Enhancing the Validity of Stated Preference Consumer Surveys: A Cross-Cultural Choice Experiment on Dairy Milk and its Substitutes

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Abstract

Background: The development of sustainable agri-food systems, and in particular the shift in dietary patterns towards replacing animal protein foods with plant proteins, has an important role to play in reducing environmental burdens and nutritional inequalities. There are an increasing number of studies of stated preferences for plant-based alternatives, but such approaches may be prone to hypothetical bias， which is an open question in these studies. **Research Question:** Addressing hypothetical bias in SP surveys allows for a more accurate analysis of consumer behavior and is theoretically important for optimizing behavioral and experimental economics models. Estimates that are more accurate in practice are also beneficial for the plant-based diet market and industry development. **Methodology:** Methods like uncertainty and consequentiality assessments aim to improve these surveys' reliability. This study evaluates the effect of uncertainty and consequentiality questions on enhancing the validity of two particular stated preference (SP) surveys, using a choice experiment on preferences for dairy and plant-based beverage alternatives in China and Canada. A fractional factorial experimental design of a choice experiment with 1865 Chinese and 1825 Canadian participants measured the probability that individuals would select certain beverages and from that we calculated the willingness to pay (WTP) for various beverages. We

conducted pre-experimental cheap talks and post-experimental incorporation of uncertainty and consequentiality questions to conduct validity checks for examining and eliminating selectivity bias. Comparing the effects on Canadian consumers can make the results more robust and verify the generalizability of the optimization method and thus be more conducive to policy analysis and forecasting. **Results:** Findings show a negative correlation between certainty and WTP, with cultural differences in consumption preferences and the perceived impact of survey responses on real-world outcomes. Consequentiality statements are positively correlated with consumers' beverage consumption, with respondents exhibiting higher WTP for the various beverages. **Conclusion:** Consideration of uncertainty and consequentiality questions yields more realistic WTP estimates, with a more conservative value for certain groups and a higher value for the inclusion of consequentiality. This insight is vital for developing more accurate and representative SP surveys, facilitating better consumer behavior predictions in behavioral and experimental economics, and providing a more solid basis for industry decisions on the development of a sustainable beverage industry.
Keywords: Stated preference, choice experiment, willingness to pay, uncertainty, consequentiality

1. Introduction

Stated preference (SP) research is of great significance in studying consumer behavior, particularly in understanding the decision-making process, marketing influences, and purchase behavior in the field of marketing, specifically with reference to non-market

goods. Still, there are concerns about how well SP captures actual customer choices (Bishop & Boyle, 2019). The bias can be a reflection of study design issues such as scenario rejection (Horowitz, et al., 2003; Hammitt et al., 2014), or actual behavioral incentives including commitment costs (Kim et al., 2015), substitution effects (Hanemann, 1991), and reference dependence (Tversky & K ahneman, 1979).

It is important to investigate methods for enhancing the reliability of welfare estimates obtained from DCEs. (Johnston et al., 2017). There are two aspects of validity of focus for improvement, internal validity relates to accuracy within the sample (Hensher and Bradley, 1993), and external validity relates to extrapolation to the population (Rose and Bliemer, 2012). The external validity is usually enhanced by sampling strategies and comparative studies, while the internal validity is enhanced by reducing hypothetical bias (HB).

Reducing HB related to internal validity in SP surveys is crucial for obtaining a clearer understanding and more accurate analysis of the factors driving consumer behavior. To address the hypothetical bias, two methods have been commonly employed. One method uses uncertainty questions to gauge respondents' certainty in their decisions (Lundhede et al., 2009; Vossler et al., 2018). The other method involves informing respondents that the program described in the questionnaire has real consequences (Carson and Groves, 2007; Vossler et al., 2012; Zawojska et al., 2019). The concept of consequentiality refers to asking people if they think their survey responses will influence actual outcomes (Vossler et al., 2012; Carson et al., 2014; Lloyd-Smith et al., 2019), while the uncertainty is asking people how certain they are about their stated

choice responses (Akter et al., 2008). These approaches may result in a significant reduction in mean WTP estimates in the context of environmental and resource issue (Sergio et al., 2022), aiming to enhance the validity and reliability of SP surveys.

This study aims to improve SP surveys by examining the results of a choice experiment on dairy milk and its substitutes in Canada and China, incorporating the analysis of responses to uncertainty and consequentiality questions. In this study, we will look at the effects of uncertainty and one type of consequentiality on regressions and WTP calculated from regression results. to assess their impact on willingness to pay (WTP), and explore methods for enhancing the internal validity of SP surveys. Whether there are changes in results for either or both countries will be discussed in terms of external Our sampling and comparison strategy could contribute to enhancing external validity for Canada and China.

2. Literature review

Reducing hypothetical bias (HB) related to internal validity in SP surveys is crucial for obtaining a clearer understanding and more accurate analysis of the factors driving consumer behavior. This study incorporates two kinds of survey design and analysis features to strive to reduce the effects of hypothetical bias, uncertainty and consequentiality.

2.1 Uncertainty

The uncertainty techniques employ methods that filter the data for implausible responses, frequently based on answers to questions posed following the valuation tasks. A usual approach is the follow-up certainty question, asking respondents to express how

certain they are about their choices (Akter and Bennett, 2013; Blumenschein et al., 1998; Blomquist et al., 2009; Johannesson et al., 1998). Another approach asks respondents to state their maximum WTP for the good in question (Bush et al., 2009; Colombo et al., 2016). Besides follow-up questions, the combination of data from revealed preference studies with SP data can also help with calibrating stated WTP (Adamowicz et al., 1994; Boxall et al., 1996; Fox et al., 1998).

2.2 Consequentiality

Respondents mentally accept that surveys are important and have consequential effects, and that they are important to capture true preferences (Carson and Groves, 2007). The consequentiality method involves informing respondents that the program described in the questionnaire has real policy consequences or payment consequentiality (Vossler et al., 2012; Zawojska et al., 2019). It is commonly acknowledged that HB may cause respondents to inflate their willingness to pay (WTP) if they do not strongly anticipate having to personally face the indicated cost. This is especially possible given the possibility that responders will want to portray themselves as "doing the right or good thing" or will be eager to show support for the expanded societal norm.

Applying multiple mitigating strategies at once could improve the decrease of HB. To our knowledge, few research has paid attention to how employing both strategies might affect a DCE study on environmentally friendly food, like plant-based beverages. In order to fill this research vacuum, we examine the combined impact of consequentiality and uncertainty approaches on HB mitigation by using data from a DCE on the WTP for dairy and non-dairy beverages.

3. Study design and data collection

3.1 Choice experiment

In this study, we employed a choice experiment to measure WTP for dairy milk and its substitutes. The choice experiment design is the same as what we did for the framing paper. We chose 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. The choices were designed in two choices and neither of the two choices, the choice sets include four different beverages (cow's milk, soy, oat, and almond beverage), two levels of organic production (organic or conventional production), two levels of protein (existing or added protein), and four prices ($1.00, $4.00, $7.00 and $10.00 per 946 ml in Canada; ¥2.50, ¥5.00, ¥7.50, ¥10.00 per 250ml in China) as shown in Table 1.

Table 1 Stated 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 g for dairy, 11g 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

***The same with another framing paper design

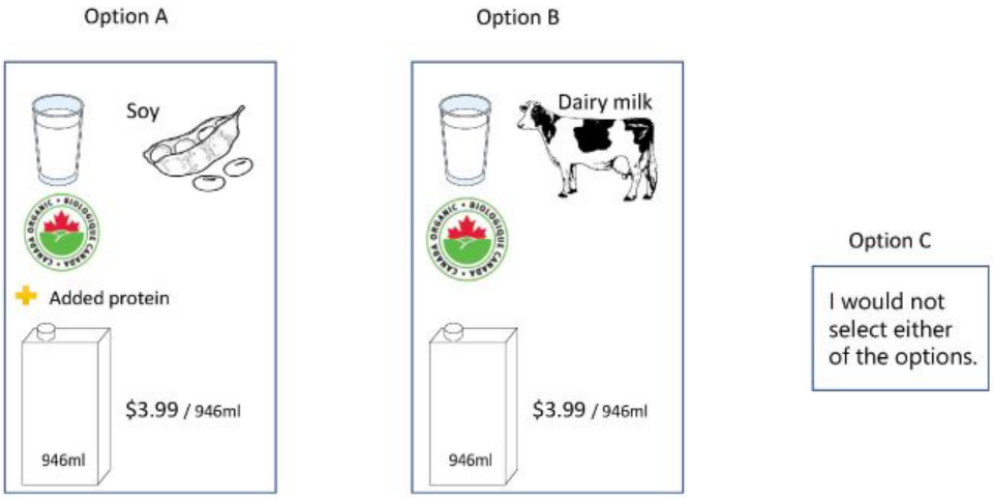

Figure 1 Example choice experiment question

***The same with another framing paper design

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 2 Explanation before the choice experiment

***The same with another framing paper design

3.2 Cheap talk

Before initiating the experimental selection process, a cheap talk mechanism was employed to mitigate response biases. Cheap talk is a technique commonly used in experimental settings to encourage participants to provide more accurate and truthful responses by explicitly addressing potential biases or misconceptions. The inclusion of a cheap talk mechanism in the experimental design enhances the validity and reliability

of the study findings by addressing potential biases and promoting more realistic decision-making. In our study, we emphasized their budget constraints to ensure their choices were more aligned with real-world decision-making scenarios. We also remind them their answers could represent the preferences of Canadian/Chinese consumers, and findings from the research may affect the practices of businesses involved in the food system and relevant public policies. so that we can explore consequentiality issues later. We ask their attention to nutrition label, especially protein and organic certification, each beverage type and the offered size are also provided. We told them about the options that might come up and that they would be given greenhouse gas information.

Cheap Talk Content:

The following questions will ask you to choose one of four types of beverages that you may purchase. You will be presented with eight choice scenarios. For each choice scenarios, we will provide you with two beverages that you could purchase and an option of purchasing neither of the products. It is very important that you consider these choices as if you were choosing products in an actual grocery store. Please keep in mind that you have a specific budget for food and beverages. Purchasing one of the products would mean that you would not have that money available to purchase something else.

Keep in mind that the answers you provide will be combined with others' answers to represent the preferences of Canadian consumers. Findings from the research may

affect the practices of businesses involved in the food system. Findings may also affect relevant public policies.

In Canada, beverage manufacturers must provide nutrition facts on food packages, including fat, protein, calcium and several vitamins for each 1 cup serving (240ml). Dairy milk, soy beverage, oat beverage and almond beverage products vary in their nutrition profiles, depending upon the base ingredients and enrichments. Many people choose among these products depending upon their protein content. Proteins occur naturally or can be added. All of these products can be produced using conventional or certified organic methods.

For each choice, you will also be given information about the greenhouse gases associated with the relevant types of beverages.

3.3 Ex-post approaches

To reduce the HB and enhance validity, we conducted ex-post approaches. For instance, asking follow-up questions about uncertainty and consequentiality and recoding them for recalibration. After the choice experiment, we asked respondents "how certain are you that this is the choice you would make in an actual vote?", with four possible answers: "Very uncertain," "Uncertain," "Certain," and "Very certain." Respondents answering Very uncertain and somewhat uncertain were designated as the uncertain group (25.35% in Canada, 3.13% in China).

Following Herriges et al (2010), we deal with consequentiality by asking the following three ancillary questions to assess respondents' perceptions of consequentiality: "Please identify how strongly you agree with the following statements: My individual survey

response can affect the outcome of this survey" Possible answers were "Strongly disagree" "Disagree" "Agree" "Strongly agree" We labeled respondents who answered "Strongly disagree" "Disagree" perceived the study to be less consequential (12.53% in Canada, 11.84% in China).

4. Description analysis

4.1 Data collection

Consumers in different countries may behave differently in answering a questionnaire due to cultural and dietary differences. Participants in this research came from online national market panels in Canada (n=1825) and China (n=1865).

The survey was conducted through soliciting respondents online. The panel data were collected from adults recruited by different survey companies in Canada and China. After an explanation of the purpose of the study, those willing to participate were administered the survey online. Participants were only allowed to participate if they were older than 16 and thus could have the ability to afford daily consumption by themselves. After removing respondents who failed the trap questions, we ended up with a sample of 1428 in Canada and 1756 in China. The study was covered by a general approval for consumer research from the University of Alberta Research Information Services (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 variables

In the Canadian sample, the mean age of respondents is 53 years old, with roughly equal numbers of males and females. Most respondents have 2 people in their family, only 6.2% of respondents have a five-person family. 26.8% of respondents no children in their family now, and 64.0% have no seniors in their family now. Only 2.9% of respondents have a pregnant woman in their family now. Most respondents have education beyond Secondary (high) school. More than 60% of respondents live in a city, where they have more opportunities to encounter new products. Near 40% of respondents is fully employed. 79.3% claim they are not allergic to dairy milk, more than 90% of them are not allergic to soy and oat products.

In the Chinese sample, the mean age is 30 years, much younger than the Canadian sample, perhaps due to lack of Internet habits among the elderly. 57.2% of Chinese respondents were female. 3 person families were more common in China than Canada. Chinese respondents are much better educated than Canadian respondents, which may be related to the lack of older people in the Chinese sample.

Table 2 Demographic description

Variable	Description	Canada	China
		Percent(%)	Percent(%)
Gender	male	49.51	42.48
	female	50.49	57.52
People in family	1	26.82	2.28
	2	38.59	5.69
	3	17.86	44.02
	4	10.5	25.68
	5	6.23	22.32
Number of kids in the family	0	78.22	29.95
	1	12.25	54.44
	2	6.37	14.64
	3	2.52	0.68
	4	0.42	0.06
	no less than 5	0.2131t	0.23
Number of olds in family	0	61.55	56.89
	1	23.81	19.99
	2	13.87	20.39

	3	0.28	1.25
	4	0.35	1.37
	no less than 5	0.14	0.11
If pregnant in the family	no	97.06	95.96
	yes	2.94	4.04
Education situation	Elementary school (8 years)	1.82	0.11
	Secondary (high) school (12 years)	26.40	0.8
	Technical/ business school/Community college (14 years)	31.51	3.59
	University (16 years)	30.46	85.08
	Postgraduate studies (Masters or PhD) (18 years)	9.80	10.42
Area	in city	63.45	88.33
	in town	18.35	9.11
	in rural	18.21	2.56
If employed full-time	yes	39.29	86.22
	no	60.71	13.78
If allergic to dairy	not allergic	79.34	83.66
	slightly allergic	10.01	14.98
	moderately allergic	6.51	1.31
	highly allergic	4.13	0.06
If allergic to soy	not allergic	90.13	95.62
	slightly allergic	3.43	3.64
	moderately allergic	3.50	0.57
	highly allergic	2.94	0.17
If allergic to oats	not allergic	92.09	96.98
	slightly allergic	2.38	2.51
	moderately allergic	3.15	0.4
	highly allergic	2.38	0.11
If allergic to almond	not allergic	87.82	96.36
	slightly allergic	4.20	2.9
	moderately allergic	4.62	0.68
	highly allergic	3.36	0.06

4.3 Distribution of uncertainty and consequentiality

In terms of uncertainty questions, the Chinese sample tended to express greater certainty, with over 95% of consumers stating they were certain or very certain of their response. While less than 75% of respondents express those levels of certainty in Canada as shown in Table 1. Regarding consequentiality questions, over 60% of the Canadian

sample agreed or strongly agreed that their responses would impact the survey results, while in the Chinese sample, 65% believed their answers would influence the overall results.

Table 3 Distribution of uncertainty

Uncertainty	Canada		China	
	Frequency	Percent	Frequency	Percent
Very uncertain	58	4.06	4	0.23
Uncertain	304	21.29	51	2.9
Certain	656	45.94	1263	71.92
Very certain	410	28.71	438	24.94
Total	1432	100	1756	100

Table 4 Distribution of consequentiality

My individual survey response can affect the outcome of this survey.	Canada		China	
	Frequency	Percent	Frequency	Percent
Strongly Disagree	57	3.99	41	2.33
Disagree	122	8.54	167	9.51
Neither agree nor disagree	390	27.31	419	23.86
Agree	618	43.28	702	39.98
Strongly agree	241	16.88	427	24.32
Total	1432	100	1756	100

4.4 Distribution of demographic variables by uncertainty and consequentiality

We separate the samples into two groups by their response to the uncertainty question. If the samples answered they were uncertain or very uncertain about their answer, they were sorted into the "uncertain" group (n=362 in Canada, n=55 in China), otherwise, they were in "certain" group (n=1066 in Canada, n=1701 in China). For the consequentiality question, if they strongly disagree or disagree that their individual survey response can affect the outcome of this survey, they would be allocated to the "inconsequential" group (n=179 in Canada, n=208 in China), otherwise they were in

the “consequential” group (n=1249 in Canada, n=1548 in China). There are final 1292 samples in Canada and 1504 in China allocated in the “stable” group, which is both certain and believe their answers are consequential for this survey. Below is the distribution of demographic status in different groups. Basically, the demographic characters don’t change a lot for the only “certain” group and “stable” group, and also the perception of environment and consumption behavior.

Table 5 Demographic description

Variable	Description	Canada (Percent %)			China (Percent %)		
		Whole	Certain	Stable	Whole	Certain	Stable
Gender	male	49.51	50.66	48.89	42.48	42.92	42.42
	female	50.49	49.34	51.11	57.52	57.08	57.58
People in family	1	26.82	25.61	25.45	2.28	2.29	2.13
	2	38.59	40.06	39.45	5.69	5.82	5.78
	3	17.86	16.89	16.86	44.02	44.39	44.61
	4	10.5	11.26	11.56	25.68	25.28	25.07
	5	6.23	6.19	6.68	22.32	22.22	22.41
Education situation	Elementary school (8 years)	1.82	1.41	1.38	0.11	0.12	0.07
	Secondary (high) school (12 years)	26.4	27.39	27.78	0.8	0.82	0.80
	Technical/ business school/Community college (14 years)	31.51	31.43	30.86	3.59	3.47	3.26
	University (16 years)	30.46	30.21	29.80	85.08	85.13	85.24
	Postgraduate studies (Masters or PhD) (18 years)	9.8	9.57	10.18	10.42	10.46	10.64
Area	in city	63.45	63.23	63.31	88.33	88.36	88.36
	in town	18.35	18.48	18.88	9.11	9.11	9.24
	in rural	18.21	18.29	17.82	2.56	2.53	2.39
If employed full-time	yes	39.29	39.21	58.96	86.22	85.95	86.30
	no	60.71	60.79	41.04	13.78	14.05	13.70
If allergic to dairy	not allergic	79.34	79.83	79.22	83.66	83.66	0.07
	slightly allergic	10.01	10.13	10.50	14.98	15.05	0.80
	moderately allergic	6.51	6.10	6.26	1.31	1.23	3.26
	highly allergic	4.13	3.94	4.03	0.06	0.06	85.24
If allergic to soy	not allergic	90.13	90.71	90.35	95.62	95.65	0.07
	slightly allergic	3.43	3.38	3.50	3.64	3.59	0.80
	moderately allergic	3.5	3.19	3.29	0.57	0.59	3.26
	highly allergic	2.94	2.72	2.86	0.17	0.18	85.24
If allergic to	not allergic	92.09	92.50	91.73	96.98	96.94	0.07

oats	slightly allergic	2.38	1.97	2.23	2.51	2.53	0.80
	moderately allergic	3.15	3.38	3.61	0.4	0.41	3.26
	highly allergic	2.38	2.16	2.44	0.11	0.12	85.24
If allergic to almond	not allergic	87.82	88.27	88.12	96.36	96.41	96.54
	slightly allergic	4.2	4.03	4.03	2.9	2.82	2.66
	moderately allergic	4.62	4.22	4.35	0.68	0.71	0.73
	highly allergic	3.36	3.47	3.50	0.06	0.06	0.07
Strict vegetarian	no	98.32	98.12	98.09	99.77	99.76	99.73
	yes	1.68	1.88	1.91	0.23	0.24	0.27
Myths of nature (environment problems)	hard to control	50.91	50.28	51.86	27.45	99.76	28.39
	not out of control	26.19	27.39	26.83	61.96	0.24	61.30
	not need to worry	7.21	7.04	6.79	1.82	99.76	1.86
	may not aggravate	15.69	15.29	14.53	8.77	0.24	8.44
Consumption frequency	consume nothing	2.87	3.10	2.65	0	0	0
	consume only dairy	30.53	32.83	30.65	0.17	0.18	0.20
	consume dairy more than PB	33.40	31.14	32.24	63.27	63.67	63.36
	consume dairy equal to PB	11.83	10.41	10.71	18.11	17.81	18.15
	consume PB more than dairy	15.41	16.32	17.71	17.48	17.40	17.22
	consume only PB	5.95	6.19	6.04	0.97	0.94	1.06
Total		1428	1066	943	1756	1701	1504

5. Results

5.1 Regression results

5.1.1 Coefficient estimates

We estimated 6 models in total. As described above, we estimated the full sample as Model 1, which is consistent with the result from another paper. In Model 2 we only estimated the certain group. While in Model 3, we screened the group with less consequential perception, only the stable group was left for estimates. The Model 4-Model 6 of the Chinese sample followed the same process as the Canadian one.

Of interest in our analysis is the role of specific environmental information related to GHG emissions for each beverage in a choice between two beverages. So the information treatment is for individual choices made by a respondent. Whenever there is a choice between two different versions of the same beverage (cow's milk with added

protein versus cow's milk with no added protein) then no environmental information is provided. Not all estimated effects of the different information treatments are as might be expected. For example, when we provide environmental information on the GHG emissions associated with cow's milk versus soy beverage the estimated coefficient is positive and significant for cow's milk and for soy beverage (Avoid cow's milk 0.597 and soy beverage 0.729; Generate cow's milk 0.539 and soy beverage 0.617). The regression coefficients suggest that the comparison of GHG emissions between cow's milk and soy beverage is positive and significant for both beverages whether it is framed in an avoid sense or a generate sense. The majority of the information treatments are statistically significant. When we compare the regression coefficients across our three models, in general the regression coefficients for the group that is certain about their stated choices are smaller for cow's milk, larger for soy beverage, smaller for oat beverage and for almond beverage smaller with avoid framing and larger with most of the generate framing comparisons in Canada. For the group that is certain about their choices and thinks that their own survey responses will have consequences, the regression coefficients on the information treatments have a variety of differences with the base full model including both uncertain and people and people who do not think that submitting a survey has consequences. For cow's milk the third model has smaller coefficients for cow's milk, larger coefficients for soy beverage, larger coefficients for oat beverage and again mixed responses for almond beverage. For China, regression coefficients for information treatments for cow's milk for the people who are certain about their responses are smaller for cow's milk (only in Generate framing), smaller for

oat beverage (in both framings), little difference for almond beverage in Avoid framing but smaller with Generate framing, and show very small differences for the few soy information variables that are significant.

Table 6 Coefficients estimates

VARIABLES	Canadian Sample			Chinese Sample		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
cow	1.209***	1.118***	1.179***	1.359	1.574*	1.246
oat	0.550**	0.708**	0.750**	0.00702	-0.0124	0.282
soy	0.144	0.193	0.190	2.404***	2.381***	3.103***
almond	0.0698	-0.0101	0.0661	-0.455	-0.570	-0.272
addprot	0.0834	0.00739	0.0290	-0.245	-0.212	-0.310
organic	0.171	0.313	0.415*	1.021*	1.088**	1.605***
price	-0.116***	-0.120***	-0.119***	-0.120***	-0.121***	-0.116***
cow_age	-0.00230	0.000988	0.000117	-0.00234	-0.00296	-0.00754
soy_age	-0.0280***	-0.0281***	-0.0292***	-0.0135**	-0.0129**	-0.0186***
oat_age	-0.0247***	-0.0265***	-0.0291***	-0.00487	-0.00522	-0.0112*
almond_age	-0.0197***	-0.0176***	-0.0183***	0.00814	0.00816	0.00153
organic_age	-0.00245	-0.00459	-0.00560*	-0.00428	-0.00430	-0.00312
addprot_age	0.00558**	0.00497*	0.00472	-0.0159***	-0.0166***	-0.0172***
cow_gender1	0.121	0.0783	0.0460	0.396***	0.396***	0.394***
soy_gender1	-0.0108	-0.142	-0.0987	0.105	0.113	0.139
oat_gender1	-0.173**	-0.439***	-0.381***	0.110	0.0961	0.0596
almond_gender1	-0.296***	-0.466***	-0.462***	0.172**	0.188**	0.220**
organic_gender1	0.00145	0.0525	0.0803	0.119**	0.112**	0.124**
addprot_gender1	-0.0981	-0.0348	-0.0302	-0.157***	-0.163***	-0.186***
cow_edu1	-0.0173	-0.0160	-0.00782	-0.00371	-0.00830	0.0157
soy_edu1	0.0618***	0.0595***	0.0712***	-0.0631	-0.0603	-0.101*
oat_edu1	0.0636***	0.0642***	0.0757***	0.0658	0.0687	0.0631
almond_edu1	0.0462***	0.0410***	0.0533***	-0.00119	0.00677	0.00232
organic_edu1	0.00552	5.93e-05	-0.00182	-0.0194	-0.0250	-0.0520
addprot_edu1	-0.00488	-0.000195	-0.00195	0.0639**	0.0623**	0.0676**
cow_family1	0.000594	-0.127	-0.192	-0.0678	-0.0712	-0.0627
soy_family1	0.229**	0.0122	-0.0417	0.272*	0.274*	0.388**
oat_family1	0.348***	0.307**	0.287**	-0.0801	-0.0577	-0.0251
almond_family1	0.279***	0.130	-0.00526	0.219	0.196	0.248
organic_family1	0.110	0.117	0.156	0.141	0.155	0.0690
addprot_family1	0.0468	0.0715	0.0877	0.213**	0.203*	0.219*
cow_kids1	0.702***	0.924***	1.008***	0.0816	0.0763	0.0872
soy_kids1	0.394***	0.698***	0.724***	0.170*	0.159	0.113
oat_kids1	0.213*	0.373**	0.338**	0.270***	0.271***	0.253**
almond_kids1	0.343***	0.572***	0.650***	0.305***	0.302***	0.328***
organic_kids1	-0.149	-0.101	-0.151	0.225***	0.227***	0.205***
addprot_kids1	-0.143	-0.124	-0.109	-0.0663	-0.0572	-0.0268
cow_olds1	0.143	0.0490	-0.0163	0.0736	0.0444	0.0483
soy_olds1	0.213**	0.0362	0.0225	-0.0342	-0.0527	-0.0658
oat_olds1	0.0346	-0.0353	0.0101	0.0871	0.0732	0.0960
almond_olds1	0.0451	-0.135	-0.132	0.0117	-0.0112	-0.0765
organic_olds1	0.0665	0.0763	0.0991	0.0105	0.0148	-0.0209

addprot_olds1	-0.159**	-0.0713	-0.0827	-0.0601	-0.0598	-0.0623
cow_pregs1	0.499*	0.786**	0.611*	-0.612***	-0.657***	-0.780***
soy_pregs1	0.295	-0.0400	-0.126	-0.135	-0.123	-0.138
oat_pregs1	0.0446	-0.425	-0.466	-0.178	-0.193	-0.207
almond_pregs1	0.420*	0.582*	0.450	0.0325	0.0461	0.101
organic_pregs1	-0.121	-0.116	-0.140	-0.234*	-0.186	-0.128
addprot_pregs1	0.274	0.361	0.320	-0.0920	-0.111	-0.196
cow_emplo1	0.0823	0.116	0.0367	0.149	0.171	0.244
soy_emplo1	0.244**	0.353***	0.263**	0.332***	0.295**	0.318**
oat_emplo1	0.222**	0.256**	0.158	0.189	0.187	0.189
almond_emplo1	0.177*	0.338***	0.240**	0.142	0.138	0.107
organic_emplo1	0.138**	0.128	0.120	-0.0692	-0.0684	-0.103
addprot_emplo1	0.0342	0.0169	0.0310	0.00659	0.0359	-0.0136
cow_area1	-0.0488	0.0998	0.106	0.258*	0.209	0.133
soy_area1	-0.0952	-0.216**	-0.197*	0.0541	0.0672	0.0942
oat_area1	-0.0825	-0.0838	-0.0618	0.144	0.151	0.102
almond_area1	-0.0958	-0.0900	-0.0460	0.274**	0.289**	0.311**
organic_area1	-0.107	-0.0666	-0.0979	0.000297	0.0213	0.0408
addprot_area1	-0.0157	-0.0417	-0.0525	0.185**	0.183**	0.223**
cow_alg	-0.770***	-0.936***	-0.912***	-0.358***	-0.380***	-0.397***
soy_alg	0.280**	0.160	0.0649	-0.344**	-0.406***	-0.375**
oat_alg	0.360***	0.447***	0.357**	-0.211	-0.245	-0.288
almond_alg	-0.273***	-0.281**	-0.279**	0.134	0.115	0.0774
info1cow	0.597***	0.456***	0.391**	-0.211	-0.270	-0.246
info1soy	0.729***	0.737***	0.746***	0.182	0.188	0.184
info2cow	0.826***	0.743***	0.694***	-0.00101	-0.0724	-0.0398
info2oat	0.581***	0.539***	0.632***	1.103***	1.079***	1.076***
info3cow	0.799***	0.745***	0.702***	0.0198	-0.0144	0.0547
info3almond	1.436***	1.476***	1.394***	1.354***	1.401***	1.377***
info4soy	-0.250**	-0.303**	-0.314**	0.320*	0.325*	0.366*
info4oat	-0.476***	-0.603***	-0.567***	-0.0820	-0.108	0.0220
info5soy	-0.309**	-0.366**	-0.297*	0.219	0.231	0.348*
info5almond	0.445***	0.348**	0.289*	0.371**	0.381**	0.380**
info6oat	-0.504***	-0.681***	-0.643***	-0.403***	-0.458***	-0.416**
info6almond	0.720***	0.600***	0.497***	0.964***	0.947***	0.895***
info7cow	0.539***	0.484***	0.358*	-0.523***	-0.543***	-0.564***
info7soy	0.617***	0.746***	0.726***	-0.197	-0.200	-0.287*
info8cow	0.799***	0.728***	0.747***	-0.0558	-0.107	-0.122
info8oat	0.514***	0.509***	0.641***	0.622***	0.618***	0.593***
info9cow	0.757***	0.836***	0.863***	-0.234	-0.306	-0.267
info9almond	1.430***	1.545***	1.567***	0.783***	0.778***	0.676***
info10soy	-0.216	-0.156	-0.0608	0.0270	0.0388	0.136
info10oat	-0.351***	-0.429***	-0.330**	-0.00533	0.00897	0.0798
info11soy	-0.233*	-0.268*	-0.203	0.228	0.217	0.227
info11almond	0.450***	0.509***	0.462***	0.454***	0.446***	0.396**
info12oat	-0.537***	-0.651***	-0.600***	-0.347**	-0.406***	-0.485***
info12almond	0.713***	0.711***	0.669***	0.710***	0.673***	0.552***
Number of individuals	1428	1066	943	1756	1701	1504
Number of rows	34272	25584	22632	42144	40824	36096

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

5.1.2 MWTP estimates

Similar patterns are exhibited in the WTP calculations for each beverage under all information treatments and without information treatments. Without information treatments in Canada, all of the WTP for the three models are smaller than all the WTPs for the models with information treatments for cow's milk while the opposite holds for China. In Canada, the WTP for soy beverage is smaller without information than with the information comparing soy beverage and cow's milk (some of the across-plant beverage comparisons are in the opposite direction), in China the WTPs for soy beverage are all smaller without information than with information comparing soy and any of the other beverages. In China all the WTPs for almond beverage with information are larger than the WTP without any GHG information and similar results are exhibited for oat beverage. In Canada the results for WTP for almond beverage with no information are all smaller than the WTP for almond beverage with information on GHG emissions comparing cow's milk with almond beverage – the results are more varied with the GHG emission information on the comparisons with other plant beverages. In Canada, the WTPs are all smaller for the oat beverage without any information than for the oat beverage with information comparing oat beverage and cow's milk but more varied when other plant beverages are compared to oat beverage.

Table 7 MWTP estimates

	Canadian					Chinese				
Scenario	Model 1	Model 2		Model 3		Model 4	Model 5		Model 6	
	MWTP	MWTP	M2-M1	MWTP	M3-M1	MWTP	MWTP	M5-M4	MWTP	M6-M4
cow info1	13.753	12.886	-0.867	12.942	-0.811	12.372	12.437	0.065	12.481	0.109
cow info2	15.898	15.38	-0.518	15.614	-0.284	14.159	14.086	-0.073	14.282	0.123
cow info3	15.52	15.226	-0.294	15.52	0	14.278	14.529	0.251	15.063	0.785

cow info7	13.45	13.379	-0.071	12.935	-0.515	9.704	10.12	0.416	9.673	-0.031
cow info8	15.587	15.292	-0.295	16.137	0.55	13.572	13.699	0.127	13.522	-0.05
cow info9	15.219	16.145	0.926	17.098	1.879	12.132	12.09	-0.042	12.268	0.136
cow noinfo	8.484	8.823	0.339	9.478	0.994	14.093	14.635	0.542	14.573	0.48
soy info1	4.607	2.933	-1.674	3.714	-0.893	15.525	15.58	0.055	16.422	0.897
soy info4	-3.772	-5.618	-1.846	-5.16	-1.388	16.682	16.72	0.038	17.977	1.295
soy info5	-4.385	-6.235	-1.85	-5.212	-0.827	15.862	15.96	0.098	17.813	1.951
soy info7	3.677	3.315	-0.362	3.905	0.228	12.439	12.427	-0.012	12.361	-0.078
soy info10	-3.477	-4.166	-0.689	-2.668	0.809	14.224	14.323	0.099	15.934	1.71
soy info11	-3.514	-4.982	-1.468	-3.837	-0.323	15.827	15.726	-0.101	16.642	0.815
soy noinfo	-1.611	-2.995	-1.384	-2.274	-0.663	14.036	14.042	0.006	14.826	0.79
oat info2	7.342	6.014	-1.328	7.49	0.148	20.823	20.737	-0.086	21.517	0.694
oat info4	-1.912	-3.641	-1.729	-2.816	-0.904	10.895	10.853	-0.042	12.339	1.444
oat info6	-2.021	-4.117	-2.096	-3.214	-1.193	8.309	8.029	-0.28	8.627	0.318
oat info8	6.656	5.699	-0.957	7.739	1.083	16.776	16.892	0.116	17.325	0.549
oat info10	-0.762	-2.035	-1.273	-0.545	0.217	11.567	11.86	0.293	12.903	1.336
oat info12	-2.423	-3.844	-1.421	-2.763	-0.34	8.761	8.448	-0.313	8.045	-0.716
oat noinfo	2.265	1.508	-0.757	2.024	-0.241	11.562	11.743	0.181	12.133	0.571
almond info3	7.342	8.473	1.131	9.324	1.982	16.588	16.855	0.267	17.967	1.379
almond info5	-1.912	-0.923	0.989	-0.093	1.819	8.329	8.336	0.007	9.277	0.948
almond info6	-2.021	1.271	3.292	1.902	3.923	13.437	13.179	-0.258	13.907	0.47
almond info9	6.656	9.163	2.507	10.995	4.339	11.817	11.701	-0.116	11.966	0.149
almond info11	-0.762	0.674	1.436	1.703	2.465	9.093	8.982	-0.111	9.596	0.503
almond info12	-2.423	2.206	4.629	3.373	5.796	11.254	10.859	-0.395	10.907	-0.347
almond noinfo	2.265	-3.86	-6.125	-2.43	-4.695	5.214	5.168	-0.046	6.017	0.803

For Canada the almond WTP on average is smaller for the group that is certain and for the group that is certain and thinks their own survey is of consequence. In China, the almond WTP for almond beverage are larger in the models for people who are certain and for people who are certain and think their own survey is of consequence; for oat beverage the WTP results are always larger for people who are certain and think that their own survey is of consequence for the Generate framing but are smaller for people who are certain and larger for people who are both certain and think that their survey is of consequence for the Avoid framing; for soy beverage the majority of WTP for people who are certain and for people who are both certain and think that their survey is of consequence are larger than the base model but the differences are very small; for cow's milk the WTP are larger for people who are certain and larger for people who are both certain and think that their own survey is of consequence than for the base model (sometimes the WTP for people who are both certain and think their survey is of consequence are smaller than for the model for people who are just certain but still larger than the base model).

6. Conclusions

The purpose of this analysis was to see if accounting for respondent uncertainty and for respondent attitude toward survey consequentiality had any effect on the significance of variables in the analysis of stated choice data and on the resulting WTP calculations. In this analysis we changed the sample under analysis – if people suggested they were very uncertain or uncertain about their stated preference choices then they were deleted

from analysis and if people suggested they were uncertain and that they did not think their own survey response would be of much consequence then they were deleted from the analysis. For Canada this reduced sample size much more than it did for China.

Our analysis of this stated choice experiment suggests that the results do vary with the exclusion of uncertain respondents and those that think their survey is not of consequence. The regression coefficients were affected in many cases leading to effects on the WTP from each model. Sometimes the effects were small but for each country for each calculated WTP our results suggest that it is important for some WTPs to consider both uncertainty and consequentiality in this type of analysis.

From the above findings, firstly we have clarified that the addition of an uncertainty follow-up question to the questionnaire has a significant effect in correcting the overly high WTP obtained from the stated preference surveys and that samples who are truly certain that they would do the same in reality will answer with a more conservative and cautious WTP, and that these more truthful responses should be screened out and adopted. Additionally, those who were more confident that completing this questionnaire would indeed have some subsequent impacts were more positively motivated to answer the questions, a finding that could be significant in promoting the consumption of plant-based beverages in Canada. As for China, if there is a sense of belief that personal choices will have a consequence significantly encourages consumer WTP. After exploration, this study provides a direction of improvement for more

rigorous scientific and near-realistic stated preference survey research that can be used as a reference, and subsequent comparisons can be made in more detail to clarify more precise research methods and advance the discipline.

Reference

Adamowicz, Wiktor, Jordan Louviere, and Michael Williams. "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." *Journal of Environmental Economics and Management* 26, no. 3 (1994): 271–92. https://doi.org/10.1006/jeem.1994.1017.

Akter, Sonia, and Jeff Bennett. "Preference Uncertainty in Stated Preference Studies: Facts and Artefacts." *Applied Economics* 45, no. 15 (May 2013): 2107–15. https://doi.org/10.1080/00036846.2012.654914.

Bishop, Richard C., and Kevin J. Boyle. "Reliability and Validity in Nonmarket Valuation." *Environmental & Resource Economics* 72, no. 2 (2019): 559–82. https://doi.org/10.1007/s10640-017-0215-7.

Bliemer, Michiel C.J., and John M. Rose. "Confidence Intervals of Willingness-to-Pay for Random Coefficient Logit Models." *Transportation Research Part B: Methodological* 58 (December 2013): 199–214. https://doi.org/10.1016/j.trb.2013.09.010.

Blomquist, Glenn C., Karen Blumenschein, and Magnus Johannesson. "Eliciting Willingness to Pay without Bias Using Follow-up Certainty Statements: Comparisons between Probably/Definitely and a 10-Point Certainty Scale." *Environmental and Resource Economics* 43, no. 4 (August 2009): 473–502. https://doi.org/10.1007/s10640-008-9242-8.

Carson, Richard T., Theodore Groves, and John A. List. "Consequentiality: A Theoretical and Experimental Exploration of a Single Binary Choice." *Journal of the Association of Environmental and Resource Economists* 1, no. 1/2 (March 2014): 171–207. https://doi.org/10.1086/676450.

Coffey, Brian K., Ted C. Schroeder, and Glynn T. Tonsor. "A Novel Approach to Boxed Beef Market Reports." *Food Policy* 118 (July 1, 2023): 102474. https://doi.org/10.1016/j.foodpol.2023.102474.

Colombo, Sergio, Wiktor Budziński, Mikołaj Czajkowski, and Klaus Glenk. "The Relative Performance of Ex-Ante and Ex-Post Measures to Mitigate Hypothetical and Strategic Bias in a Stated Preference Study." *Journal of Agricultural Economics* 73, no. 3 (September 2022): 845–73. https://doi.org/10.1111/1477-9552.12484.

Entem, Alicia, Patrick Lloyd-Smith, Wiktor (Vic) L. Adamowicz, and Peter C. Boxall. "Using Inferred Valuation to Quantify Survey and Social Desirability Bias in Stated Preference Research." *American Journal of Agricultural Economics* 104, no. 4 (August 2022): 1224–42. https://doi.org/10.1111/ajae.12268.

Hanemann, W. Michael. "Willingness to Pay and Willingness to Accept: How Much Can They Differ?" *The American Economic Review* 81, no. 3 (1991): 635–47.

Hensher, David A., John M. Rose, and William H. Greene. *Applied Choice Analysis*. 2nd ed. Cambridge University Press, 2015. https://doi.org/10.1017/CBO9781316136232.

Kahneman, Daniel, and Amos Tversky. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47, no. 2 (1979): 263–91. https://doi.org/10.2307/1914185.

Kilders, Valerie, and Vincenzina Caputo. "Is Animal Welfare Promoting Hornless Cattle? Assessing Consumer's Valuation for Milk from Gene-Edited Cows under Different Information Regimes." *Journal of Agricultural Economics* 72, no. 3 (September 2021): 735–59. https://doi.org/10.1111/1477-9552.12421.

Kim, Hyo Jin, and Yung Wook Kim. “The Interaction Effects of Message Framing, Risk Types and Audience Expertise on Risk Perception in Risk Communication: An Analysis of Radiation Risks.” *J Public Relat Res* 17 (2013): 143–83.

Lehberger, Mira, and Sven Grüner. “Consumers’ Willingness to Pay for Plants Protected by Beneficial Insects – Evidence from Two Stated-Choice Experiments with Different Subject Pools.” *Food Policy* 102 (July 1, 2021): 102100. https://doi.org/10.1016/j.foodpol.2021.102100.

Lloyd-Smith, Patrick, Wiktor Adamowicz, and Diane Dupont. “Incorporating Stated Consequentiality Questions in Stated Preference Research.” *Land Economics* 95 (August 1, 2019): 293–306. https://doi.org/10.3368/le.95.3.293.

Zawojska, Ewa, Anna Bartczak, and Mikołaj Czajkowski. “Disentangling the Effects of Policy and Payment Consequentiality and Risk Attitudes on Stated Preferences.” *Journal of Environmental Economics and Management* 93 (January 2019): 63–84. https://doi.org/10.1016/j.jeem.2018.11.007.