RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

Trust, Fairness and Acceptance of Food Technologies

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Project Report

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Abstract

Trust and perceptions of fairness in markets have been shown to be important in consumer behavior in different contexts. However, there have not been many studies relating the concept of fairness is supply chains to food purchasing behavior. In this study, we explore the relationships between trust, fairness and perception of quality of food produced from three food technologies. The technologies are as follows: (i) bread fortified with omega-3 fatty acids using nanotechnology (ii) pork chops from pigs selectively bred for disease resistance using genomic selection (iii) baby spinach treated with essential oils to reduce concentrations of *E. coli* O157:H7. Data are from a small exploratory project conducted in 2015 at the University of Alberta, Canada, where 31 non-academic staff participated in stated preference experiments and completed a survey questionnaire. Stated preference data are analysed using conditional logit regressions. Different potential explanatory fairness variables are created using questions from previous studies. From the results, both the constructs associated with trust and with fairness in supply chains have explanatory power. Although there are some variations in results (depending on the type of questions used to measure fairness), fairness positively influences trust in the food supply chain. Future studies might need to consider including perceptions of fairness in supply chains in the analysis of consumer acceptance of novel technologies.

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Preface

The research project, of which this report is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project name: Do Perceptions of Trust and Fairness Affect Food Choices?, No. Pro00056226, 2015.

Introduction

Trust is an important factor in terms of how individuals make food choices. Specifically, in the case of food safety incidents, trust in the food system can ameliorate market level responses. People who trust the food system are less likely to make dramatic changes in their food purchasing behavior in response to a food safety incident. However, food safety is not the only element of food choice in which trust can play a role. Fear of the adoption of new technologies, desire for regulation of production practices (e.g. genetically modified organisms), desire for labelling and certification are all aspects of food purchasing behavior which might be affected if an individual trusts the food system or not.

Trust is a complex construct, linked to transparency, competence and commitment. It is becoming more common to also associate perceptions of fairness of markets/outcomes with trust constructs. The literature on food and trust appears in numerous different disciplines sometimes with similar approaches sometimes with very different approaches. For example, Martin et al. (2009) investigate the linkages between perceptions of fairness, trust and ultimately loyalty to branded products in retail environments. In a completely different context, Ross et al. (2014) found that perception of fairness on the part of a water regulator influenced the public sense of shared identity with the regulator, leading to more trust in the regulator and a greater willingness to use recycled water under drought conditions in Australia. There have not been many studies relating the concept of fairness to food purchasing behavior although Chang and Lusk (2009) found that food purchasers were concerned about the distribution of economic benefits through the supply chain (farmers, processors, retailers) as part of their food purchasing decision.

From the trust and food literature, Siegrist et al. (2007) found that social trust in the food industry strongly influenced the perceived affect of foods produced with nanotechnology applications. Siegrist et al. (2008) also found that trust in the food industry was a strong predictor of willingness to buy functional foods. There is much evidence that trust is a predictor of food behavior when there are crises or novel technologies (for example, Siegrist et al., 2012; Roosen et al., 2015; Lobb et al., 2007).

This research is an attempt to test the different strands of the literature on trust and fairness in the context of specific food decisions. Specifically, the research is aimed at testing different relationships between trust and fairness (does perception of fairness lead to trust) and their impact on perception of quality for three different food applications i.e. bread and fortification with nanotechnology, pork and genomic selection for disease resistance and spinach and *E. coli* O157:H7. Data are from a small exploratory project conducted in 2015 at the University of Alberta, Edmonton, Canada.

The results of this study can provide the theoretical basis for further investigation of trust and fairness perceptions of the Canadian public and how those perceptions are influencing their willingness to purchase foods produced with novel technologies. The research will assist in broadening our understanding of the role of trust in other contexts than food safety (which was the focus of our previous research) and to investigate people's perceptions of the fairness of the food system and trust as co-determinants of purchase behavior. Different scales for measuring trust and perceptions of fairness in the food system will be tested to develop a framework for further in depth analysis. The research will also help in identifying consumer attitudes that can be used to identify responses to new food technologies, and to food health interventions ex ante. Understanding the factors that influence choices made by consumers is also important in the development of products and marketing decisions (Chang and Lusk, 2011).

Theoretical framework

In this study, it is hypothesized that trust and fairness perceptions significantly influence consumers' acceptance of food technologies. There are different definitions of trust found in the literature and different types of trust are included in our analysis i.e. generalized trust in people and institutional trust in a variety of food system agents. We start from the definition of trust from Rousseau et al. (1998, pg. 395) as '… a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another'. Although there is consensus that trust is a multidimensional concept, there are still debates on the number of its dimensions (Earle, 2010; McAllister, 1995; Lewis and Weigert, 1985). Trust has been found to influence consumers' attitudes toward novel technologies (Siegrist et al., 2007, 2008; Siegrist et al., 2012; Roosen et al., 2015), risk perceptions (Ross et al., 2014; Lobb et al., 2007; Flynn et al., 1994; Setbon et al., 2005; Tonsor et al., 2009), information on food labels (Janssen and Hamm, 2014) and loyalty (Jambulingam et al., 2011), for example.

Fairness is also a multidimensional construct, which can be classified into three types i.e. distributional, procedural and interactional fairness. Distributional fairness refers to people's judgment of fairness of an outcome or price (Holtz, 2015; Duffy et al., 2003; Devlin et al., 2014). or refers to the allocation of benefits and burdens between individuals or entities (Kumar, 1996). Procedural fairness refers to a judgment of fairness of processes and procedures or policies (Holtz, 2015; Devlin et al., 2014; Kumar, 1996). Procedural fairness assesses the degree of impartiality (consumers, for example, are treated equally), refutability (all consumers can dispute decisions and policies), explanation (consumers are provided with logical and consistent reasons for decisions and policies) and familiarity (efforts are made by the more powerful individual/organization to familiarize themselves with the conditions in which the other party operates) during an exchange (Devlin et al., 2014). Interactional fairness refers to fairness in personal interactions i.e. it looks at how the other party was treated (courtesy, respect and bilateral communication) and it is further categorized as informational and interpersonal fairness (Holtz, 2015; Devlin et al., 2014). Interpersonal fairness relates to retailers, for example, showing concern to consumers about the distribution of outcomes in a polite or civil manner (Carr, 2007). Informational fairness refers to the provision of information or knowledge with respect to procedures which show concern for consumers, for example (Carr, 2007). In some studies, systemic or overall fairness/unfairness is assessed based on judgments about distributional, procedural and interactional fairness or unfairness (Carr, 2007).

In previous literature, dimensions of fairness (e.g. distributive, procedural and interactional) have been analysed (e.g. Devlin et al., 2014; Ting, 2013; Duffy et al., 2003). In addition, perceptions about fairness have been linked to different outcome variables e.g. perceptions about service quality (e.g. Carr, 2007), food choice (Chang and Lusk, 2009), support for novel technologies such as genetic (Siegrist et al., 2012; McComas et al., 2014), trust in institutions (Wang and Tsai, 2014) and perceived transaction risk (Wang and Tsai, 2014).

We also account for consumers' familiarity with a variety of technologies since it has been shown to influence their acceptance of food technologies in other studies. For example, Vandermoere et al. (2011) found that people who were not familiar with nanotechnology were less supportive of its use in food packaging as compared to people who were more familiar with the technology. We also test whether differences in demographic variables significantly influence acceptance of the technologies.

Empirical Methods

Thirty one participants were recruited from the University of Alberta campus to participate in the data collection. Participants completed choice experiments (payment card approach) and a survey. The choice experiment was limited to two attributes i.e. a production attribute and price. There were three groups of participants. Each group of participants was presented with the option of choosing between products with different attributes i.e. bread fortified with omega-3 fatty acids using nanotechnology or conventional bread (Group 1), pork from pigs produced using genomic selection for disease resistance or conventional pork (Group 2) and baby spinach treated with essential oils to reduce concentrations of *E. coli* O157:H7 or conventional spinach (Group 3). There were three price levels for each product. Base prices for bread, pork chops and baby spinach were obtained from a local supermarket at the time of the data collection. The attributes and attribute levels are presented in Table 1.

Table 1: Attributes and attribute levels for the choice experiments

Attribute	Attribute levels		
	Group 1	Group 2	Group 3
Production	Conventional bread Bread fortified with omega-3 fatty acids using nanotechnology	Conventional pork chops Pork chops from pigs selectively bred for disease resistance using genomic information	Conventional baby spinach Baby spinach treated with essential oils to reduce concentrations of *E. coli* O157:H7
Price	$2.84 per 675g loaf[a] $4.26 per 675g loaf $5.28 per 675g loaf	$13.02 per kg[a] $19.53 per kg $26.04 per kg	$13.55 per kg[a] $20.33 per kg $27.10 per kg

[a] indicates base price for the product

Each respondent compared choices between 9 pairs of the specific product they faced and had to choose option A, B or neither of the two options. Each participant was provided with an information sheet with the description of the products. Conventional products were described as products from standard production in Canada (for bread and pork) or Canada and the United States (for spinach). The three food technologies being examined in this study were described as below. Product descriptions are based on previous studies (Roosen et al., 2015; Siegrist et al., 2008 for nanotechnology; Yossa et al., 2012 for essential oils and previous surveys conducted by Professor Ellen Goddard for genomics).

Trust in the government, food industry and scientists was measured using questions adopted from de Jonge et al. (2008) and the statements were modified to suit this study (removing the references to food safety). The trust questions assessed people's perceptions about the competence, knowledge, honesty, openness, care and attention of the government, food industry and scientists regarding the uses of nanotechnology, genomics and essential oils in the production of bread, pork and spinach respectively.

Bread Fortified with Omega-3 Fatty Acids Using Nanotechnology

Nanotechnology refers to materials, systems and processes which exist or operate in the range of about 1 to 100 nanometers (nm). One nanometer (nm) is one millionth of a millimeter (mm). Nanotechnology offers opportunities for food industry applications because it allows foods to be fortified (to have nutrients added) with vitamins and essential oils.

Nanotechnology can be used to enhance the nutritional value of bread through the addition of

nutrients such as omega-3 fatty acids. In this case, omega-3 fatty acids are incorporated into tiny (nano sized) capsules and infused into the bread. The nanocapsules are made in such a way that they open only when they reach the stomach. Therefore, the nutritional value of bread is enhanced using omega-3 fatty acids but the bread does not have any fish-like flavor. However, other human health effects of nanocapsules are not known.

Pork Chops from Pigs Selectively Bred for Disease Resistance Using Genomic Information

Genomics is the study of the genes and genetic characteristics of organisms like plants, animals, and humans. The study of genomics in pigs can allow for the identification of specific genes that are linked to disease susceptibility. With knowledge of the presence (absence) of these genes, selective breeding can produce pigs with significantly lower probabilities of diseases. These diseases affect health and mortality of pigs. However, **there is no possibility that the diseases can be transferred to people through eating pork.**

Baby Spinach Treated With Essential Oils to Reduce Concentrations of *E coli* O157:H7

Escherichia coli or *E. coli* is a group of bacteria found in the intestines of humans and animals which are important for digestion. Most strains of these bacteria are not harmful but *E. coli* O157:H7 can lead to sickness and life threatening complications in humans. Vegetables can be contaminated with the bacteria in the field due to contaminated manure or irrigation water, for example.

Essential oils which are natural oils extracted from plants have been shown to have antibacterial, antifungal, antiviral, insecticidal and antioxidant properties. Studies have shown that essential oils could reduce the concentrations of *E. coli* O157:H7 in fresh vegetables such as spinach. In this case, fresh spinach would be immersed in a treatment solution containing essential oils and spin dried.

Questions about fairness were adopted from a number of previous studies and in some cases they were modified to suit this study (Martin et al., 2009, distributive and procedural fairness; Wang and Tsai, 2014, distributive fairness; Metlay, 1999; Devlin et al., 2014, distributive, procedural and interactional fairness; McComas et al., 2014, distributive, procedural and interactional fairness; Carr 2007, distributive, procedural and interactional fairness; Ting, 2013, distributive, procedural and interactional fairness). The questions used in this study are reported in the data section of this paper.

Respondents were also asked about their familiarity, attitudes and perceptions regarding the technologies under study. Lastly, respondents were asked three questions relating to generalized trust in people adopted from the General Social Surveys which assesses individual's perceptions about whether people can be trusted and are helpful or fair[1]. Conditional logit regressions are estimated in Nlogit 5 in order to assess the effects of trust and fairness on the consumers' probability of purchasing a product with certain attributes.

Data

Surveys were conducted on the 8th, 9th and 10th of March, 2015 at the University of Alberta, Edmonton, Canada. Three groups of non-academic staff (31 people in total) participated in the surveys and they were compensated with $25 each for their participation.

Individual characteristics and habits of participants are summarized in Table 2. Most of the respondents had at least a college diploma. A majority of the respondents are female. Most of

[1] http://www.europeansocialsurvey.org/docs/round7/questionnaire/ESS7_source_main_questionnaire_final_alert_03.pdf

the participants stated that there were no children aged less than 18 years of age in their households.

All people in the group of respondents who answered questions about nanotechnology consumed bread. One person in the group of respondents who answered questions about genomics did not consume pork while 4 people who answered questions about essential oils and spinach did not eat spinach. Most people buy bread (100%), pork (80%) or spinach (90.9%) from supermarkets.

Table 2: Demographic characteristics and habits of respondents and generalized trust in people

Variable	Categories	Nanotechnology survey	Genomics survey	Essential oils survey
		Frequency (%)		
Gender	Male	0.0	20.0	18.2
	Female	100.0	80.0	81.8
Age of respondent	20-24	10.0	0.0	0.0
	25-29	20.0	20.0	18.2
	30-39	10.0	20.0	18.2
	40-49	40.0	20.0	18.2
	50-64	20.0	40.0	45.5
	65+	0.0	0.0	0.0
Number of children younger than 18 living in the house	No home living children	80.0	90.0	45.5
	1	0.0	0.0	18.2
	2	20.0	10.0	27.3
	3	0.0	0.0	0.0
	4	0.0	0.0	9.1
	More than 4	0.0	0.0	0.0
Education	Elementary school	0.0	0.0	0.0
	Secondary (high) school	0.0	10.0	9.1
	Technical/Business school/ Community college	30.0	30.0	36.4
	University	40.0	30.0	27.3
	Post graduate studies (Masters or PhD)	30.0	30.0	27.3
Household Income	$ 24,999 or under	10.0	0.0	0.0
	Between $25,000 and $39,999	0.0	0.0	0.0
	Between $40,000 and $64,999	50.0	30.0	9.1
	Between $65,000 and $79,999	10.0	50.0	9.1
	Between $80,000 and $99,999	0.0	0.0	27.3
	Between $100,000 and $119,999	20.0	10.0	27.3
	$120,000 or more	10.0	10.0	27.3
How often do you eat … (bread/pork/spinach)? Is it… (pick one	Never	0.0	10.0	36.4
	About once per week	20.0	90.0	27.3
	Once a day	60.0	0.0	18.2
	Twice a day	20.0	0.0	0.0
	More than two times a day	0.0	0.0	18.2
How often do you buy … (bread/pork/spinach)? Is it… (pick one)	Never	0.0	10.0	9.1
	A few times a year	0.0	20.0	27.3
	About once a month	20.0	60.0	9.1
	About once per week	70.0	10.0	54.5
	Everyday	10.0	0.0	0.0
When you buy … (bread/pork/spinach), is it usually in …… (one only	A supermarket	100.0	80.0	90.9
	A bakery	0.0	n/a	n/a
	A butcher	n/a	10.0	n/a
	Another small shop	0.0	0.0	0.0

	A farmer's market	0.0	0.0	0.0
	Another way (directly from a farm or through acquaintances)	0.0	10.0	9.1
Generally speaking, would you say that most people can be trusted?	People can be trusted	40.0	60.0	54.5
	Can't be too careful in dealing with people	40.0	40.0	27.3
	Don't know	20.0	0.0	18.2
Would you say that most people would try to take advantage of you if they got the chance or would they try to be fair?	Most people would try to take advantage of me	10.0	10.0	18.2
	Most people would be fair	60.0	80.0	63.6
	Don't know	30.0	10.0	18.2
Would you say that most of the time people try to be helpful or that they are mostly looking out for themselves?	People mostly look out for themselves me	20.0	10.0	45.5
	People mostly try to be helpful	50.0	80.0	45.5
	Don't know	30.0	10.0	9.1
Sample size		10	10	11

n/a - not applicable

Forty percent of the respondents in the group that answered questions about nanotechnology stated that people can be trusted while 60% and 54.5% of respondents who answered questions on genomics and essential oils respectively stated the same. Most of the respondents (60% in the survey about nanotechnology, 80% in the survey about genomics and 63.6% in the survey about essential oils) stated that they believed most people would be fair when dealing with them. Eighty percent of the respondents in the genomics survey stated that people mostly try to be helpful while 50% and 45.5% of respondents who answered questions about nanotechnology and essential oils stated the same.

The descriptive statistics for the questions on trust in the government, the food industry and scientists are summarized in Table 3. Scientists are rated highly for all the questions on trust as compared to the government and food industry. Since this study was conducted at a university, it is not surprising that the respondents trust scientists more than the government and the food industry.

Table 3: Trust in the government, food industry and scientists regarding the use of the three technologies (1. strongly disagree … 5. strongly agree)

	Government	Food industry	Scientists
		Mean (SD)	
(i) Use of nanotechnology in the fortification of bread			
… has the competence to regulate the use of nanotechnology in the fortification of bread	3.60 (0.97)	3.50 (0.97)	4.20 (0.63)
… has sufficient knowledge to regulate the use of nanotechnology in the fortification of bread	2.40 (1.43)	3.60 (0.52)	4.40 (0.52)
… would be honest about the use of nanotechnology in the fortification of bread	2.50 (1.18)	3.10 (0.88)	4.20 (0.63)
… would be sufficiently open about the use of nanotechnology in the fortification of bread	2.60 (1.17)	3.10 (0.88)	3.90 (0.74)
… would take good care of the use of nanotechnology in the fortification of bread	2.30 (0.95)	2.80 (0.63)	3.90 (0.88)

… would give special attention to the use of nanotechnology in the fortification of bread	2.20 (0.92)	2.80 (1.03)	3.80 (0.79)
(ii) Use of genomic information to selectively breed pigs for disease resistance			
… has the competence to use genomic information to selectively breed pigs for disease resistance	2.70 (1.34)	2.70 (0.82)	4.30 (0.48)
… has sufficient knowledge to use genomic information to selectively breed pigs for disease resistance	3.00 (1.41)	2.80 (1.23)	4.20 (0.63)
… would be honest about the use of genomic information to selectively breed pigs for disease resistance	2.70 (1.34)	2.40 (0.70)	4.10 (0.57)
… would be sufficiently open about the use of genomic information to selectively breed pigs for disease resistance	3.00 (1.25)	2.80 (1.03)	4.10 (0.57)
… would take good care of the use of genomic information to selectively breed pigs for disease resistance	2.90 (1.20)	2.80 (0.92)	4.10 (0.57)
… would give special attention to the use of genomic information to selectively breed pigs for disease resistance	3.00 (0.82)	3.40 (1.07)	4.20 (0.42)
(iii) The use of essential oils to reduce concentrations of E. coli O157:H7 in spinach			
… has the competence to use essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.45 (0.69)	3.82 (0.40)	4.00 (0.63)
… has sufficient knowledge to use essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.27 (0.65)	3.45 (0.69)	4.09 (0.70)
The food industry would be honest about the use of essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.00 (0.77)	2.73 (0.65)	3.82 (0.60)
… would be sufficiently open about the use of essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.09 (0.83)	3.09 (0.83)	4.09 (0.70)
… would take good care of the use of essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.00 (0.77)	3.27 (0.79)	3.91 (0.83)
… would give special attention to the use of essential oils to reduce concentrations of *E. coli* O157:H7 in spinach	3.00 (0.77)	3.55 (0.93)	3.91 (0.83)

In Tables 4-7, summaries for the questions about fairness for the food industry are provided. The questions on fairness from the different studies are included separately in the empirical regressions.

Table 4: Please indicate to what extent you agree with each statement (1. strongly disagree … 5. strongly agree)

	Nanotechnology survey	Genomics survey	Essential oils survey
		Mean (SD)	
(i) Martin et al. (2009) (modified for this research)			
Distributional fairness			
Food prices paid by consumers are fair	3.10 (0.88)	2.20 (0.79)	2.27 (0.79)
Food prices paid by consumers are reasonable	3.30 (0.82)	2.50 (0.97)	2.64 (1.03)
Food prices paid by consumers are acceptable	3.20 (0.92)	2.50 (0.97)	2.64 (0.92)
Food prices paid to farmers are fair	2.50 (0.85)	2.30 (0.95)	2.82 (0.98)
Food prices paid to farmers are reasonable	2.40 (1.17)	2.50 (0.85)	2.91 (0.94)
Food prices paid to farmers are acceptable	2.40 (1.17)	2.50 (0.85)	2.64 (0.92)
Procedural fairness			
The food industry's pricing policies and procedures are fair	2.30 (0.67)	2.50 (0.53)	2.36 (0.50)
The food industry's pricing policies and procedures are reasonable	2.60 (0.52)	2.60 (0.52)	2.55 (0.69)
The food industry's pricing policies and procedures are acceptable	2.60 (0.70)	2.80 (0.79)	2.82 (0.75)
(ii) Wang & Tsai (2014)			
Overall, … (bread/pork/spinach) sold in Canada is sold at a fair price	3.10 (0.99)	3.00 (0.94)	2.73 (0.79)
Overall, ... (bread/pork/spinach) spinach sold in Canada is sold at a reasonable price	3.10 (0.99)	3.20 (0.92)	2.73 (0.79)
Overall, … (bread/pork/spinach) sold in Canada is sold at an acceptable price	3.60 (0.52)	3.30 (0.95)	3.18 (0.87)
(iii) Metlay (1999)			
The government is committed to impartial processes for making decisions	1.90 (0.88)	2.20 (1.03)	2.73 (1.01)
The government makes a good faith effort to treat everyone even handedly in general	2.20 (0.92)	2.00 (0.94)	2.72 (0.90)
Sample size	10	10	11

Table 5: Questions about fairness regarding the use of the three technologies (1. strongly disagree … 5. strongly agree)

	When it comes to using nanotechnology in the fortification of bread	When it comes to using genomic information to selectively breed pigs that have significantly lower probabilities of diseases	When it comes to using essential oils to reduce concentrations of *E. coli* O157:H7 in spinach
	Mean (SD)		
Distributive fairness			
R. The benefits will all go to food processors, not regular farmers	3.80 (0.42)	3.10 (0.99)	3.27 (1.10)
It's fair spending my tax dollars on this technology	3.50 (0.97)	2.90 (1.27)	2.55 (1.13)
R. All the benefits will go to consumers	2.20 (0.79)	2.10 (0.99)	2.45 (0.69)
R. Consumers will experience an unfair amount of risk	2.70 (0.82)	2.60 (1.26)	2.64 (0.92)
Procedural fairness			
Decision makers would be willing to listen to people like me	2.50 (0.85)	2.60 (1.07)	3.09 (0.94)
R. Decision makers would not respond if someone like me tried to voice my views	3.00 (0.94)	3.10 (0.88)	3.18 (0.75)
Decision makers are trying to hear what people like me think	3.00 (1.05)	2.60 (0.84)	2.91 (0.83)
R. Decision makers let their own opinions affect what they hear from people like me	3.60 (0.70)	3.20 (1.14)	3.73 (0.65)
Interpersonal fairness			
Decision makers care about what people like me think	2.90 (0.99)	2.40 (0.97)	3.00 (0.77)
Decision makers respect people like me	2.90 (0.57)	2.60 (0.84)	2.91 (0.70)
Decision makers are polite to people like me	3.10 (0.88)	3.60 (0.70)	3.09 (0.70)
Decision makers try hard to understand the views of people like me	3.30 (0.82)	2.50 (0.97)	2.82 (0.87)
Informational fairness			
Decision makers make information available quickly enough	2.70 (0.16)	2.40 (0.84)	2.82 (0.87)
Decision makers realise information that goes against their views	3.30 (0.95)	3.22 (0.67)	3.36 (0.81)
Decision makers try to make things clear for most people to understand	2.60 (0.84)	3.70 (0.48)	3.18 (0.75)
Decision makers make enough information available	2.10 (0.57)	2.40 (0.70)	2.82 (0.85)
Sample size	10	10	11

McComas et al. (2014). Items with the later 'R' were recoded for the regression analysis

Table 6: Please indicate to what extent you agree with each statement (1. strongly disagree … 5. strongly agree)

	Nanotechnology survey	Genomics survey	Essential oils survey
	Mean (SD)		
Procedural fairness			
Food retailers make sure that they are not biased towards certain customers	2.40 (1.26)	3.10 (0.99)	2.82 (1.08)
Food retailers make effort to treat all customers equally	2.40 (1.26)	3.40 (0.84)	3.00 (0.89)
Food retailers make sure that they do not favour some customers over others	2.50 (1.18)	3.10 (0.99)	3.09 (0.83)
Food retailers take notice when I complain about something	2.90 (0.99)	3.10 (1.20)	3.55 (0.93)
Food retailers are willing to change things when I tell them I am not satisfied	2.90 (0.99)	2.60 (0.84)	3.00 (0.89)
Food retailers let me change things on fair and reasonable terms	2.80 (0.92)	2.30 (0.67)	3.18 (0.98)
Food retailers take time to explain their decisions to me	2.50 (0.85)	2.30 (0.95)	2.55 (1.04)
Food retailers are willing to explain their products and services	3.00 (0.94)	2.60 (0.70)	3.82 (0.75)
Food retailers try to make sure that I understand the information they provide	2.80 (0.92)	2.80 (1.23)	3.55 (0.69)
Food retailers try to make sure that I understand what I am buying	2.50 (1.18)	3.00 (1.33)	3.18 (0.98)
Food retailers provide me with clear information at all times	2.10 (0.99)	2.50 (1.08)	2.64 (1.03)
Food retailers keep me appropriately informed when providing products and services	2.20 (0.92)	2.80 (1.14)	3.09 (1.04)
Food retailers make the effort to understand my circumstances	2.30 (0.95)	2.40 (0.97)	2.45 (0.82)
Food retailers provide advice which is suitable for me	2.70 (1.06)	2.70 (1.16)	3.00 (0.63)
Food retailers provide advice which takes account of my circumstances	2.50 (0.97)	2.30 (0.82)	2.82 (0.60)
Interactional fairness			
Food retailers listen to my needs and react accordingly	2.90 (0.88)	2.60 (1.07)	2.82 (0.60)
Food retailers are willing to listen to my point of view	3.10 (0.99)	2.70 (1.06)	2.73 (0.90)
Food retailers take notice of any points and suggestions that I make	3.00 (0.94)	2.50 (0.85)	2.64 (0.67)
Food retailers show courtesy in their dealings with me	3.70 (0.48)	3.90 (0.74)	3.64 (0.50)
Food retailers treat me with respect	3.60 (0.52)	3.70 (0.67)	3.55 (0.69)
Food retailers are considerate in their dealings with me	3.70 (0.48)	3.70 (0.67)	3.55 (0.52)
Distributive fairness			
Food retailers provide products which perform as I have been led to expect	3.30 (0.48)	3.60 (0.97)	3.36 (0.67)
Food retailers keep their promises	2.80 (0.79)	2.60 (0.84)	2.91 (0.54)
Food retailers deliver what they say they will	2.60 (0.84)	2.60 (0.84)	3.18 (0.60)
I benefit from my interactions with food retailers as much as they do	2.90 (0.99)	2.80 (1.23)	2.91 (0.70)
Food retailers ensure that any charges I pay are fair	2.40 (0.70)	2.50 (0.97)	2.73 (0.47)
Food retailers give me a fair deal	2.40 (0.70)	2.40 (0.84)	2.55 (0.52)
Food retailers make sure that I end up with products which take account of my circumstances and are suitable for me	2.00 (0.67)	2.40 (0.97)	2.73 (0.79)
Food retailers ensure that any terms and conditions attached to products are fair	2.30 (0.67)	2.90 (0.57)	3.00 (0.77)
I get the impression that food retailers would share with me the benefits associated with product usage	2.80 (0.92)	3.00 (1.25)	2.73 (0.79)
Sample size	10	10	11

Devlin et al. (2014)

Table 7: Please indicate to what extent you agree with each statement (1. strongly disagree … 5. strongly agree)

	Nanotechnology survey	Genomics survey	Essential oils survey
	Mean (SD)		
Interpersonal fairness			
Food retail staff are polite	3.60 (0.52)	4.10 (0.32)	3.82 (0.40)
Food retail staff are respectful	3.60 (0.70)	3.80 (0.63)	3.73 (0.47)
Food retail staff treat customers with dignity	3.60 (0.70)	3.90 (0.57)	3.73 (0.47)
Food retail staff are courteous	3.60 (0.70)	4.00 (0.47)	3.82 (0.40)
Food retail staff are friendly	3.70 (0.67)	4.00 (0.47)	3.82 (0.40)
Food retail staff treat me with an unbiased attitude	3.60 (0.70)	3.80 (0.79)	3.55 (0.69)
Informational fairness			
Food retail staff give timely and specific explanations	2.80 (0.92)	3.00 (1.25)	2.91 (0.70)
Food retail staff give thorough explanations	2.70 (1.06)	2.60 (1.07)	2.82 (0.75)
Food retail staff provide reasonable explanations	3.30 (1.06)	3.00 (1.05)	3.36 (0.67)
Food retail staff tailor their explanations to customer needs	3.40 (0.70)	3.40 (0.97)	2.91 (0.70)
Food retail staff give open communication with customers	3.20 (0.79)	3.30 (0.82)	2.82 (0.87)
Procedural fairness			
The process of working with food retail staff is generally fair	3.40 (0.52)	3.30 (0.95)	3.55 (0.52)
The activities of food retail staff are conducted without bias	3.30 (0.82)	3.20 (1.14)	2.82 (0.87)
The procedures used by food retail staff are consistent across customers	2.30 (0.82)	3.10 (0.99)	2.91 (0.83)
Waiting time at food retail stores is reasonable	2.90 (1.20)	3.10 (0.99)	3.45 (0.82)
Distributive fairness			
Food retail staff help all customers get the outcomes they need without favouring any group	2.80 (0.79)	3.00 (0.94)	3.00 (0.77)
Food retail staff produce desired results for all customers without bias of any kind	2.80 (0.42)	3.00 (0.82)	3.09 (0.70)
Food retail staff deliver good outcomes for all customers regardless of who they are	3.00 (0.67)	2.80 (0.79)	3.00 (0.77)
In general, food retail staff deliver reasonable results for all customers	3.40 (0.70)	3.10 (0.88)	3.36 (0.81)
I can get the same outcomes as others do	3.30 (0.82)	3.90 (0.88)	3.45 (0.69)
Systemic fairness			
In general, food retail staff are consistent in their dealings with all customers	3.00 (0.94)	3.40 (1.17)	3.27 (0.79)
Generally, food retail staff treat all customers in a fair and balanced way	3.10 (0.88)	3.40 (1.07)	3.36 (0.81)
The assistance food retail staff provide to customers is unbiased	2.90 (0.74)	3.10 (0.99)	3.00 (0.77)
Overall, food retail staff try to meet their customers' needs fairly	3.30 (0.82)	3.40 (0.97)	3.73 (0.65)
Sample	10	10	11

Carr (2007) and Ting (2013). Similar questions on price fairness from Martin et al. (2009) are also included in Ting (2013).

Participants were also asked about whether they had heard or read news about nanotechnology, genomics or essential oils over the previous three months (Table 8). None of the participants had heard about essential oils over the previous three months and 82% stated that they were not familiar with the technology. About half of the respondents who answered questions related to the use of genomics were somewhat familiar/very familiar with the

technology. Six out of ten of the respondents who answered questions related to the use of nanotechnology were somewhat familiar with the technology.

Table 8: Awareness and perceptions about the use of the technologies

Questions	Responses	Nanotechnology survey	Genomics survey	Essential oils survey
		Frequency (%)		
(i) Over the last three months, have you read or heard any news stories involving… (nanotechnology/the use of genomic information to selectively breed livestock/the use of essential oils to reduce concentrations of *E. coli* O157:H7 in spinach)?	Yes	50.0	40.0	0.0
	No	50.0	60.0	100.0
(ii) How would you describe your familiarity with … (nanotechnology/genomics/essential oils as a food safety technique)?	Not at all familiar	20.0	0.0	81.8
	Not very familiar	20.0	50.0	9.1
	Somewhat familiar	60.0	30.0	9.1
	Very familiar	0.0	20.0	0.0
(iii) In general, to what extent do you support or oppose the use of products and processes that involve … (nanotechnology/genomics/ the use of essential oils for food safety reasons)?	Strongly oppose	0.0	0.0	0.0
	Somewhat oppose	20.0	30.0	27.3
	Somewhat support	70.0	60.0	63.6
	Strongly support	10.0	10.0	9.1
(iv) How risky do you consider the use of … (nanotechnology in the fortification of bread/ genomic information, to undertake selective breeding for disease resistance in pigs/ essential oils to reduce concentrations of *E. coli* O157:H7 in spinach), to be for your health?	Not at all risky	10.0	10	40.0
	Some risk	70.0	10	20.0
	Moderate risk	10.0	70	30.0
	Risky	10.0	0	10.0
	Very risky	0	10	0.0
(v) How beneficial do you consider the use of … (nanotechnology in the fortification of bread/ genomic information, to undertake selective breeding for disease resistance in pigs/ essential oils to reduce concentrations of *E. coli* O157:H7 in spinach), to be for your health?	Not at all beneficial	20.0	11.1	0.0
	Some benefits	60.0	66.7	36.4
	Moderate benefits	10.0	11.1	27.3
	Beneficial	10.0	11.1	27.3
	Very beneficial	0.0	0.0	9.1

Participants were also asked about their human health risk and benefit perceptions about the use of the technologies. Most respondents stated that the technologies have at least some risks and benefits to human health. Four out of 11 respondents stated that the use of essential oils to reduce concentrations of *E.coli O157:H7* in spinach is not risky at all. None of the respondents stated that genomics and nanotechnology are very beneficial to their health.

Empirical model results

Results from conditional logit regressions of the factors that influence the probability of purchasing a product with different attributes are summarized in Table 9. For each technology, six models are estimated whereby the first model includes only product attributes and the other five models include attributes, trust, fairness, familiarity with the technology, age and the education level attained by the respondent. For the five models with product attributes and individual specific variables, the fairness variable is created by averaging responses to questions from the different studies.

Average willingness to pay (WTP) values for the use of nanotechnology and genomics are negative which shows that there is relatively low acceptance for those technologies. Although the average willingness to pay values for essential oils are positive, they are not statistically significantly different from 0.

All the coefficients on the price variables are negative and significant as expected. For nanotechnology, the coefficient of the interaction term between institutional trust (average of the questions on trust in the government, the food industry and scientists) and the production attribute is positive and significant and this result is robust across the 5 models. The coefficient for the interaction term between trust and the production attribute for essential oils is not significant across the 5 models. For the model with genomics as the production attribute, the interaction term between the attribute and institutional trust is only significant for the model where the fairness questions from the study by McComas et al. (2014) are used.

Perceptions about fairness have an effect on choice of the products but results also vary across the technologies. For the models for nanotechnology, the coefficient for the interaction term between fairness and the attribute is significant in the regressions except when we use questions from Martin et al. (2009). For the models for genomics, the coefficient for the interaction term between the fairness variable and the attribute is only significant for the models where we use fairness questions from Metlay (1999) and McComas et al. (2014). For the regression model for essential oils, the coefficient between the interaction term between fairness and the attribute is only significant when we use questions from Martin et al. (2009) and McComas et al. (2014).

The interaction term, between familiarity with the technology and the production attribute is significant in all the models for nanotechnology and essential oils and two of the models for genomics. Age and education also influence choice of food products.

Table 9: Factors influencing choice of products from the different technologies

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Coefficient (SD)					
(i) Bread and nanotechnology						
Price	-1.25***	-1.98***	-2.27***	-2.18***	-2.08***	-2.13***
	(0.22)	(0.34)	(0.41)	(0.39)	(0.36)	(0.37)
Nanotechnology	-0.28	1.67	12.3	17.3*	15.2	2.60
	(0.30)	(8.62)	(9.45)	(9.95)	(10.1)	(7.45)
Neither	-5.51***	-8.69***	-9.93***	-9.54***	-9.11***	-9.33***
	(0.94)	(1.52)	(1.80)	(1.70)	(1.60)	(1.65)
Nanotechnology*Age		-0.12*	-0.31***	-0.28***	-0.18**	-0.16**
		(0.07)	(0.12)	(0.10)	(0.09)	(0.07)
Nanotechnology*Education		-1.86***	-3.65***	-2.65***	-2.91***	-2.08***
		(0.57)	(1.01)	(0.71)	(1.14)	(0.66)
Nanotechnology*Institutional trust		6.86***	12.3***	9.28***	11.1***	9.88***
		(1.89)	(3.06)	(2.29)	(4.01)	(2.60)
Nanotechnology*Fairness		0.15	-2.77***	-2.49***	-4.69**	-2.68**
		(1.25)	(1.07)	(0.99)	(2.29)	(1.13)
Nanotechnology*Familiarity with the technology		3.39***	8.22***	4.02***	5.70**	4.53***
		(1.26)	(2.32)	(1.32)	(2.62)	(1.55)
R^2	0.24	0.51	0.57	0.55	0.54	0.55
# of observations	90	90	90	90	90	90
Average WTP	-0.22	-0.91**	-2.03***	-1.46***	-1.37***	-1.13***
	(0.24)	(0.38)	(0.63)	(0.43)	(0.53)	(0.38)
(ii) Pork and genomics						
Price	-0.13***	-0.15***	-0.15***	-0.15***	-0.15***	-0.15***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Genomics	-1.42***	-26.4*	-45.8	-23.0***	-23.3**	-23.2***
	(0.33)	(15.5)	(31.9)	(8.99)	(10.3)	(9.02)
Neither	-3.15***	-3.55***	-3.55***	-3.57***	-3.63***	-3.56***
	(0.77)	(0.84)	(0.84)	(0.84)	(0.85)	(0.84)
Genomics*Age		-0.04	0.38	0.08	-0.03	0.14
		(0.18)	(0.40)	(0.12)	(0.16)	(0.12)
Genomics*		0.55	1.44	0.60	0.87*	0.66*
Education		(0.54)	(1.25)	(0.39)	(0.49)	(0.37)
Genomics*Institutional trust		9.73	-1.58	2.64	5.71**	1.70
		(6.98)	(4.03)	(1.81)	(2.85)	(1.50)
Genomics*Fairness		-8.78	1.09*	-1.28	-4.04**	-1.54
		(6.39)	(0.65)	(0.88)	(1.85)	(1.06)
Genomics*Familiarity with the technology		2.43*	2.59	1.12	0.89	1.57*
		(1.42)	(2.16)	(0.91)	(1.08)	(0.89)
R^2	0.08	0.21	0.21	0.19	0.21	0.19
# of observations	89	89	89	89	89	89
Average WTP	-10.8***	-20.13**	-16.6***	-12.5***	-13.2***	-12.8***
	(3.34)	(9.61)	(6.61)	(3.73)	(3.95)	(3.85)
(iii) Spinach and essential oils						
Price	-0.34***	-0.40***	-0.39***	-0.39***	-0.47***	-0.39***
	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)
Essential oils	0.52	1.82	3.19	4.37	-32.3***	2.94
	(0.35)	(4.75)	(5.11)	(5.16)	(10.1)	(5.08)
Neither	-6.15***	-7.22***	-7.02***	-7.07***	-8.53***	-7.00***
	(0.98)	(1.15)	(1.11)	(1.22)	(1.39)	(1.11)
Essential oils*Age		0.08***	0.07*	0.09***	0.16***	0.08***
		(0.03)	(0.04)	(0.03)	(0.04)	(0.03)
Essential oils*Education		-0.35	-0.48**	-0.49**	-0.12	-0.46**
		(0.22)	(0.22)	(0.22)	(0.32)	(0.22)
Essential oils *Institutional trust		0.59	-0.73	-0.04	0.50	0.08
		(0.93)	(0.94)	(0.82)	(1.18)	(0.95)
Essential oils *Fairness		-1.76**	0.46	-1.20	7.52***	-0.72
		(0.92)	(0.56)	(0.86)	(2.02)	(1.01)
Essential oils *Familiarity with the technology		2.28***	2.40***	2.67***	2.56***	2.39***
		(0.76)	(0.76)	(0.80)	(0.99)	(0.75)
R^2	0.38	0.46	0.44	0.45	0.54	0.44
# of observations	95	95	95	95	95	95
Average WTP	1.52	1.40	1.49	1.40	0.88	1.47
	(1.02)	(0.95)	(0.96)	(0.96)	(0.97)	(0.96)
Source of questions about fairness		Martin et al. (2009)	Metlay (1999)	Devlin et al. (2014)	McComas et al. (2014)	Carr (2007) & Ting (2013)

***, ** and * indicate significance at the 1%, 5% and 10% levels respectively

Tobit regression models were also estimated to determine the relationship between trust and fairness. The dependent variable is trust in food institutions and the explanatory variables and demographic variables (age, gender (male=0, female=1), education and income) and fairness.

Table 10: Factors influencing trust in food institutions

	Model 1	Model 2	Model 3	Model 4	Model 5
	Coefficient (SD)				
Constant	5.06***	4.62***	3.54***	1.89*	3.36***
	(1.00)	(1.05)	(0.98)	(1.11)	(0.97)
Age	0.01	0.005	0.003	0.004	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Female	-0.47	-0.34	-0.25	0.04	-0.39
	(0.29)	(0.31)	(0.26)	(0.26)	(0.25)
Education	-0.11**	-0.09*	-0.07*	-0.07*	-0.08*
	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)
Income	0.005	0.01	0.005	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Fairness	-0.001	0.03	0.33***	0.76***	0.40***
	(0.0004)	(0.10)	(0.12)	(0.20)	(0.13)
Sigma	0.39***	0.40***	0.36***	0.34***	0.35***
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)
Log likelihood	-15.2	-15.8	-12.5	-10.1	-11.8
# of observations	31	31	31	31	31
Source of questions about fairness	Martin et al. (2009)	Metlay (1999)	Devlin et al. (2014)	McComas et al. (2014)	Carr (2007) & Ting (2013)

***, ** and * indicate significance at the 1%, 5% and 10% levels respectively

There is a significant positive relationship between trust and fairness when we use questions about fairness from Devlin et al. (2014), McComas et al. (2014) and Ting, 2013 (or Carr, 2007). However, the relationship between trust and fairness is not significant when we use the questions from Martin et al. (2009) and Metlay (1999).

Conclusions

In this research, the aim was to test the relationships between trust, fairness and perception of quality in three different contexts i.e. bread fortified with omega-3 fatty acids using nanotechnology, pork chops from pigs selectively bred for disease resistance using genomic selection and baby spinach treated with essential oils to reduce concentrations of *E. coli* O157:H7. Data are from a small project conducted in 2015 at the University of Alberta, Canada where 31 non-academic staff completed stated preference experiments and surveys. Data are analysed using conditional logit models. Different variables of fairness are created using questions from previous studies.

From the analysis, there is evidence that trust and fairness influence consumers' choice of bread produced using nanotechnology and fairness play a significant role in the choice of pork and spinach produced using genomics and essential oils respectively. Results show that perceptions of fairness influence trust and both trust and fairness influence acceptance of food technologies. Fairness has some explanatory power so the implication is that some measures of fairness perceptions may be important in explaining other food choices. The results also show that the effects of fairness vary depending on the questions used to measure the variable.

Familiarity with the technologies also has a strong influence with choice of products

from the different technologies especially nanotechnology and essential oils. The results of this study will provide the conceptual basis for further investigation of trust and fairness perceptions of the Canadian public and how those perceptions influence their willingness to purchase foods produced with novel technologies. Our results suggest that at a minimum including the definitions of fairness from the McComas et al. (2014) could be an important first step in explaining consumer behaviour.

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