and health consciousness was significant (β= 0.1, SD=0.05, p <0.05). Also, when the natural food product was perceived as healthy, the interaction between iron and health consciousness was significant (β= 0.11, SD=0.05, p <0.05).

Moreover, when the natural food product was perceived as unhealthy, the interaction between saturated fat and health consciousness was significant (β= -0.09, SD=0.03, p <0.05). In addition, when the GM food product was perceived as unhealthy, the interaction between protein and nutrition involvement (β= 0.18, SD=0.05, p <0.05), saturated fat and nutrition involvement (β= -0.11, SD=0.05, p <0.05), protein and health consciousness (β= 0.18, SD=0.05, p <0.05), and saturated Fat and health consciousness (β= -0.12, SD=0.05, p <0.05) was significant. As the results show, when the product has been perceived as unhealthy (vs. healthy), individuals care mostly about negative nutrition attributes, which might be because of the negativity effect (Balasubramanian & Cole, 2002). However, it seems that nutrition involvement and health consciousness increase consumers' attention to specific negative nutrition attributes not all negative nutrition attributes. Moreover, when the food product is perceived as healthy, consumers care more about the positive nutrition attributes and disregard negative nutrition attributes; however, this effect is not significant for all positive nutrition attributes which means that health consciousness may increase consumers' attention to specific nutrition attributes. Therefore, the analysis suggests that further research on the influence of high and low levels of nutrition involvement and health consciousness on consumers' preferences of nutrition attributes is required.

Chapter 5: Discussion

The overall objective of this study was to investigate whether positive or negative nutrition attributes are more determinative to consumer choice of healthy and unhealthy food products depending on the ingredients they are made from (naturally grown and genetically modified). Specifically, this thesis investigated the influence of all-natural and GMO label on the relative importance of nutrition attributes. Conducting discrete choice experiment and analyzing data, key findings were obtained which are discussed below.

First, supporting our assumptions, the results indicated that GMO label does not change combined preferences for the positive nutrition attributes and also negative nutrition attributes when the food product is unhealthy. That is, unhealthiness perception may mitigate the influence of GMO label because the food product already has been perceived as unhealthy and the presence of GMO label may not more change consumers' nutrition preferences. Besides, the results indicated that consumers' preferences for negative nutrition attributes are less for food products with all-natural label compared to no-label condition for unhealthy food products. As the results of the positive/negative nutrition attributes comparisons within no-label condition showed when the food product has been perceived as unhealthy, consumers care more about negative nutrition attributes in no-label condition and the presence of all-natural label can decrease the importance of negative nutrition attributes. Therefore, these findings give new insights to manufacturers and marketers of natural food products to not be worried about negative nutrition attributes of unhealthy food products when it is inevitable. However, contradictory to our hypothesis, the results showed that the existence of all-natural label does not increase the importance of positive nutrition attributes when the product is unhealthy.

Second, supporting our assumptions, the results revealed that all-natural label does not change combined preferences for the positive nutrition attributes and also negative nutrition attributes when the food product is healthy. This may be attributed to the reason that healthiness perception mitigates the influence of all-natural label because the food product has already been perceived as healthy and the presence of all-natural label will not more change consumers preferences regarding positive and negative nutrition attributes.

Third, surprisingly and contradictory to our assumptions regarding the influence of GMO label on nutrition perception of healthy food products, we did not find any difference between negative and positive nutrition attribute preferences when GMO label exists compare to no-label condition. In other words, based on the results of the GMO label, we can say that this label does not have any influence on the relative importance of positive and negative nutrition attributes no matter the product is healthy or unhealthy. This may be explained by the fact that as long as the food product is produced from genetically modified ingredients, positive or negative nutrition attributes are not important to consumers for decision making. That is, labeling food products with GMO tag does not change the importance of positive or negative nutrition. Therefore, increasing the amount of positive nutrition attributes or decreasing the amount of negative nutrition attributes may not change their mind for choosing GM food products. Although this study failed to find a way for increasing consumers' willingness to choose GM food products through manipulating nutrition attributes, our results confirm previous research findings which revealed that improved functionality of GM food products will not compensate the negative perceptions that consumers have regarding GM food products (Grunert et al., 2001).

Moreover, the result of the interaction between nutrition attributes and nutrition involvement and also interaction between nutrition attributes and health consciousness was significant and had meaningful signs for some of the nutrition attributes. Although we are not sure whether nutrition involvement and health consciousness could influence consumers' combined preferences of positive and negative nutrition attributes, further research on the influence of high and low levels of nutrition involvement and health consciousness on consumers' preferences of nutrition attributes is required.

Chapter 6: Contributions

6.1 Theoretical Contributions

From a theoretical perspective, this study contribute to the body of literature by presenting a better understanding of how GMO horn and natural halo effect may influence nutrition attribute preferences by empirically testing consumers' preferences for positive and negative nutrition attributes. In addition, this study presents a better understanding of the role of healthiness perception of food product on the influence of GMO and all-natural label on consumers' preferences which ultimately may lead to identifying critical nutritional attributes which influence consumers' decision making regarding different food products when all-natural labels exist.

This research also extended the literature of GM food products by examining the role of GMO label on nutrition perception and establishing that this label does not bring down or increase the importance of different nutrition attributes. So, the reason why consumers avoid GM food products may not be unfavorable feelings regarding nutrition attributes. This research also extended the literature on natural food products by revealing the influence of all-natural label and positive beliefs regarding these label on nutrition perception.

6.2 Managerial Contributions

From a managerial perspective, this study improves understanding of the importance of nutrition attributes on consumers' decision making and provides insight into the influence of GMO and all-natural label for marketers and manufacturers. This study could demonstrate the influence of all-natural label on nutrition attribute preferences for unhealthy food products. It seems that unhealthy products may benefit more from all-natural labels. So, manufacturers may not be worried about the negative nutrition attributes of unhealthy food products when it is inevitable.

In addition, this research provides insight into the role of positive and negative nutrition attributes for GM food product. It seems that nutrition attributes are not influential factors in choosing or avoiding GM food products no matter the product is healthy or unhealthy. Manufacturers will also be able to find ways that nutrition labels could be best applied in order to match consumers' expectations based on the type of product.

Chapter 7: Limitations & Future Research

Despite efforts that have been done to create reliable research, this study has some limitations. The first limitation is related to the sample used in this study. In this study, the participant's pool consisted of the students at the University of Guelph. Therefore, this narrowly focused sample may not be a good representative of all people who actually care more about all-natural and GMO labels. Since students are not the ones that make most household purchase decisions, future research can conduct this study with different samples to see if the results observed are generalizable.

The second limitation is related to the sample size that has been used in this study. The minimum sample size required was more than what we collected and analyzed because there was some limitation regarding the participants' pool and also we had to remove the answers of some of the participants from analyzing because of the wrong answer to the manipulation check. Therefore, future research should leverage the findings and lead to more accurate and representative results by using more sample size.

The third limitation is the failure to examine the potential impact of individual differences. Consumers' lifestyle, health consciousness or nutrition involvement may result it different evaluation of nutrition attributes. Studies have shown that it is possible that all consumers do not make decision about their food products based on health or nutrition thoughts and other factors influence their choices (Wansink & Chandon, 2007). Also, as the results of the interaction revealed, there is significant interaction between some of the nutrition attributes and health consciousness and nutrition involvement. It seems that individual differences result in some expectations regarding benefits obtained by consuming food products which may ultimately influence the importance of specific nutrition attributes. So, future research can consider collecting data on participants with high and low levels of health consciousness and nutrition involvement besides their preferences for nutrition attributes.

The fourth limitation of this research is that consumers' preferences are their stated preferences, not their revealed preferences. In real life, it is possible that consumers act differently. Therefore, future research should investigate whether consumers' stated and revealed preferences are the same when it is related to their actual purchase intention.

This research focused on the consumers' preferences regarding different nutrition attributes as the outcome variable. However, future research can look into willingness-to-pay for different nutrition attributes to compare consumers' willingness-to pay to their preferences for positive and negative nutrition attributes and test whether the results are different.

Also, this study tried to moderate attribute importance by using different nutrition attributes. This research can be extended to evaluate the degree to which multiple a priori defined benefits or risks mediate natural and GMO product choices and also the presence of multiple segments in market using recent advances of methodological frameworks (Burke et al., 2010; Burke et al., 2020).

There is an opportunity for future research by conducting the same study using different stimuli. There might be different preference level with different food products which influence the results of the study. In addition, consumer may expect to obtain specific nutrition attributes by consuming food products which may ultimately influence the importance of specific nutrition attributes. Therefore, future studies can apply different healthy and unhealthy food products and examine the nutrition perception of consumers to examine whether the results are the same for different food products or the results are based on the product type. Also, this study can be conducted by different positive and negative nutrition attributes based on the food product that will be chosen to see whether the results change based on different nutrition attributes.

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APPENDICES

Appendix 1: Pre-Test Mean Healthiness and Familiarity Scores

Healthiness:

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
How healthy each one of the food products available in the grocery stores seems to be? - Apple juice	70	4.54	1.510	.181
How healthy each one of the food products available in the grocery stores seems to be? - Rice crisp	70	3.70	1.517	.181
How healthy each one of the food products available in the grocery stores seems to be? - Pasta	71	4.03	1.158	.137
How healthy each one of the food products available in the grocery stores seems to be? - Cottage cheese	70	4.56	1.490	.178
How healthy each one of the food products available in the grocery stores seems to be? - Bread	71	4.14	1.246	.148
How healthy each one of the food products available in the grocery stores seems to be? - Japanese noodle	71	3.94	1.206	.143

One-Sample Test

	Test Value = 4					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
How healthy each one of the food products available in the grocery stores seems to be? - Apple juice	3.007	69	.004	.543	.18	.90
How healthy each one of the food products available in the grocery stores seems to be? - Rice crisp	-1.655	69	.102	-.300	-.66	.06
How healthy each one of the food products available in the grocery stores seems to be? - Pasta	.205	70	.838	.028	-.25	.30
How healthy each one of the food products available in the grocery stores seems to be? - Cottage cheese	3.128	69	.003	.557	.20	.91
How healthy each one of the food products available in the grocery stores seems to be? - Bread	.953	70	.344	.141	-.15	.44
How healthy each one of the food products available in the grocery stores seems to be? - Japanese noodle	-.394	70	.695	-.056	-.34	.23

Familiarity:

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
How familiar are you with each one of the food products available in the grocery stores? - Apple juice	71	5.80	1.348	.160
How familiar are you with each one of the food products available in the grocery stores? - Rice crisp	71	4.48	1.796	.213
How familiar are you with each one of the food products available in the grocery stores? - Pasta	71	5.97	1.298	.154
How familiar are you with each one of the food products available in the grocery stores? - Cottage cheese	71	4.55	1.991	.236
How familiar are you with each one of the food products available in the grocery stores? - Bread	71	6.32	.968	.115
How familiar are you with each one of the food products available in the grocery stores? - Japanese noodle	71	3.96	2.059	.244

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
How familiar are you with each one of the food products available in the grocery stores? - Apple juice	36.267	70	.000	5.803	5.48	6.12
How familiar are you with each one of the food products available in the grocery stores? - Rice crisp	21.017	70	.000	4.479	4.05	4.90
How familiar are you with each one of the food products available in the grocery stores? - Pasta	38.766	70	.000	5.972	5.66	6.28
How familiar are you with each one of the food products available in the grocery stores? - Cottage cheese	19.250	70	.000	4.549	4.08	5.02
How familiar are you with each one of the food products available in the grocery stores? - Bread	55.066	70	.000	6.324	6.09	6.55
How familiar are you with each one of the food products available in the grocery stores? - Japanese noodle	16.193	70	.000	3.958	3.47	4.45

Appendix 2: Advertising Descriptions

Healthy - GMO Condition

Sahar is a global food manufacturing company that produces and sells dry pasta and vegetable based snacks such as dried fruit, veggie and fruit chips. Traditionally, Sahar only offered its product in bulk packaging. This December, Sahar will introduce dry pasta in small packages to the market.

- This product will be sold in a pack of five cups (450g) and **each cup is about 85g.**
- Pasta will be made from wheat that has been **genetically modified through gene splicing technology.**

Pasta will be offered in a variety of shapes. Depending on the shape, selling price may vary slightly. In the table below, you will find some information about the nutritional facts of each serving cup of dry pasta.

Dry Pasta	
Nutrition Facts	**Nutrition Amount Available (Per serving cup)**
Fiber	10% OR 14%
Iron	6% OR 10%
Protein	12% OR 16%
Sodium	1% OR 5%
Saturated Fat	2% OR 6%
Calories	13% OR 17%
Note: 1. Available nutritional amount is calculated based on one single-serve cup (85g); 2. Pasta is made from genetically modified wheat.	

Healthy - Natural Condition

Sahar is a global food manufacturing company that produces and sells dry pasta and vegetable based snacks such as dried fruit, veggie and fruit chips. Traditionally, Sahar only offered its product in bulk packaging. This December, Sahar will introduce dry pasta in small packages to the market.

- This product will be sold in a pack of five cups (450g) and **each cup is about 85g.**
- Pasta will be made from wheat that has been **grown using a natural farming practice.**

Pasta will be offered in a variety of shapes. Depending on the shape, selling price may vary slightly. In the table below, you will find some information about the nutritional facts of each serving cup of dry pasta.

Dry Pasta	
Nutrition Facts	**Nutrition Amount Available (Per serving cup)**
Fiber	10% OR 14%
Iron	6% OR 10%
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Sodium	1% OR 5%
Saturated Fat	2% OR 6%
Calories	13% OR 17%
Note: 1. Available nutritional amount is calculated based on one single-serve cup (85g); 2. Pasta is made from naturally grown wheat.	

Unhealthy - GMO Condition

Sahar is a global food manufacturing company that produces and sells dry pasta and snacks including crunchy cheese, corn chips, potato chips, salty pretzel and popcorns. Traditionally, Sahar only offered its product in bulk packaging. This December, Sahar will introduce dry pasta in small packages to the market.

- This product will be sold in a pack of five cups (450g) and **each cup is about 85g.**
- Pasta will be made from wheat that has been **genetically modified through gene splicing technology.**

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Note: 1. Available nutritional amount is calculated based on one single-serve cup (85g); 2. Pasta is made from genetically modified wheat.	

Unhealthy - Natural Condition

Sahar is a global food manufacturing company that produces and sells dry pasta and snacks including crunchy cheese, corn chips, potato chips, salty pretzel and popcorns. Traditionally, Sahar only offered its product in bulk packaging. This December, Sahar will introduce dry pasta in small packages to the market.

- This product will be sold in a pack of five cups (450g) and **each cup is about 85g.**
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Pasta will be offered in a variety of shapes. Depending on the shape, selling price may vary slightly. In the table below, you will find some information about the nutritional facts of each serving cup of dry pasta.

Dry Pasta	
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Iron	6% OR 10%
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Sodium	1% OR 5%
Saturated Fat	2% OR 6%
Calories	13% OR 17%
Note: 1. Available nutritional amount is calculated based on one single-serve cup (85g); 2. Pasta is made from naturally grown wheat.	

Appendix 3: Example Choice Set in the Main Study

Please indicate below which offer you like the MOST among these three dry pasta options?

Dry Pasta Options (S1)			
	Option 1	Option 2	Option 3
Fiber	14%	14%	10%
Iron	6%	10%	6%
Protein	16%	16%	12%
Sodium	1%	1%	5%
Saturated Fat	2%	6%	6%
Calories	13%	17%	17%
Price per 5 cups ($)	1.99	1.49	1.49

Option 1 ○ Option 2 ○ Option 3 ○

Appendix 4: Factor Analysis, Rotated Component Matrix (Nutrition Attribute Valence)

Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
"Calorie"- Less/More			.850			
"Calorie"- Unhealthy: Healthy			.914			
"Calorie" Bad: Good	.103		.921			
"Sodium"- Less/More	.118	.882				
"Sodium"- Unhealthy: Healthy	.196	.927				
"Sodium"- Bad: Good	.225	.904				
"SaturatedFat"- Less/More	.869	.205				
"SaturatedFat"- Unhealthy: Healthy	.942	.172				
"SaturatedFat"- Bad: Good	.942	.158				
"Protein"- Less/More						.817
"Protein"- Unhealthy: Healthy			.119	.230	.288	.786
"Protein"- Bad: Good			.102	.248	.254	.771
"Iron"- Less/More		-.108		.107	.722	.214
"Iron"- Unhealthy: Healthy				.213	.871	.171
"Iron"- Bad: Good				.217	.856	.132
"Fiber"- Less/More				.790		.107
"Fiber"- Unhealthy: Healthy				.875	.246	.109
"Fiber"- Bad: Good				.875	.215	.120

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Appendix 5: Nutrition Attributes Valence

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Fiber	303	5.9417	.81463	.04680
Iron	303	5.9197	.84646	.04863
Protein	304	6.2412	.70067	.04019
SaturatedFat	299	2.4359	1.25730	.07271
Sodium	299	2.8841	1.29039	.07463
Calorie	299	4.0992	1.24160	.07180

One-Sample Test

	Test Value = 4					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Fiber	41.490	302	.000	1.94169	1.8496	2.0338
Iron	39.477	302	.000	1.91969	1.8240	2.0154
Protein	55.771	303	.000	2.24123	2.1621	2.3203
SaturatedFat	-21.511	298	.000	-1.56410	-1.7072	-1.4210
Sodium	-14.954	298	.000	-1.11594	-1.2628	-.9691
Calorie	1.382	298	.168	.09922	-.0421	.2405

Appendix 6: Variance-Covariance Matrix

Healthy_GMO condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002369	0.000035	0.000172	-0.000138	-0.000386	-0.000113	0.000066
Iron	0.000035	0.002947	0.000484	-0.000215	-0.000496	-0.000776	0.000090
Protein	0.000172	0.000484	0.002464	-0.000306	-0.000353	-0.000456	-0.000183
Sodium	-0.000138	-0.000215	-0.000306	0.002180	0.000309	0.000642	0.000026
SaturatedFat	-0.000386	-0.000496	-0.000353	0.000309	0.002569	0.000178	0.000525
Calories	-0.000113	-0.000776	-0.000456	0.000642	0.000178	0.002561	-0.000162
Price	0.000066	0.000090	-0.000183	0.000026	0.000525	-0.000162	0.002410

Healthy_All-natural condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002351	0.000092	0.000175	-0.000142	-0.000297	-0.000216	0.000028
Iron	0.000092	0.003087	0.000272	-0.000160	-0.000549	-0.000785	-0.000005
Protein	0.000175	0.000272	0.002408	-0.000300	-0.000272	-0.000273	-0.000212
Sodium	-0.000142	-0.000160	-0.000300	0.002259	0.000263	0.000599	0.000063
SaturatedFat	-0.000297	-0.000549	-0.000272	0.000263	0.002522	0.000317	0.000491
Calories	-0.000216	-0.000785	-0.000273	0.000599	0.000317	0.002509	-0.000030
Price	0.000028	-0.000005	-0.000212	0.000063	0.000491	-0.000030	0.002378

Healthy_No-label condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002432	-0.000087	0.000220	-0.000258	-0.000360	-0.000218	-0.000001
Iron	-0.000087	0.003105	0.000278	0.000007	-0.000377	-0.000674	0.000230
Protein	0.000220	0.000278	0.002403	-0.000377	-0.000293	-0.000306	-0.000309
Sodium	-0.000258	0.000007	-0.000377	0.002278	0.000287	0.000531	0.000194
SaturatedFat	-0.000360	-0.000377	-0.000293	0.000287	0.002615	0.000197	0.000522
Calories	-0.000218	-0.000674	-0.000306	0.000531	0.000197	0.002453	-0.000110
Price	-0.000001	0.000230	-0.000309	0.000194	0.000522	-0.000110	0.002469

Unhealthy_GMO condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002615	-0.000042	0.000138	-0.000312	-0.000452	-0.000228	0.000026
Iron	-0.000042	0.003662	0.000458	-0.000231	-0.000587	-0.001110	0.000173
Protein	0.000138	0.000458	0.002683	-0.000480	-0.000423	-0.000488	-0.000376
Sodium	-0.000312	-0.000231	-0.000480	0.002529	0.000410	0.000771	0.000146
SaturatedFat	-0.000452	-0.000587	-0.000423	0.000410	0.002991	0.000312	0.000680
Calories	-0.000228	-0.001110	-0.000488	0.000771	0.000312	0.002998	-0.000131
Price	0.000026	0.000173	-0.000376	0.000146	0.000680	-0.000131	0.002775

Unhealthy_All-natural Condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002308	-0.000010	0.000139	-0.000108	-0.000303	-0.000078	-0.000060
Iron	-0.000010	0.003062	0.000203	-0.000208	-0.000377	-0.000749	0.000172
Protein	0.000139	0.000203	0.002372	-0.000333	-0.000140	-0.000335	-0.000071
Sodium	-0.000108	-0.000208	-0.000333	0.002238	0.000252	0.000570	0.000067
SaturatedFat	-0.000303	-0.000377	-0.000140	0.000252	0.002412	0.000203	0.000398
Calories	-0.000078	-0.000749	-0.000335	0.000570	0.000203	0.002521	-0.000065
Price	-0.000060	0.000172	-0.000071	0.000067	0.000398	-0.000065	0.002336

Unhealthy_No-label Condition

	Fiber	Iron	Protein	Sodium	SaturatedFat	Calories	Price
Fiber	0.002299	0.000006	0.000072	-0.000112	-0.000322	-0.000129	0.000009
Iron	0.000006	0.003045	0.000269	-0.000181	-0.000290	-0.000861	0.000242
Protein	0.000072	0.000269	0.002326	-0.000297	-0.000151	-0.000338	-0.000157
Sodium	-0.000112	-0.000181	-0.000297	0.002184	0.000355	0.000529	0.000080
SaturatedFat	-0.000322	-0.000290	-0.000151	0.000355	0.002526	0.000102	0.000417
Calories	-0.000129	-0.000861	-0.000338	0.000529	0.000102	0.002662	-0.000178
Price	0.000009	0.000242	-0.000157	0.000080	0.000417	-0.000178	0.002389

Appendix 7: Post Hoc Results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Healthy Pasta	5.15	41	1.424	.222
	Unhealthy Pasta	3.56	41	1.246	.195

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Healthy Pasta & Unhealthy Pasta	41	.347	.026

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Healthy Pasta - Unhealthy Pasta	1.585	1.533	.239	1.102	2.069	6.624	40	.000

Appendix 8: Factor Analysis, Rotated Component Matrix

Rotated Component Matrix[a]

	Component	
	1	2
Seeking out nutrition information actively	.868	.262
Pay close attention to nutrition information	.889	.259
Importance of the presence of nutrition information	.794	.123
Understanding nutrition information	.749	.173
Following a healthful diet.	.188	.904
Eating healthy food	.321	.720
Following a balanced diet.	.184	.887
Currently dieting to lose weight.	.278	.142

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.