Influence of CO2 save-cost-framed emission labelling on consumer behaviour

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Executive Summary

We investigated how the principles of save-cost-framing, a variation of gain-loss framing, affected the shopping choices of UBC students. We examined whether the save-cost-framing of CO_2 emission from transportation impacts the choice between local or non-local food items. Knowing that loss-framed climate protection messages are more effective in increasing willingness to comply compared to gain-framed messages[8], we predicted that given a choice between local and non-local foods, students would be more likely to choose the local option under a carbon-cost-frame compared to a carbon-saving frame. Additionally, we predicted that students would be more likely to choose local options under a carbon-saving frame compared to a neutral frame. Using Qualtrics, participants were allocated to 1 of 3 survey conditions: neutral, carbon-save-frame, or carbon-cost-frame, and given a choice between local and non-local options across 7 paired food items. Data was collected from 155 students through online recruitment, with 124 valid responses. Results of a one-way between-subjects ANOVA revealed no significant differences, but a chi-square test indicated a significant difference between the conditions and our hypothesis was partially supported. We found participants chose the local options in the save-frame and cost-frame conditions more than in the neutral frame.

Keywords: CO_2 emission, gain-loss framing, local, non-local, save-frame, cost-frame

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Project Title: Influence of CO2 save-cost-framed emission labelling on consumer behaviour

Introduction

At a time when consumer purchasing decisions can reflect customer's awareness of climate change, the addition of climate-friendly labels on food items is key in aiding shoppers to make environmentally-conscious food choices.[1] Data obtained from 428 UK supermarket shoppers indicated that 72% of respondents preferred carbon labels on food products and that 68% of the shoppers revealed that their shopping habits have shifted towards climate-friendly foods.[2] Another study conducted in a Belgian Supermarket found that eco-friendly food labels that included environmental friendliness and standardized numerical information regarding its environmental impacts were more effective in increasing climate-friendly shopping choices by 5.3%, compared to the default label.[3] Providing relevant information to help enable personal agency in consumer-decision making has been discussed in the context of real-world applications.[4] This is highly relevant considering that people tend to underestimate the amount of greenhouse gas emissions (GHG), such as CO2, involved in food and product transportation in an increasingly globalized food chain.[5] One study examined the discrepancy between perceived versus actual energy consumption in greenhouse gas emissions suggests that including GHG emissions in food labels can increase consumers' tendencies to choose lower-emission options, compared to when no emission information is provided.[5]

The psychological insight this paper is concerned with are perception nudges on the basis of gain-loss framing. It has been documented that decisions can be influenced by manipulating a neutral action to be perceived as positive or negative (gain or loss).[6] A study investigated the effects of gain-loss framing in anti-drug advertisements found loss-framing to be a more effective deterrent for young people with drug-using friends, and no effect for those without drug-using friends.[7] In a study that examined the strategic use of message framing in health-related behaviours, loss-framed messages were predicted to be most effective when people are involved in an issue and are continually processing the information.[8] Considering the current climate emergency, this is consistent with the results of a study that revealed loss-framed climate protection messages were more effective in enhancing negative emotions and willingness to sacrifice, in comparison to gain-framed messages.[9] While impacts of climate information labelling on food purchases have been explored, research has yet to demonstrate the impacts of using CO2 emission information labels accompanied by gain-loss framing. We targeted the concern of purchasing climate-friendly foods at UBC by using a CO2 save-cost-framing, derived from the foundations of gain-loss framing, to study its effects on the desirability of buying local food products with a smaller carbon footprint.

We sought to answer the question: does the save-cost-framing of CO2 emissions from transportation affect shopping choices of students between local foods vs. non-local foods? We hypothesized that given a choice between local and non-local food options, students are more likely to choose local options under a carbon-cost-frame compared to a carbon-saving frame. Furthermore, we predicted that students will be more likely to choose local food options under a carbon-saving frame compared to a neutral frame.

Methods

Participants

      We aimed to recruit a minimum of 111 UBC undergraduate students through convenience sampling using social networks of the research team. This number was determined using G*Power 3.1 assuming a one-tailed F-Test (between subjects) with an effect size of 0.3, an alpha of 0.05, and a power of 0.80. UBC Qualtrics was used to design the survey and it was distributed through social media groups (ex. Facebook, Instagram) primarily made up of UBC students as well as through personal contact (ex. Text message). We received $N=155$ responses in total. 34 were excluded (29 incomplete, 5 failed to pass the attention check question in the survey), leaving a final sample of $N=124$ responses (50% were female, 42.7% male, 2.4% non-binary, 1.6% other, and 3.2% preferred not to say; mean age = 22.3 years). 44.3 % were East Asian, 20.2 % Caucasian, 12.9% Southeast Asian, 8.9% South Asian, 2.4% Black, 1.6% Indigenous, and 22.6% Other (mixed ethnicity, Central Asian, Egyptian).

Conditions

      The survey asked participants to choose between the local or non-local variant of the same food item per question. There were a total of seven food items and the order the food items were presented in was randomized for each respondent (see Appendix C). Each food item was accompanied with a sticker. Local food items had the sticker "Product of B.C." while non-local food items had "Product of (Place)" with *Place* being different for each item. The order in which the non-local and local food items were presented (either left or right side) was also randomized. We also included 3 of the 15 New Ecological Paradigm (NEP) questions suggested to have the greatest reliability and measurement precision in gauging environmental attitudes of respondents.[10] The NEP statements were presented and respondents indicated where they found themselves along a 5-point likert scale of *Strongly Disagree- Disagree- Neutral- Agree- Strongly Agree* for each question. A filler attention check question was also incorporated in this section asking participants to "Choose Agree if you are still reading the survey" (see Appendix C-4).

      There were 3 survey conditions: neutral frame, carbon-save-frame, carbon-cost-frame. Each condition consisted of 14 questions: 7 condition-framed questions, 3 NEP questions, and 4 demographics questions. In the neutral condition, no CO2 information was presented. In the carbon-save-frame condition, each local food item was accompanied by the caption "By choosing this [food item], you are saving [X] grams of carbon emissions" and each non-local food item had no caption. In the carbon-cost-frame condition, each local-food item had no caption while each non-local food item included the caption "By choosing this [food item], you are incurring a cost of [X] grams of carbon emissions." The independent variables being manipulated in our study were the save-cost labelling and whether the carbon-save-frame or the carbon-cost-frame label would influence choosing of local food items.

      For each non-local food item, we conducted the same calculations to determine its CO2 transportation emission. The full breakdown can be found in Appendix B. Local was defined as being sourced in British Columbia (B.C.) while non-local was defined as being sourced from 400 km or further from B.C.

Measures

The dependent measures of our study were the number of times the local food item options were chosen, compared to non-local ones, across all conditions. First, we used a parametric test (one-way between-subjects ANOVA) to calculate the number of times, in percentage form, that participants selected the local option across all the 7 questions. For example, if a participant selected the local option for all 7 questions, they would get a score of 100%. For the nonparametric test (chi-square), we calculated the total number of times the local options and the non-local options were selected in each of the three conditions. For example if in one condition, all the participants selected only the local option across all 7 questions, the tally would be Local = 100 and Non-local = 0. For the NEP questions we calculated the degree to which they agreed with the NEP statements in percentages, with higher percentages equating to a more environmental worldview. A participant who selected *Strongly Agree* for all 3 NEP questions would have received a score of 100%.

Procedure

Our survey ran from March 5th, 2021 to March 23rd, 2021 for a duration of 18 days. The first page was a consent form agreeing to participate in the survey, and on the next page, instructions for the 7 condition-framed questions were presented: "You are at the supermarket shopping for groceries. All the products listed are the same price. Please indicate which item you would pick out of the choices given." The following page presented the 7 food item pairs and participants indicated their pick of local or non-local. The proceeding page consisted of the 3 NEP questions along with 1 attention check question where respondents expressed the degree to which they agree or do not agree with the statements that follow. The last page of the survey consisted of the demographics section, where they were asked to indicate their age, gender, and ethnicity.

One of the challenges we encountered during the data collection processes was finding enough participants for our study in order to show a statistically significant result. Another set of challenges were getting the respondents who started the survey to complete it and to pass the attention check.

Results

We found that on average, participants chose the local food options 90.7% of the time in the neutral condition, 96.1% in the carbon-save-frame condition, and 95.8% in the carbon-cost-frame condition (Appendix A, Table 1). We hypothesized that participants would be more likely to choose local options under a carbon-cost-frame compared to a carbon-save-frame, but our data indicates that there were more participants who chose the local food options under a carbon-save-frame than a carbon-cost-frame. We also predicted that participants would be more likely to choose local options under a carbon-save-frame compared to a neutral frame, which was supported by our data. To test for significance, we initially conducted a parametric test: a one-way between-subjects ANOVA with an alpha level of $\alpha = .05$. There were no statistically significant differences between the conditions detected, $F(2, 121) = 2.015$, $p > .05$, $\eta^2_p = 0.032$.

We then followed up with a non-parametric test. See Appendix A for the frequency distribution matrixes. We conducted a chi-square test which indicated that there was a significant difference between our three conditions, χ^2 (2, N = 868) = 9.48, p < .05. Chi-square tests of

independence were performed to examine the relationship between the conditions and the locality of food choices. We obtained significant results for 2 out of the 3 relationships in our tests. There was a statistically significant difference between the save-frame and neutral condition. Respondents were more likely to choose the local food options in the save-frame condition than the neutral condition, χ^2 (1, N = 560) = 6.51, p < .05, φ = 0.11. The chi-square test performed to examine the relation between the carbon-cost-frame and the neutral condition revealed that the variables were significant, χ^2 (1, N = 588) = 6.08, p < .05, φ = 0.10. We did not find any significant association between the choice of local food options under the carbon-save-frame and neutral conditions, χ^2 (1, N = 588) = 0.03, p > .05. The NEP scores were found to be high across all conditions (M = 84%) and an ANCOVA did not yield any significant results. Statistical analyses were conducted using JASP 0.14.1.0 and https://www.socscistatistics.com/.

Discussion

Our initial parametric ANOVA statistical analysis test, yielded no significant differences between any of the conditions. We suspect that this was because of a ceiling effect and there was not enough difference between the conditions such that it became too 'easy' to choose local; the percentage of local choices across the conditions was extremely high. In an attempt to rectify this, we chose to run additional tests on our data, of a non-parametric nature instead. From the non-parametric tests, our results revealed that participants choose local food options over non-local food options more under cost-framing and save-framing compared to no framing. This is partially consistent with our hypothesis as participants did choose local food options more in the save-frame condition than the neutral condition; it was initially predicted that there would be a greater effect of cost-framing than save-framing on choosing local, but no such effect was observed. Although there was not a significant difference in participants' choices of local options between the carbon-save frame and carbon-cost frame conditions, the results suggest that CO2 save- and cost-framing can influence students to choose local options more often.

However, there are several limitations to our study. Our sample was composed of UBC students who use social media, and from the research team's social circles. Because of this, the external validity of the experiment is compromised due to our sample potentially not accurately representing the general population of students. The high NEP scores across all conditions may also suggest that our participants already had pro-environmental biases. Due to the self-report nature of our survey, participants may have answered questions in a socially desirable way that made them appear more environmentally-friendly. Additionally, the local and non-local choices presented in the survey were priced equally to control for confounding variables and to avoid confusion between cost-framing and cost of the product, which is not representative of real life food prices, as local food options are sometimes more expensive than non-local food products. This is a difficult challenge to overcome as cost is one of the major deciding factors of consumer behaviour, and for those in B.C. who are willing to pay extra for local products, most are only willing to pay up to 10% more.[11] Continuing with the ceiling effect, because our questions were presented in pairs, with only one equally priced local and one non-local choice, the results may not have allowed us to distinguish the real influence of save-cost frames on consumer behaviour because respondents were ready to opt for the local choice over the non-local choice each time. A follow up study would ideally make the non-local food options more appealing, potentially with price being included as a variable, or by presenting more than one local and non-local pair in each question. As our survey was distributed mainly to people who live in the Greater

Vancouver region, and more broadly in B.C., labelling local products as B.C. could have biased those who view B.C. favourably to choose local. In a future study, local food items could be labelled as a product of an area less than 400 km from B.C. instead of only B.C. Future studies should also consider testing more variety of food options, and if possible, include the GHG emission associated from the entire life cycle (transportation, production, water use, land use, and pesticides) in their calculations and subsequent labelling.

Despite the limitations, our research contributes to the knowledge of environmental attitudes and shopping behaviour through nudges and different ways of framing products through advertising. As climate change fueled by greenhouse gas emissions becomes an increasing concern, a more fuel-friendly and resilient pathway for food is needed, and local systems can serve as one.[12] The use of CO2 save-cost framing illuminates a path towards better environmental stewardship through supporting local as opposed to non-local food options while grocery shopping, and may further branch out to choices at restaurants.

Recommendations for UBC Client

The findings from this research suggest that the addition of a label highlighting that a food product is local positively influences UBC student consumer behaviour, such that they choose the local product over the non-local product. Building off of this, we found that a label including either cost or save framed CO2 emission information had an even stronger effect on consumer behaviour. Compared to the control, in which the vast majority of participants already chose local options, participants were even more likely to choose local food options when CO2 emission framing was present, regardless of whether it was cost or save. The UBC community prides itself on maintaining a clean campus with sustainability and environmental concerns at the forefront of our actions. We also recognize the motivation to increase consumption for climate-friendly foods at UBC. As indicated by the results from the NEP questions, UBC students consider themselves to be very environmentally conscious and showed an overwhelming preference for local food options when shopping on campus.

Based on the findings from this research, one could logically infer that an effective way to promote local food consumption on UBC campus would be to implement a policy that requires all applicable food products be labelled with A) local versus non-local, and/or B) cost or save framed CO2 emission information. For the purposes of this policy on campus, save-framing makes more sense; for example: "By choosing this local product, grown in Langley, B.C., you are saving X grams of carbon emissions."

Seeing as UBC students already have intentions to support local, the subtle guilt produced by a save-framed label could provide a nudge. A nudge, a behavioural modification tool that uses choice options to predictably change behaviour without forbidding either, would be an ethical and feasible way to encourage local food product consumption.[13] Research evaluating American University campuses sustainability initiatives found that the traditional manners of promoting sustainability are ineffective - a systematic approach that emphasizes the reduction of consumption and ways to make greener choices instead is necessary.[14] By informing UBC students about the ways in which their food consumption on campus is impacting the environment, they may be ethically persuaded to choose local options wherever possible.

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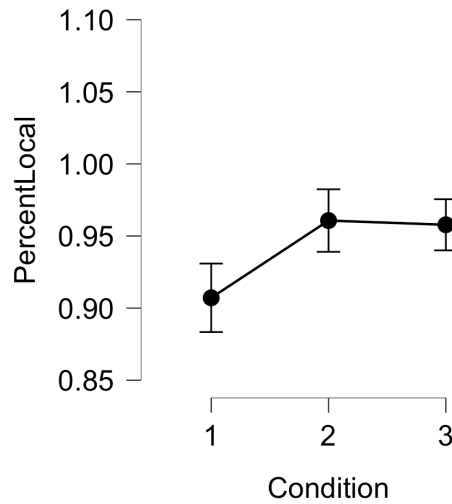
Appendix

A: Figures and Tables

Table 1. Mean percentage of local food items chosen

	Mean (% local)	Standard Deviation
Neutral Condition	90.7	15.0
Save-Frame Condition	96.1	13.7
Cost-frame Condition	95.8	11.8

Figure 1. Graph showing the average percentage of local choices in the three conditions. (1 = Neutral, 2 = Save-frame, 3 = Cost-frame)

Table 2. Locality preference of food choices according to the three conditions

	Local	Non-local	*Raw Totals*
Neutral	254	26	280
Save-frame	269	11	280

Cost-frame	295	13	308
Column Totals	818	50	**868 (Grand Total)**

Table 3. Locality preference of food choices according to the Neutral and Save-frame conditions

	Local	Non-local	*Marginal Row Totals*
Neutral	254	26	280
Save-frame	269	11	280
Marginal Column Totals	523	37	**560 (Grand Total)**

Table 4. Locality preference of food choices according to the Neutral and Control-frame conditions

	Local	Non-local	*Marginal Row Totals*
Neutral	254	26	280
Cost-frame	295	13	308
Marginal Column Totals	549	39	**588 (Grand Total)**

Table 5. Locality preference of food choices according to the Save-frame and Cost-frame conditions

	Local	Non-local	*Marginal Row Totals*
Save-frame	269	11	280
Cost-frame	295	13	308
Marginal Column Totals	564	24	**588 (Grand Total)**

B: Calculation of CO2 emission by transportation

$((y/3)*2.3*z/13500)*1000) = X$ grams of CO2

y = distance in km from the non-local remote location
z = weight in lbs. of the food item depicted in the picture
3 = 3km per litre of gas
2.3 = 2.3 kg of CO2 (= 1 litre of gas)
13,500 = in lbs, how much weight each truck carries
1000 = to convert from kilograms to grams

Calculation outline provided by Dr. Zhao and adapted by Green Beans

Item	Remote Place	CO2 emission (grams)
Apple	California	37 (one apple)
Strawberries	Florida	280 (one box)
Raspberries	Chile	450 (12 oz)
Lettuce	Honduras	134 (one head)
Carrots	India	620 (4 carrot sticks - a bundle)
Beef	Texas	153 (one sirloin strip)
Lamb	Texas	230 (one cutlet)

C: Survey

Neutral, save-frame, and cost-frame conditions all started with the following information:

You are at the supermarket shopping for groceries. All the products listed are the same price. Please indicate which item you would pick out of the choices given.

C-1. Neutral condition

Which apple would you choose? Please select 1 option from the 2 provided.

Product of California ○

Product of B.C. ○

Which box of strawberries would you choose? Please select 1 from the 2 provided.

Product of B.C. ○

Product of Florida ○

Which box of raspberries would you choose? Please select 1 from the 2 provided.

Product of B.C.

O

Product of Chile

O

Which lettuce would you choose? Please select 1 from the 2 provided.

Product of Honduras

O

Product of B.C.

O

Which bundle of carrots would you choose? Please select 1 from the 2 provided.

Product of India

O

Product of B.C.

O

Which beef sirloin would you choose? Please select 1 from the 2 provided.

Product of B.C.

Product of Texas

○   ○

Which lamb cutlet would you choose? Please select 1 from the 2 provided.

Product of B.C.

Product of Texas

○   ○

C-2. Save-frame condition

Which apple would you choose? Please select 1 option from the 2 provided.

Product
of
California

Product
of
B.C.
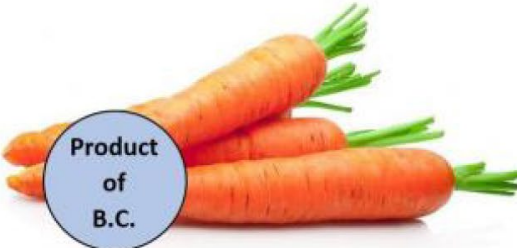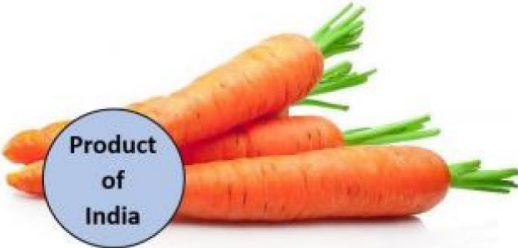
By choosing this apple, you are saving 37 grams of carbon
emissions.

○   ○

Which box of strawberries would you choose? Please select 1 from the 2 provided.

Product
of
B.C.

Product
of
Florida

By choosing these strawberries, you are saving 280 grams of carbon
emissions.

○   ○

Which box of raspberries would you choose? Please select 1 from the 2 provided.

Product
of
Chile

Product
of
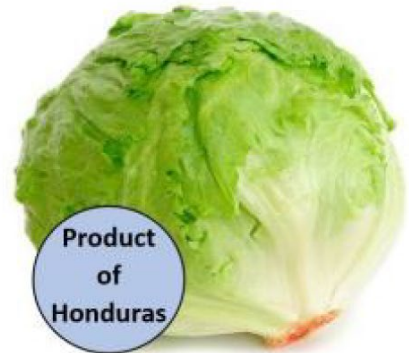B.C.

By choosing these raspberries, you are saving 450 grams of carbon
emissions.

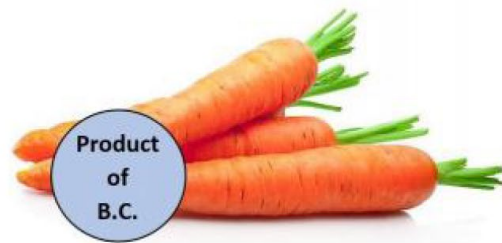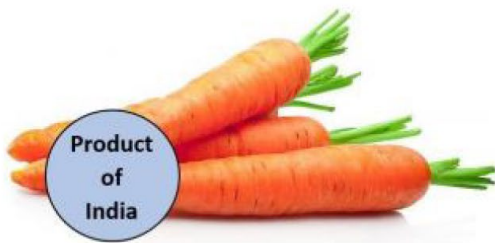○   ○

Which lettuce would you choose? Please select 1 from the 2 provided.

Product of B.C.

By choosing this lettuce, you are saving 134 grams of carbon emissions.

O

Product of Honduras

O

Which bundle of carrots would you choose? Please select 1 from the 2 provided.

Product of India

O

Product of B.C.

By choosing these carrots, you are saving 620 grams of carbon emissions.

O

Which beef sirloin would you choose? Please select 1 from the 2 provided.

Product of B.C.

By choosing this beef sirloin, you are saving 153 grams of carbon emissions.

O

Product of Texas

O

Which lamb cutlet would you choose? Please select 1 from the 2 provided.

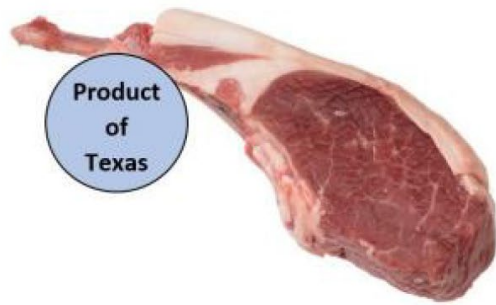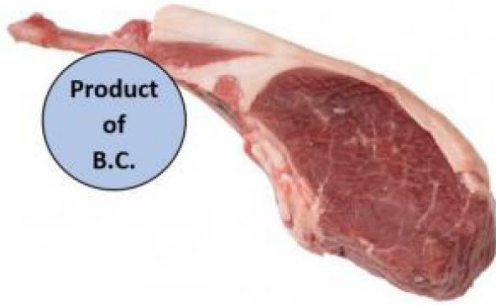By choosing this lamb cutlet, you are saving 230 grams of carbon emissions.

○   ○

C-3. Cost-frame condition

Which apple would you choose? Please select 1 option from the 2 provided.

By choosing this apple, you are incurring a cost of 37 grams of carbon emissions.

○   ○

Which box of strawberries would you choose? Please select 1 from the 2 provided.

Product
of
B.C.

Product
of
Florida

By choosing these strawberries, you are incurring a cost of 280 grams of carbon emissions.

O   O

Which box of raspberries would you choose? Please select 1 from the 2 provided.

Product
of
Chile

By choosing these raspberries, you are incurring a cost of 450 grams of carbon emissions.

Product
of
B.C.

O   O

Which lettuce would you choose? Please select 1 from the 2 provided.

Product
of
Honduras

By choosing this lettuce, you are incurring a cost of 134 grams of carbon emissions.

Product
of
B.C.

O   O

Which bundle of carrots would you choose? Please select 1 from the 2 provided.

Product of B.C.

Product of India
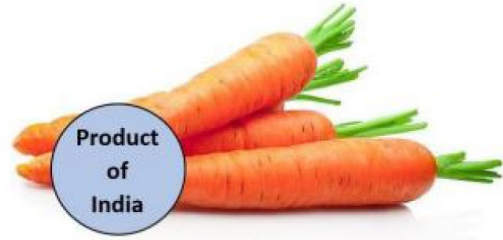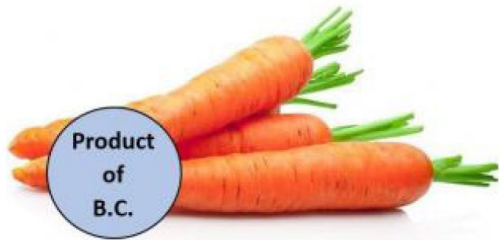
By choosing these carrots, you are incurring a cost of 620 grams of carbon emissions.

○   ○

Which beef sirloin would you choose? Please select 1 from the 2 provided.

Product of Texas

Product of B.C.

By choosing this beef sirloin, you are incurring a cost of 153 grams of carbon emissions.

○   ○

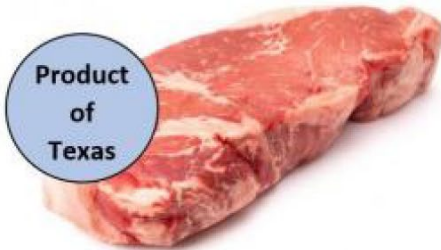Which lamb cutlet would you choose? Please select 1 from the 2 provided.

Product of B.C.

Product of Texas

By choosing this lamb cutlet, you are incurring a cost of 230 grams of carbon emissions.

○   ○

C-4. NEP Questions - Neutral, Save-frame, and Cost-frame conditions

Please rate the following statements.

The Earth is like a spaceship with very limited room and resources.	⌄
When humans interfere with nature it often produces disastrous consequences.	⌄
Choose Agree if you are still reading this survey.	⌄
If things continue on their present course, we will soon experience a major ecological catastrophe.	⌄

Dropdown menu options: *Strongly Disagree- Disagree- Neutral- Agree- Strongly- Agree*

C-5. Demographics

Please provide us with some information about yourself. This information will be used for demographic purposes only.

What is your age? (In years)

[   ]

Please identify your gender.

○ Male

○ Female

○ Non-binary

○ Prefer not to say

○ Other, please specify [   ]

What is your ethnicity?

○ Caucasian (E.g., German, Irish, English, Italian, Polish, French etc.,)

○ First Nations (Eg., Musqueam, Skwxwú7mesh, Kwikwetlem, Tsleil-Waututh etc.,)

○ Hispanic, Latino or Spanish origin (E.g., Mexican, Puerto Rican, Cuban, Salvadoran, etc.,)

○ Black or African American (E.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.,)

○ Native Hawaiian or Pacific Islander (E.g., Native Hawaiian, Samoan, Guamanian or Chamorro, Fijian, Tongan, or Marshalles, etc.,)

○ East Asian (Chinese, Japanese, Korean, etc.,)

○ South East Asian (Filipino, Indonesian, Vietnamese, etc.,)

○ South Asian (Bangldeshi, Skri Lankan, Tamil, etc.,)

○ Other (please specify) [   ]

D: Contributions of Team Members

Ariel Shatsky	Attended all meetings with clients and with Dr. Zhao; took part in project proposal and creation of survey; took part in promotion of survey and collection of data; took part in creating the presentation; took part in final research report
Chanbin Lee	Attended most of the meetings with clients and with Dr. Zhao; took part in project proposal and creation of survey; took part in promotion of survey and collection of data; took part in creating the presentation; took part in final research report
Coleen Tolentino	Attended all meetings with clients and with Dr. Zhao; took part in project proposal and creation of survey; took part in promotion of survey and collection of data; took part in creating the presentation; took part in final research report
Melissa Li	Attended all meetings with clients and with Dr. Zhao; took part in project proposal and creation of survey; took part in promotion of survey and collection of data; took part in creating the presentation; presented research in-class; took part in final research report
Naomi Perkins	Attended all meetings with clients and Dr. Zhao; took part in project proposal and creation of survey; took part in promotion of survey and collection of data; took part in creating presentation; presented research in-class; took part in final research report