Avoid is Better than Generate: The Effect of Framing Information on Consumer Preferences and Willingness to Pay for Plant-Based Milk

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Abstract:

Agricultural and food systems play a crucial role in affecting climate change, and shifting towards plant-based diets has been recognized as a beneficial strategy to reduce environmental pressures. A stated choice study was conducted to better understand consumers' interest and motives toward consuming alternative plant-based beverages, particularly the way that information is communicated to consumers. We collected 1825 online survey responses in Canada and 1865 survey responses in China using panels accessed through market research companies. Te results confirm the positive impact of GHG information exposure and highlight the importance of information framing. In both countries, the "avoid" framing has a stronger influence on the probability of choosing beverages with lower GHG emissions. Additionally, we find that some respondents strongly prefer products consistent with traditional dietary patterns, highlighting the potential difficulty of promoting dietary transitions, such as plant-based diets, in different contexts. These findings contribute to the understanding of consumer behavior and provide guidance for the development of sustainable consumption strategies.

Keywords: greenhouse gas emissions, willingness to pay, information framing, consumer preferences, cross-cultural differences.

1. Introduction

Agricultural and food systems are significantly influencing climate change. As the global population grows and the need for sustainable food systems increases, there is a growing demand for plant-based alternatives to animal-sourced protein (Pingali et al., 2023; Wood & Tavan, 2022). The adoption of plant-based diets has gained recognition as a beneficial strategy to reduce environmental pressures and foster a more sustainable food system (Ruini et al., 2015; Tziva et al., 2023). According to many in the field, plant-based beverages substitutes have significant effect on greenhouse gases emissions and resources used (water, energy, and land) (Grant & Hicks, 2018; Carlsson et al., 2021). Poore and Nemecek (2018) found the effects of the least harmful animal products still outweigh those of plant-based substitutes.

Plant-based diets have also been linked to increased nutrition equity. The relative cost of food varies across nations in a predictable way. For underdeveloped nations, the high price of animal-based protein sources may provide an affordability hurdle (Beheshti et al., 2016; Ederer et al., 2023). Diets based primarily on plants provide a potential remedy for the problems with high protein costs faced by many developing nations (Nadathur et al., 2017). Countries can improve food security, nutritional outcomes, and the financial burden associated with protein availability by promoting and incorporating plant-based diets. In terms of the price per unit at the grocery store, legumes, grains, and some vegetables can provide nutritionally equivalent alternative raw ingredients at a lower cost, especially in regions where protein affordability is a concern (Masters

et al., 2023; Gradl et al., 2024).

Consumers' reactions to environmental information and decision-making processes are influenced by a number of factors, including eco-consciousness, perceived environmental benefits, trust in labeling, information awareness, and personal values (Palczak et al., 2019; Caputo et al., 2020; Balcombe et al., 2021; Cardello et al., 2022; Estell et al., 2021). Research has demonstrated that consumers' preferences and willingness to pay may be influenced by information exposure such as environmental labeling and carbon footprint certification (Van Loo et al., 2017; Edenbrandt et al., 2018; Chen et al., 2018). Furthermore, providing information on its own is a necessary but insufficient requirement for changing behavior. People must convert information into knowledge, and knowledge into conduct (Adamczyk et al., 2022; Schruff et al., 2023). This is something that policy interventions should take into account.

According to prospect theory, people may react differently to communications that are portrayed as gains versus losses (Kahneman & Tversky, 1979). By using this approach to analyze environmental data about plant-based milk, one can gain insight into customer preferences and readiness to pay for the lowering of carbon emissions. The majority of recent food-related research on framing focuses on controlling health behaviors, such as using framing information to increase dietary intake of nutritious foods, lower obesity or food waste rates, and ensure food safety (Rahn, et al., 2017; Britwum et al., 2019; Binder et al., 2020; Begho et al., 2023; Panzone et al., 2022). A large portion of the recent literature has been on the effects of eating meat, fruits and vegetables, sugar-filled beverages, and junk food, among other things. Although several studies attempting to explore the framing impact in promoting healthy eating and environmental benefits, there is little literature on the explicit willingness-to-pay enhancement of a specific product by the labeling of specific environmental information. By expanding the focus of framing research to include certain food consumption patterns, we may discover more about how framing information may be used to effectively guide individuals toward healthier and more sustainable dietary choices. Thus, the study may aid in the development of evidence-based initiatives and policy interventions that promote public health and sustainable food systems.

Due to a variety of reasons, including individual views, historical backdrop and economic development, it is proved that consumer behavior varies greatly throughout nations and cultures (Yang & Hobbs, 2020). Meanwhile, different countries adopt varied diets at different rates and according to multiple methodologies. Analyzing customer preferences for plant-based milk and their willingness to pay in various nations, such China and Canada, can reveal consumer behavior drivers and point out possible roadblocks or enablers to sustainable dietary shifts. Chinese consumers are regarded to have a long history of consuming plant-based beverages and higher acceptance of plant alternatives because of higher lactose intolerance. Canadian consumers usually have stronger environmental concerns and more awareness and perception about climate change, but may have stronger affinity to dairy milk. By identifying the unique challenges and opportunities specific to each country, policymakers and stakeholders can develop strategies to facilitate and accelerate the adoption of plant-based diets, taking into account cultural, economic, and social factors. This research can contribute to the development of global and context-specific initiatives that promote both individual and planetary health.

In summary, the effective promotion of alternative proteins for the transformation of sustainable food systems requires comprehensive consideration in terms of nutritional equivalence, economic costs, environmental attitudes and social culture in dietary. This paper is written to understand consumer's interest and motivation toward the consumption of plant-based alternative beverages. First, this study is the first to consider the application of framing effects to plant milk substitutes to examine the impact of carbon emission information on consumption intention and to provide more precise policy recommendations on information presentation strategies from a psychological perspective. Second, by comparing four beverages with different carbon emissions (including animal milk and emerging/traditional varieties of plant milk), this study provides research on the motivations for and factors influencing the consumption of plant milk substitutes. Finally, this study takes into account the heterogeneity of the consumer population and compares the differences in consumer motivation and behavior in different countries, which provides a comprehensive reference for dietary pattern changes in different cultures.

2. Theoretical background

2.1 Environmental information

People's concern about climate change is increasing, public food values, such as environmental impacts and animal welfare, drive consumers' demand for alternative meat and milk products (Matin et al., 2012; Knaapila et al., 2022). This indicates that consumers' willingness to pay (WTP) for products that have an impact on the environment has changed. (Lusk et al., 2018; Kilders et al., 2021; Wang et al, 2022; Sun et al., 2023). Researches find that minimizing adverse environmental effects is a primary driving force for customer purchases of plant-based protein beverages. (Haas et al. 2019; McCarthy et al. 2017; Schiano et al. 2020). Although environmental awareness among consumers may positively influence their decisions to make green purchases (Mahmoud et al., 2022), the mentality–behaviorsny gap may prevent consumers from acting in an actual environmentally friendly manner (Kaiser et al., 1999). It is possible that this gap is a result of individuals not knowing the specific information and understanding the practical benefits of behavioral changes. As consumers are not all informed of the precise impacts of their food choice activities may have on the environment, a lack of awareness and understanding of potential effects of particular actions may account for this gap. Additionally, research has shown that people who are informed about "how" rather than "why" they can reduce their greenhouse gas emissions through food choices will feel more empowered to take action (Snyder, 2002, p. 249; Khalil, 2022), which will lead to stronger attitudes and intentions. Educating customers on how food choice affects the environment will have an impact on their dietary decisions. Hence, we suppose the first hypothesis of this study: Exposure to greenhouse gas emissions information will cause consumers' different response towards animal and plant-based beverages.

2.2 Framing effects

Prospect theory (Kahneman & Tversky, 1979) states that people's decisions depend on the way information is presented. In particular, gain/loss message frames are essential since they have the power to directly affect an individual's behaviors (McCormick & Seta, 2016). As a psychological term, framing is the act of presenting information in a way that shapes people's opinions, perceptions, and procedures for making decisions. It is hypothesized and supported by research that framing information in either a positive (gain-frame) or negative (loss-frame) way

might influence consuming behaviors, including eating habits (Godinho et al, 2016; Zhang et al., 2022).

Previous studies (Nabi et al., 2018) have demonstrated that gain- or loss-framed messages evoke positive or negative emotions in regard to addressing climate change. Krpan et al.(2020) found that a pro-environmental frame, a social frame, and a neutral frame all increased the likelihood of vegetarian choice compared to a vegetarian frame. The effect of these messages on attitudes toward and advocacy for climate change policies is mediated by hope, which is examined by Khalil et al.(2022) through a survey regarding food waste reduction. It is generally expected that when it comes to encouraging adherence to preventive practices, gain-framed messages outperform loss-framed ones (Gallagher & Updegraff, 2012).

In our study, we utilized the terms “avoid” and “generate” greenhouse gas (GHG) emissions, respectively. These terms effectively capture the essence of gain framing, which emphasizes the potential benefits gained from emission reduction, and loss framing, which highlights the negative consequences associated with emission generation. In light of previous research on gain- and loss-framed messages, in the second study, we hypothesize that the avoid framing has a stronger effect than loss framing to improve consumers’ utility for products with less carbon emissions.

2.3 Cultural drivers

The differences across different countries and cultures may cause the disparity of response to framing and WTP. The nations varied in terms of their geographic location, population density and composition, economic status, national cultures (Hofstede Insights,2023), percentage of the vegetarian dietary population (Bryant et al., 2019; Statista,2023b), markets trends of plant-based products (Slade, 2023; Statista,2023a; Statista,2024), and regarding laws and regulations (Naab et al., 2021).

China and Canada are two common instances that deserve worthwhile research. Although eating dairy products is deeply ingrained in Canadian culture, this has been changing in recent years. Cross-sectional data from the Canadian Community Health Surveys show a dramatic decline in the percentage of Canadians who consume whole milk, the proportion of Canadians consuming plant-based beverages (PBBs) rose dramatically. (Islam et al., 2021). In China, dairy milk once was a seldom consumed food, but has grown rapidly in recent years (Bu et al., 2021; Sun et al., 2023). Additionally, Chinese people have long been traditional consumers of vegan products like tofu and soy milk. In order to identify the factors influencing the variability of their stated preference, it is interesting to develop a cross-cultural comparative survey with respondents in Canada and China so that the driver of their willingness to pay could be recognized.

Hence, in the third component of this study, we examine the difference in plant-based alternatives preference between Canada and China. Figure 1 shows the conceptual model of the three components.

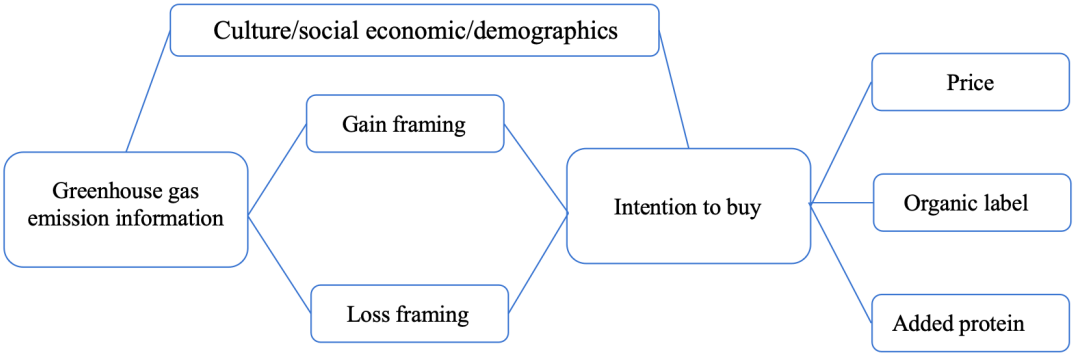

Figure 1 Conceptual Model of the Studies.

3. Study design

3.1 Choice experiment design

Choice experiments have several advantages in eliciting preferences over other stated preference techniques (Muringai, et al., 2020). And considering the diversity of the sample distribution, we use conditional logit for further estimates and the calculation of WTP. In the choice experiment, we choose the beverage type, organic label, added protein label, and price as the attributes (shown in Table 1). The experimental design was developed using mktEx macro in SAS. The fractional factorial design (d-efficiency of 100) resulted in 32 choice sets. They were grouped into four sets of eight choices. Each set of eight choices contained all beverages. The sets were randomized across survey respondents.

3.2 Attributes design

3.2.1 Beverage type

For the selection of plant-based alternative beverages, we first considered the sales markets in both countries. In the past two years, dollar sales of plant-based beverages such as soy, almond, rice, coconut, oat, and hemp beverages grew by 27% in Canada (Retail sales data: Plant-based meat, eggs, dairy, 2021). The increase in Canadian sales of milk alternatives was primarily driven by oat, almond, and hazelnut milk. Soy milk retained a larger market share, comprising 32% of milk alternative sales in 2018. From 2018 to 2020, sales of soy drinks declined by a Compound Annual Growth Rate (CAGR) of −2.6%, while sales of other milk alternative beverages, including oat milk, almond milk, or hazelnut milk, increased by a CAGR of 11.9% (Agriculture and Agri‐Food Canada, 2021). According to Euromonitor, the market size of China's plant-based dairy beverages in 2022 was RMB 40.68 billion. Soy milk (11.37 billion yuan), walnut milk (10.98 billion yuan), coconut milk (10.62 billion yuan), and almond milk (4.02 billion yuan) account for about 91% of the market sales of plant-based milk drinks. While in terms of category growth rate, the market size of oat milk increased by 50% year-on-year compared to 2021, far exceeding other plant-based milk drinks. In summary, soy milk, a plant-based alternative that has long held a large market share in both countries has shown a downward trend in Canada in recent years, which is worth comparing with almond milk, which also accounts for a large percentage of sales in both countries and oat milk, a typical emerging plant-based milk that is increasing rapidly in both countries. By choosing these 3 alternative products, we tried to include beans, grains, and nuts as the sources, including emerging and traditional ones, include different impacts on the environment.

3.2.2 Price range

For determining the price, The Canadian price information was obtained from local grocery store observations in Edmonton and Ottawa, in July 2022 in Canada, as well as data gathered from the official websites of major dairy and plant-based milk manufacturers. It is worth noting that after the initial pilot survey of 300 respondents, we adjusted the price from “$1.99, $3.99, $5.99 and $7.99 per 946 ml” to the present one of "$1, $4, $7 and $10 per 946 ml” The pricing information in China was sourced from observations of selected grocery stores in October 2022 in Beijing, as well as from relevant literature that commonly utilizes price attribute strategies. We didn’t adjust it and set “¥2.50, ¥5.00, ¥7.50, ¥10.00/250ml” as the final set.

3.2.3 Package label

We also included the organic certification labels specific to Canada and China, as they align with the relatively harmonized standards and reflect environmental friendliness. It is a widely recognized label that has been implemented for several years and is familiar to the populations in both Canada and China. Another attribute we included in the choice experiment was the protein label. This choice was driven by the fact that the actual protein content of plant-based beverages is much lower than animal based. Thus, we designed a protein-enhanced label to raise protein to the level of animal based and description as one of the attributes in the choice experiment. Figure 2 shows an example of one of the choice questions. Figure 3 represents the explanations provided to participants regarding the various attributes before they entered the choice experiment. This step was crucial in ensuring that participants had a clear understanding of the attributes and their implications, allowing them to make informed choices during the experiment.

Table 1 Conjoint Choice Experiment Attributes and Levels.

Attribute	Levels
Beverage types	1. Dairy milk 2. Soy beverage 3. Oat beverage 4. Almond beverage
Added protein label	1. No label 2. Added protein label (e.g. 3.9 grams for dairy milk; 4 grams for soy beverage; 9 grams for oat beverage; 11 grams for almond beverage)
Organic label	1. No label 2. Canada Organic Label/Chinese Organic Label
Price	Four levels of prices based on the market conditions for each country Canada: $1.00, $4.00, $7.00, and $10.00/946 ml China: ¥2.50, ¥5.00, ¥7.50, ¥10.00/250ml

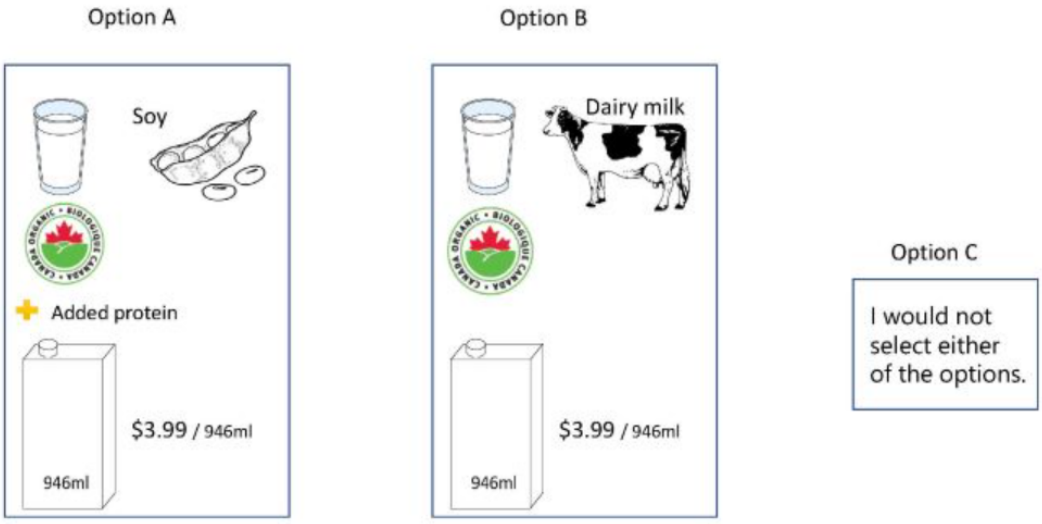

Figure 2 Example choice experiment question

Product type	Base Protein	Organic certification label	Added protein label
Dairy milk	8.1 gm		
Soy beverage	8 gm	Means milk/beverage is produced in a way that meets the *Canadian organic standard*	Means milk/beverages are *enhanced with protein* so that each has 12 gm of protein
Oat beverage	3 gm		
Almond beverage	1 gm		

Figure 3 Explanation before the choice experiment

We used a trap question to gauge the degree of participation in order to improve the questionnaire's accuracy and identify respondents who might not have approached the procedure seriously (Liu & Wronski, 2018; Malone & Lusk, 2018). Respondents were asked to choose a precise point on a five-point Likert scale in the trap question. In particular, we looked at the failure rates among Canadian participants, which come to 21.41 percent, compared to 5.69 percent in China. The study's overall precision was improved and the dataset's integrity was preserved when we eliminated those respondents who showed signs of being inattentive to the trap question.

3.3 Framing design

For the information treatment, we used several question structures to get respondents to think about how their decisions might affect greenhouse gas emissions. We give the specifics on "how" (as opposed to "why") to select a beverage that will reduce greenhouse gas emissions. The study by Poore and Nemecek served as the basis for the calculation of the GHG emission data (2018). Additionally, we got the driving-related carbon emissions from statistics report (2021). The proportion of respondents in different framing groups is shown in Table 2.

Table 2 Messages for different information treatment group

Group	Information treatment	beverage type	Canadian percentage	Chinese percentage
Avoid Group				
1	Note that substituting one cup (240 ml) of soy beverage for dairy milk every day for one year avoids 189.6 kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 832.3kms in Canada.	Cow VS Soy	6.78	6.67
2	Note that substituting one cup (240ml) of oat beverage for dairy milk every day for one year avoids 196.8 kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 863.9kms in Canada.	Cow VS Oat	6.75	6.41
3	Note that substituting one cup (240ml) of almond beverage for dairy milk every day for one year avoids 213.6 kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 937.6kms in Canada.	Cow VS Almond	6.58	6.45
4	Note that substituting one cup (240ml) of soy beverage for oat beverage every day for one year avoids 7.2 kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 31.6 kms in Canada.	Soy VS Oat	6.58	6.45
5	Note that substituting one cup (240ml) of almond beverage for soy beverage every day for one year avoids 24.0kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 105.3 kms in Canada.	Soy VS Almond	6.21	6.27
6	Note that substituting one cup (240ml) of almond beverage for oat beverage every day for one year avoids 16.8 kg of GHG emissions, equivalent to the GHG emissions avoided by NOT driving a car 73.7 kms in Canada.	Oat VS Almond	6.55	6.61
Generate Group				
7	Note that substituting one cup (240 ml) of dairy milk for soy beverage every day for one year generates 189.6 kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 832.3kms in Canada.	Soy VS Cow	6.14	6.26
8	Note that substituting one cup (240ml) of dairy milk for oat beverage every day for one year generates 196.8 kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 863.9kms in Canada.	Oat VS Cow	5.99	5.98
9	Note that substituting one cup (240ml) of dairy milk for almond beverage every day for one year generates 213.6 kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 937.6kms in Canada.	Almond VS Cow	5.92	6.05

10	Note that substituting one cup (240ml) oat beverage for soy beverage every day for one year generates 7.2 kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 31.6 kms in Canada.	Oat VS Soy	5.92	6.05
11	Note that substituting one cup (240ml) of soy beverage for almond beverage every day for one year generates 24.0kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 105.3 kms in Canada.	Almond VS Soy	5.62	5.91
12	Note that substituting one cup (240ml) of almond beverage for oat beverage every day for one year generates 16.8 kg of GHG emissions, equivalent to the GHG emissions generated by driving a car 73.7 kms in Canada.	Almond VS Oat	6.21	6.02
13	Without information	Same beverage	24.75	24.87

3.4 Experiment flow

Before initiating the experimental selection process, a cheap talk mechanism was employed to mitigate hypothetical biases, which emphasized their budget constraints to ensure their choices were more aligned with real-world decision-making scenarios. The full content of Cheap Talk is attached in Appendix B. The flow when respondents start the choice experiment is like below (Figure 4), eight questions with greenhouse gas information for each choice with different beverages.

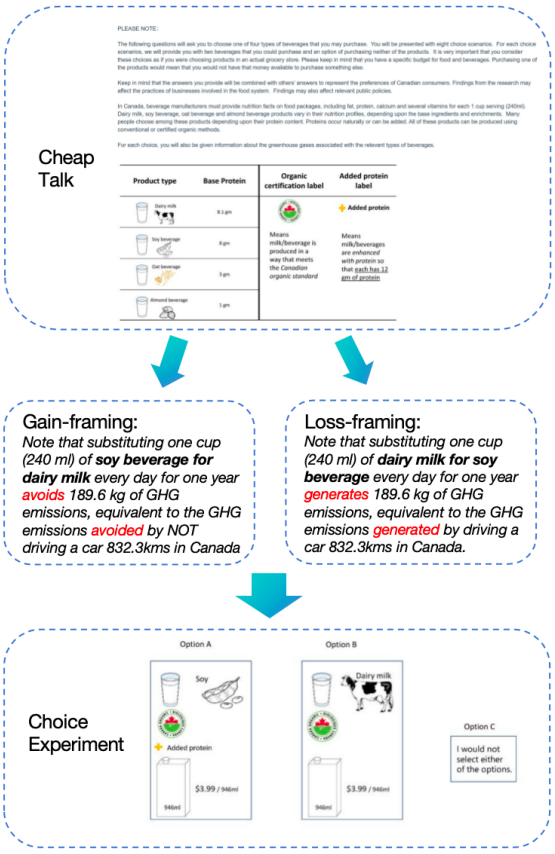

Figure 4. Experiment flow

4. Data description

4.1 Data collection

The survey was conducted by distributing a questionnaire online. The panel data were collected from adults recruited by different survey companies in Canada (CA, n=1826) and China (CH, n=1865). The study was covered by general approval for consumer research from the University of Alberta Research Ethics Board (Reference ID: Pro00119792) and the Academic Committee of Renmin University of China (Reference ID: SARD-2023-03). Participants gave voluntary consent and were assured that their responses would remain confidential. They were informed that they could end their participation at any time.

4.2 Demographic statistics

In the Canadian sample, the mean age of respondents is 53 years old. The number of male respondents is almost the same as female ones. Most respondents have 2 people in their family, and only 6.23% of respondents have a five-person family. 26.82% of respondents don't have any kids in their family now, and 64% don't have any senior members in their family now. Only 2.94% of respondents have a pregnant woman in their family now, who likely pay more attention to nutrition. Most respondents have a degree higher than secondary (high) school, which means they should have the ability to understand the questionnaire well. More than 60% of the respondents live in cities, which means they have more opportunities to learn about new products. Near 40% of respondents are fully employed. 79.34% of them claim they are not allergic to dairy milk, more than 90% of them are not allergic to soy or oat

In the Chinese sample, the mean age of samples is 30 years old, much younger than the Canadians, which may be caused by the lack of lack of Internet habits among the elderly in China. The size of female respondents is a bit larger than male ones. It is more common to see 3 people in one family in China. While for the number of senior and pregnant women in the family, there are no huge difference in distribution with Canada. Chinese samples are much better educated compared to Canadian ones, the young group may be the main reason as the education level of the new generation is growing very fast.

Table 3 Demographic descriptions of responders.

Variable	Description	Canada		China	
		Frequency	Percent(%)	Frequency	Percent(%)
Gender	1=male	707	49.51	746	42.48
	2=female	721	50.49	1010	57.52
People in family	1	383	26.82	41	2.33
	2	551	38.59	100	5.69
	3	255	17.86	773	44.02
	4	150	10.5	450	25.63
	5	89	6.23	392	22.32
Number of kids in the family	0	383	26.82	528	30.07
	1	551	38.59	955	54.38
	2	255	17.86	256	14.58
	3	150	10.5	12	0.68
	4	89	6.23	1	0.06
	no less than 5	0	0	0	0
Number of olds in family	0	879	61.55	1000	56.95
	1	340	23.81	350	19.93
	2	198	13.87	358	20.39
	3	4	0.28	22	1.25

	4	5	0.35	24	1.37
	no less than 5	2	0.14	0	0
If pregnant in the family	0=no	1386	97.06	1685	95.96
	1= yes	42	2.94	71	4.04
Education situation	1= Elementary school (8 years)	26	1.82	2	0.11
	2= Secondary (high) school (12 years)	377	26.4	14	0.75
	3= Technical/ business school/Community college (14 years)	450	31.51	66	3.54
	4= University (16 years)	435	30.46	1590	85.25
	5= Postgraduate studies (Masters or PhD) (18 years)	140	9.8	193	10.35
Area	1=in city	906	63.45	1551	88.33
	2=in town	262	18.35	160	9.11
	3=in rural	260	18.21	45	2.56
If employed full-time	1=yes	561	39.29	1514	86.22
	0= no	867	60.71	242	13.78
If allergic to dairy	0=not allergic	1133	79.34	1469	83.66
	1=slightly allergic	143	10.01	263	14.98
	2=moderately allergic	93	6.51	23	1.31
	3=highly allergic	59	4.13	1	0.06
If allergic to soy	0=not allergic	1287	90.13	1679	95.62
	1=slightly allergic	49	3.43	64	3.64
	2=moderately allergic	50	3.5	10	0.57
	3=highly allergic	42	2.94	3	0.17
If allergic to oats	0=not allergic	1315	92.09	1703	96.98
	1=slightly allergic	34	2.38	44	2.51
	2=moderately allergic	45	3.15	7	0.4
	3=highly allergic	34	2.38	2	0.11
If allergic to almond	0=not allergic	1254	87.82	1692	96.36
	1=slightly allergic	60	4.2	51	2.9
	2=moderately allergic	66	4.62	12	0.68
	3=highly allergic	48	3.36	1	0.06

5. Results

The estimated model in choice experiments is the random utility model as initially proposed and applied by McFadden (1974). The rationale is that utility is derived from the underlying attributes of a good or service rather than from the good or service per se (Lancaster, 1966) and that respondents choose those alternatives that offer the largest expected utility (Train, 2009).

There are three common estimation methods for this type of model -- multinomial logit, conditional logit and mixed logit. Here we report the conditional logit results that can provide a better test of heterogeneity and the data in this paper meet the requirements of the IID, so the conditional logit is

used for estimation. Maximum likelihood estimation of a conditional logit model was adopted as the basic analysis to comprehend consumer preferences for plant-based alternatives and their labels without considering the influence of other explanatory and demographic variables. As this model is based on the Random Utility Model (RUM), the coefficients are interpreted as marginal utilities (Johnston et al., 2017). As can be seen from the Table, the coefficient on price is negative and significant, which means that people have a positive marginal utility of money, as expected.
Table 4 shows part of the regression results, as we have 8 questions for each respondent, we got 11424 lines of data for Canada and 14896 lines of data for China.

5.1 Model results

For the regression, our model includes the main six attributes, interactions between attributes and demographic and socio-economic characteristics that can be considered exogenous to the choice context, and information treatment interaction terms.
By comparing the coefficients of the attributes, it becomes evident that Canadian consumers exhibit a significantly stronger preference for dairy milk compared to plant-based milk alternatives. On the other hand, Chinese consumers obtain the highest marginal utility from soy milk, suggesting that it is the most preferred product for them. All four beverages provide consumers with less utility as they age, but show a significantly higher preference for protein addition; female consumers in Canada show a stronger preference for oat and almond milk compared to male consumers, and female consumers in China show a significantly lower preference for cow's milk and organic labels, but protein addition brings significantly more utility to female consumers. It is worth noting that Canadian consumers show a stronger preference for cow's milk and soy beverages, and a weaker preference for oat and almond milk, while Chinese female consumers show a significantly lower preference for cow's milk and organic labeling, but protein addition brings significantly more utility to female consumers.
Subjects in all subgroups in Canada were affected by information interventions with changes in the utility of different beverages, and subjects in China also received significant effects in all but the first group. We confirm that the inclusion of the information treatment variable does make a difference in the regression results, and the interaction term for the information treatment is significant, verifying H1 and H3.

Table 4 Conditional logit results

VARIABLES	Canadian Sample choice	Chinese Sample choice
cow	0.791**	1.639***
	(0.350)	(0.558)
soy	0.0172	2.200***
	(0.382)	(0.546)
oat	-0.165	0.990*
	(0.373)	(0.547)
almond	-0.638*	0.493
	(0.364)	(0.560)
addprot	0.0280	0.399
	(0.257)	(0.336)
organic	0.312	1.032***
	(0.260)	(0.344)
price	-0.113***	-0.115***
	(0.00513)	(0.00501)
cow_age	-0.00671**	-0.00560
	(0.00328)	(0.00559)
soy_age	-0.0354***	-0.0127**

	(0.00350)	(0.00553)
oat_age	-0.0316***	-0.00883
	(0.00342)	(0.00552)
almond_age	-0.0277***	0.00406
	(0.00332)	(0.00560)
organic_age	-0.00270	-0.00298
	(0.00239)	(0.00354)
addprot_age	0.00616***	-0.0175***
	(0.00235)	(0.00345)
cow_gender1	-0.102	-0.372***
	(0.0821)	(0.0849)
soy_gender1	0.0743	-0.115
	(0.0892)	(0.0829)
oat_gender1	0.243***	-0.0971
	(0.0873)	(0.0830)
almond_gender1	0.371***	-0.151*
	(0.0844)	(0.0851)
organic_gender1	0.00348	-0.103**
	(0.0614)	(0.0511)
addprot_gender1	0.0876	0.140***
	(0.0607)	(0.0499)
cow_edu1	-0.00208	0.00802
	(0.0202)	(0.0296)
soy_edu1	0.124***	-0.0240
	(0.0221)	(0.0291)
oat_edu1	0.135***	0.0396
	(0.0216)	(0.0291)
almond_edu1	0.117***	0.0111
	(0.0209)	(0.0297)
organic_edu1	0.0101	-0.00558
	(0.0152)	(0.0183)
addprot_edu1	-0.00846	0.0282
	(0.0150)	(0.0179)
cow_family1	0.115	0.161
	(0.108)	(0.162)
soy_family1	0.364***	0.411***
	(0.114)	(0.159)
oat_family1	0.463***	0.0931
	(0.112)	(0.160)
almond_family1	0.441***	0.381**
	(0.109)	(0.165)
organic_family1	0.108	0.133
	(0.0788)	(0.104)
addprot_family1	0.0346	0.197*
	(0.0777)	(0.102)
cow_kids1	0.653***	0.121
	(0.129)	(0.103)
soy_kids1	0.459***	0.213**
	(0.133)	(0.101)
oat_kids1	0.271**	0.314***
	(0.131)	(0.101)
almond_kids1	0.363***	0.367***
	(0.129)	(0.104)
organic_kids1	-0.132	0.196***
	(0.0916)	(0.0635)
addprot_kids1	-0.121	-0.0523
	(0.0900)	(0.0620)
cow_olds1	0.184*	0.0720
	(0.0975)	(0.0855)
soy_olds1	0.238**	0.0494
	(0.106)	(0.0832)
oat_olds1	0.0425	0.108
	(0.104)	(0.0833)
almond_olds1	0.0745	0.0795
	(0.100)	(0.0857)
organic_olds1	0.0616	0.00166
	(0.0728)	(0.0513)

addprot_olds1	-0.163**	-0.104**
	(0.0719)	(0.0501)
cow_pregs1	0.454*	-0.516**
	(0.263)	(0.205)
soy_pregs1	0.459*	0.00751
	(0.270)	(0.193)
oat_pregs1	0.191	-0.0917
	(0.271)	(0.192)
almond_pregs1	0.485*	0.118
	(0.261)	(0.197)
organic_pregs1	-0.109	-0.229*
	(0.176)	(0.124)
addprot_pregs1	0.246	-0.192
	(0.172)	(0.121)
cow_area1	-0.0604	-0.265**
	(0.0855)	(0.129)
soy_area1	-0.149	-0.131
	(0.0932)	(0.127)
oat_area1	-0.126	-0.174
	(0.0912)	(0.126)
almond_area1	-0.150*	-0.327**
	(0.0881)	(0.130)
organic_area1	-0.111*	-0.0185
	(0.0643)	(0.0809)
addprot_area1	-0.00604	-0.169**
	(0.0636)	(0.0789)
cow_emplo1	-0.191**	-0.183
	(0.0945)	(0.127)
soy_emplo1	-0.374***	-0.360***
	(0.100)	(0.126)
oat_emplo1	-0.325***	-0.234*
	(0.0985)	(0.125)
almond_emplo1	-0.297***	-0.202
	(0.0958)	(0.128)
organic_emplo1	-0.134*	0.0492
	(0.0692)	(0.0796)
addprot_emplo1	-0.0182	-0.0242
	(0.0683)	(0.0776)
cow_alg	-0.582***	-1.136
	(0.166)	(1.287)
soy_alg	0.483**	-0.379
	(0.191)	(0.573)
oat_alg	0.899***	-2.036*
	(0.206)	(1.130)
almond_alg	-0.0703	0.515
	(0.182)	(0.757)
info1cow	0.950***	-0.0804
	(0.105)	(0.0930)
info1soy	-0.114	0.0715
	(0.111)	(0.0836)
info2cow	1.047***	0.199**
	(0.101)	(0.0924)
info2oat	-0.0675	1.365***
	(0.102)	(0.0884)
info3cow	0.911***	0.345***
	(0.0977)	(0.0906)
info3almond	0.592***	1.296***
	(0.103)	(0.0853)
info4soy	-0.321***	0.599***
	(0.111)	(0.0867)
info4oat	-0.223**	-0.0150
	(0.0980)	(0.0817)
info5soy	-0.294**	1.145***
	(0.117)	(0.0953)
info5almond	0.578***	-0.0352
	(0.111)	(0.103)
info6oat	-0.619***	-0.464***

	(0.119)	(0.0905)
info6almond	0.839***	0.999***
	(0.101)	(0.0876)
info7cow	0.976***	-0.145
	(0.111)	(0.0944)
info7soy	-0.199*	-0.191**
	(0.117)	(0.0856)
info8cow	1.063***	0.399***
	(0.105)	(0.0925)
info8oat	-0.146	0.895***
	(0.107)	(0.0900)
info9cow	0.869***	0.499***
	(0.101)	(0.0915)
info9almond	0.632***	0.881***
	(0.107)	(0.0865)
info10soy	-0.366***	0.214**
	(0.115)	(0.0887)
info10oat	-0.125	0.190**
	(0.100)	(0.0827)
info11soy	-0.205*	0.978***
	(0.120)	(0.0961)
info11almond	0.572***	-0.00110
	(0.116)	(0.102)
info12oat	-0.657***	-0.309***
	(0.122)	(0.0908)
info12almond	0.845***	0.654***
	(0.103)	(0.0893)
Observations	11424	14896

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2 Framing effects

To further verify the different effects of avoid and loss framing, we compare the coefficients i.e. info1cow and info7cow, in which the information context remains the same except for the gain / loss framing, allowing us to distinguish the effect of framing alone. We use DIFFERENCE to represent the value of coefficient of avoid minus that of generate, in some cases the difference could be zero-number and in other number-zero if the coefficient are not statistically different from zero and based on the GHG information (GHG of cow>oat>almond>soy), we propose a series of expectations following an hypothesis that avoid framing will have a stronger effect than generate framing of causing changes in utility. The information treatment we provide aims to cause an increasing utility for products with relatively small amounts of GHG in each context (info1~info12), if the product being compared has a higher GHG, then the value of "avoid minus generate" should be below zero. As shown in Table 5, most of the expectations are verified, except for the context of cow vs oat, generate framing has a stronger effect on substituting for dairy by oat beverage. There are differences between the Canadian and Chinese ones, as Canadian samples performed a much lower preference for soy beverage, when they compare almond and soy beverage in the choice set, avoid framing doesn't have a stronger effect of calling them consume more soy with a lower GHG. Hypotheses H2 and H3 are verified.

Table 5 Comparison of framing effects

Scene	avoid-generate	difference of coefficients (CA)	difference of coefficients (CH)	expectation
h1	info1cow-info7cow	-0.026	0.000	<0
h2	info2cow-info8cow	0.199	0.191	<0

h3	info3cow-info9cow	-0.016	-0.200	<0
h4	info1soy-info7soy	0.0785	0.470	>0
h5	info4soy-info10soy	0.042	-0.154	>0
h6	info5soy-info11soy	-0.040	0.415	>0
h7	info2oat-info8oat	0.045	0.385	>0
h8	info4oat-info10oat	-0.223	-0.190	<0
h9	info6oat-info12oat	-0.089	0.167	<0
h10	info3almond-info9almond	0.006	0.000	>0
h11	info5almond-info11almond	0.038	-0.155	<0
h12	info6almond-info12almond	-0.006	0.345	>0

5.2 WTP results

We calculated each beverage attribute's Willingness to Pay (WTP) in Table 6, showing that China and Canada have quite different WTPs for different beverages. From Table 7 and Table 8, customers' preferences for various plant-based beverages vary significantly depending on the situation. What's interesting to note is that Chinese respondents had a considerably higher value for plant-based beverage than Canadian respondents, who report a negative utility for soy beverages. Customers' preferences for various plant-based beverages vary significantly depending on the situation. It is worth noting that while the sample analysis carried out in China indicated substantial variations in the impacts of gain- and loss-framing, the difference in the Canadian sample failed in the significance test. This finding calls for more research to ascertain whether individual features within the sample may have an impact on the effects of framing and to pinpoint the elements that influence these traits.

Table 6 WTP calculation results without information treatment

Beverage type	Canadian (CAD/946ml)	Chinese (RMB/245ml)
Cow	4.654	13.293
	(4.797)	(2.381)
Soy	-0.497	16.617
	(8.665)	(2.885)
Oat	-0.988	14.212
	(8.549)	(2.966)
Almond	-1.525	11.978
	(8.113)	(3.650)
Observations	34272	44688

Table 7 WTP results in Canada

Beverage type	observations_gain	observations_loss	Mean WTP_ gain	Mean WTP_loss	Mean difference	p-value
Cow	2138	1916	6.000***	6.062***	-0.062	0.718
Soy	2138	1916	-0.847***	-0.971***	0.123	0.649

Cow	2313	2052	7.085***	6.915***	0.171	0.351
Oat	2313	2052	-0.226	-0.515***	0.289	0.268
Cow	2256	2028	6.517***	6.346***	0.171	0.310
Almond	2256	2028	-0.434**	-0.328	-0.106	0.077
Oat	2443	2218	0.107***	0.481**	-0.374	0.140
Soy	2443	2218	-1.085***	-1.140	0.054	0.832
Almond	2130	1926	-0.539**	-0.448***	-0.092	0.723
Soy	2130	1926	-1.202***	-0.687***	-0.516*	0.061
Oat	2244	2127	-2.071***	-2.272***	0.201	0.435
Almond	2244	2127	0.443**	0.241***	0.202	0.437

*** p<0.01, ** p<0.05, * p<0.1

Table 8 WTP results in China

Beverage type	observations_gain	observations_loss	Mean WTP_ gain	Mean WTP_loss	Mean difference	p-value
Cow	2720	2563	13.608***	13.251***	0.357***	0.000
Soy	2720	2563	16.364***	15.478***	0.885***	0.000
Cow	2865	2673	14.420***	14.705***	-0.285***	0.000
Oat	2865	2673	17.970***	16.518***	1.452***	0.000
Cow	2883	2703	14.758***	15.096***	-0.337***	0.000
Almond	2883	2703	15.111***	13.800***	1.310***	0.000
Oat	3145	2936	14.036***	14.314***	-0.277***	0.000
Soy	3145	2936	17.770***	16.648***	1.122***	0.000
Almond	2802	2640	11.132***	11.226***	-0.095	0.201
Soy	2802	2640	19.485***	18.914***	0.572***	0.000
Oat	2955	2688	12.663***	13.083***	-0.419***	0.000
Almond	2955	2688	14.376***	13.209***	1.167***	0.000

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

In this study, we aimed to investigate the effects of greenhouse gas (GHG) emissions information and framing on consumers' preferences for animal and plant-based beverages, as well as to explore the differences in preference between Canadian and Chinese consumers. Our findings confirm all three of our hypotheses and provide valuable insights into consumer behavior and the promotion of environmentally sustainable consumption.

Firstly, exposure to greenhouse gas emissions information enhances willingness to pay for plant-based beverages. Through conditional logit, we verified that adding information treatment as an interaction term causes some coefficients of the model to change, and most of the coefficients of the interaction terms are significant, indicating that information treatment does have an effect on the preferences of these attributes and that the marginal utility of each drink changes after displaying GHG information. Consumers in Canada and China are significantly more likely to pay for lower carbon emissions beverages most of the time, and understanding the carbon emissions caused by beverages is effective in guiding consumers' willingness to pay. It sends a favorable signal that measuring the carbon emissions of food and displaying them on packaging will

significantly contribute to green and environmentally sustainable consumption. We also found that the variation in willingness to pay due to GHG varied by product, which raises concerns about exploring more consumer sensitivities to GHG for different foods in the future.
Secondly, consumers exhibit a higher utility for beverages with lower carbon emissions when exposed to avoid framing information, as compared to generate framing. This indicates that in order to maximize the role of the exposure of GHG and other environmental information for the guidance of consumption, should be given extra attention to the adoption of the strategy of avoid framing. It is worth noting that some consumers do not always fully corroborate the hypothesis of prospect theory on avoid framing, and some consumers are more likely to be affected by generate framing and increase their willingness to pay, etc. In particular, we note that there may be differences in the effect of framing on different beverages from different consumer groups, which we believe is a key focus for future analysis. Thus, we are designing a series of studies to comprehensively analyze the mechanisms underlying the effects of framing and to conduct further explorations of heterogeneity of samples. We will also take the uncertainty and consequentiality into account in near future, in order to handle with the hypothesis bias and enhance the validity.
Thirdly, we examine the difference in plant-based alternatives preferences between Canada and China. We are very concerned about whether the same beverage consumption strategy can be implemented in different countries, whether it should be implemented in the first place, and whether it can be implemented as effectively as expected. Therefore, we designed this validation and tried to analyze cross-culture consumer differences in preferences, and the results were significant. Consumer groups with different individual differences in China and Canada exhibit different consumer preferences and are characterized by significant differences in preferences. Overall, we find that age is not the first factor, gender, education and work status have large influence on their choice of plant-based beverages. In addition to these Canadian and Chinese consumers show opposite trends in terms of the level of urbanization of the area in which they reside, i.e., Chinese urban consumers are more willing to pay for plant-based beverages, whereas the opposite is true in Canada. This lays the foundation for understanding consumer profiles in different countries and provides guidance for developing targeted consumer strategies.

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