Consumer Preference for Eggs from Enhanced Animal Welfare Production System: A Stated Choice Analysis

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Abstract

The first choice experiment investigated consumer preferences for different housing systems, while the second investigated consumer preferences for attributes of a housing system. Each choice experiment had two information treatments. In both treatments, a description of each housing system was provided, while in the second treatment, there was additional information regarding the consequences (in terms of effect on birds) of each housing systems based on scientific research. The results indicate that Canadian consumers are willing to pay a premium for eggs from free run and free range systems, but not for eggs from enriched cage systems. There are also positive marginal WTPs for cage-free, outdoor access, access to nests box, perches, scratching pads and more space. In both choice experiment, the WTP for enhanced animal welfare attributes are lower in treatment 2 (with additional information) than treatment 1. Consumer preference for outdoor access is quite consistent across two choice experiments.

1 Introduction

Increasing awareness of animal welfare is impacting how animal products are produced and marketed. Eggs are no exception. In the current Canadian market, the majority of eggs are from laying hens raised in conventional cages. Hens in conventional cages not only live in a small space, but have no opportunity to exhibit natural behaviour, such as nesting, roosting, foraging and dustbathing. A number of studies (e.g. Appleby, 2003; Bejaei et al., 2011; Lusk et al., 2007) highlighted the public's concern about conventional cage systems, and the demand for alternative housing systems. Currently, there are three types of alternative housing systems in Canada: enriched cage systems, free run and free range systems. Enriched cage systems are similar to the conventional cage system but are equipped with nest boxes, perches for roosting, and scratching area for dustbathing. In addition, free run systems keep hens in indoor barns or aviaries in a large group size so that hens can socialize with each other. Free range systems have features similar to free run systems, but free range systems allow hens to have access to outdoor spaces. The increase in living space and the improvement in living conditions for hens also increases the cost of production for producers adopting animal welfare enhanced production system. According to Chippindale (2012), the cost of production for enriched eggs, free run eggs, and free range eggs are eight, 22, and 50 per cent higher than conventional eggs, respectively. The higher cost of production for eggs from enhanced animal welfare systems is reflected by higher retail price. Figure 1 shows monthly average egg prices in Canada from December 2009 to November 2012. The average price for large free run/free range eggs is about $4.64 per dozen. This is almost $1 higher than the average price of large omega-3 eggs (eggs that are produced by hens fed a diet rich in Omega-3 fatty acids) and $2 higher than that of large regular eggs (i.e. conventionally produced eggs).

Although adopting alternative housing systems would address the concern of some in

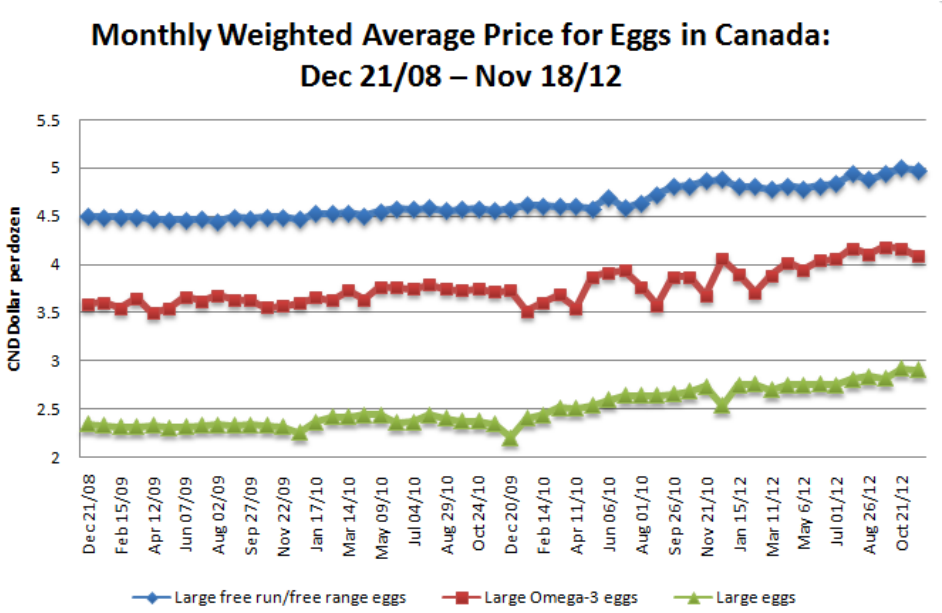

Figure 1: Monthly Weighted Average Price for eggs in Canada: Dec 21/08-Nov 18/12
Source: Agricultural and Agri-food Canada (2013)

the public, it is not known whether consumers are willing to pay a higher price as a result of increased production cost. This study will explore Canadians' general view of animal welfare, and Canadian consumer preferences and willingness to pay for eggs from enhanced animal welfare systems. The market information is of interest to producers, as it can provide information that enables producers to choose a production strategy that maximizes profits.

There has been extensive research on farm animal welfare. Research on consumer attitudes towards animal welfare shows that people in Europe, Australia, US and Canada are concerned about farm animal welfare issues (Bennett, 1997; Harper and Makatouni, 2002; Coleman et al., 2005; Tonsor et al., 2009; Lusk et al., 2007; AAFC, 2006; Romanowska, 2010, etc.). Fraser (2008) expressed different aspects of animal welfare, as illustrated in Figure 2.

Physical and mental well-being are usually not separable, but incentive compatible. However, the three domains of animal welfare are often at odds with each other and a trade-off has to be made (Fraser, 2008). For example, the cage-free system is better than the cage system in terms of greater opportunity for natural behaviours, such as perching, nesting and

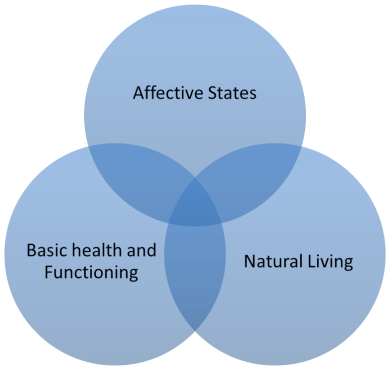

Figure 2: Three Concepts of Animal Welfare, see Fraser (2008).

dustbathing, but the larger flock size in a cage-free system can result in higher injury and mortality rates compared to cage system (Norwood and Lusk, 2011b). Therefore, cage-free systems give hens more access to natural behaviour but lower physical well-being compared to a cage system. Scientists do not have a simple answer to the question of whether it is more important to give hens opportunity to exhibit natural behaviour or to decrease the possibility of injury and mortality, nor do consumers. In a survey done by Prickett et al. (2010) in the US, among those people who valued animal welfare, 46 per cent believed outdoor access and natural behaviours were necessary for animal well-being, while 40 per cent of respondents perceived that animal welfare could be achieved by providing food, water and treatment for disease. Whether the perception of the relative importance of different aspects of animal welfare plays a role in consumers' choice has not been explored in the literature. To address this gap, consumers' perception of different aspects of animal welfare are assessed, as well as the role of information in shaping choice. Previous research has investigated the effect of information provision on consumers' WTP. Markosyan et al. (2009) found that positive health claims and information about antioxidants had a significant and positive effect on consumers' WTP to apples enriched with antioxidants. Napolitano et al. (2010) found that provision of information about benefits of organic farming on environment, animal welfare, and food safety had a positive effect on WTP for organic cheese. In this study, two information treatments are applied. In both treatments, a description of each

housing system is provided, while in the second treatment, there is additional information regarding the consequences (in terms of effect on birds) of each housing systems based on scientific research. The effects of the additional information is evaluated.

A number of studies have addressed consumers' valuation of different housing systems, such as conventional cage or free range system (e.g., Bennett and Blaney, 2003; Carlsson et al., 2007; Chang et al., 2010; Romanowska, 2010). However, it is unknown whether consumers have sufficient knowledge of each housing system, and whether consumers have a preference for particular attributes of a housing system. Only a few researchers (e.g. Norwood and Lusk, 2011a) assessed consumers' perception of specific attributes associated with housing systems. Norwood and Lusk (2011a) included space per hen, floor space per hen, room for scratching, foraging, dust bathing, nest availability, and group size in their survey and gauged consumers' relative preference among the five parameters. Providing specific information on housing systems to consumers also enables the estimation of consumer demand for certain aspects of housing system. Consumer preference toward configuration of housing systems is relevant to producers as they can adjust their production strategies by choosing the housing systems featuring the attributes that consumers are interested in. This study evaluates consumer preferences and WTP for alternative housing systems (i.e., enriched housing systems, free run and free range systems), as well as specific attributes of housing system (i.e., cage-free, outdoor access, the availability of nests, perches and scratching pad).

The organization of the paper is as follows. In the second section, the conceptual framework is presented. In the third section, the development of the survey will be described. The fourth section presents the results and the final section concludes the paper.

2 Conceptual framework

The theoretical foundation of this study rests on the Lancastrian approach to consumer theory and random utility theory. Lancastrian theory states that the good, *per se*, does not give utility to a consumer; rather, various attributes associated with the good give utility to a consumer. Moreover, a good possess more than one attribute, and an attribute can be shared by different goods (Lancaster, 1966) . The Random Utility Model (RUM) states that the utility an individual gets from consuming a good can be divided into two parts: an observed part and an unobserved part. Consumer choice behaviour can be modeled in a random utility model based on Lancastrian theory.

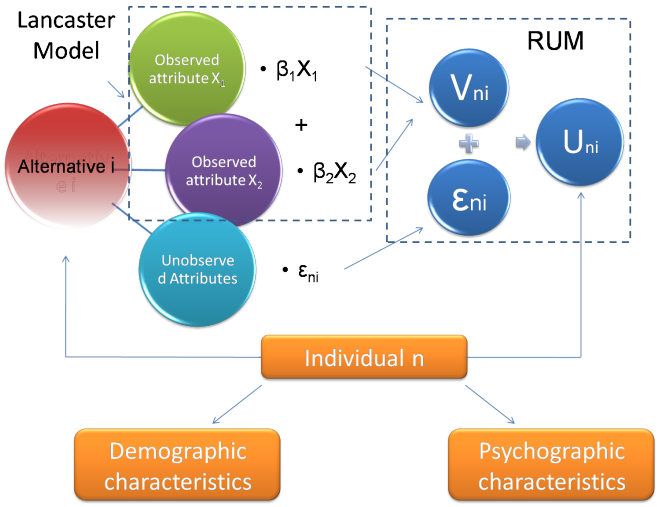

Figure 3: Comprehensive conceptual framework for choosing an egg product

Figure 3 illustrates the process of individual n choosing an egg product i. Suppose an individual n, with certain demographic and psychographic characteristics, chooses to purchase an egg product i. According to Lancasterian theory, individual n gets utility from a number of characteristics (i.e., attributes) embodied in egg product i. For simplicity, it is assumed that one can observe two attributes of the egg product, X_1 (for example, price), and X_2 (for example, the housing system), which gives utility $\beta_1 X_1 + \beta_2 X_2$, assuming the

utility is linear in β. Therefore, attributes X_1 and X_2 give individual n a total utility of V_{ni}. With RUM, apart from the utility from observed attributes, there is an unobserved part of utility, ε_{ni}. Thus, the utility individual n gets from choosing egg product i is $U_{ni} = V_{ni} + \varepsilon_{ni}$. Generally beyond two observed attributes, we can define $V_{ni} = \beta' x_{ni}$, where β' is the coefficient vector, x_{ni} is the vector of attributes for alternative i faced by individual n.

Now suppose there is another competing egg product j. Define $V_{nj} = \beta' x_{nj}$, where β' is the coefficient vector for each attribute x, and x_{nj} is the attribute levels of alternative j. Individual n will choose i over j when

$$\beta' x_{ni} + \varepsilon_{ni} > \beta' x_{nj} + \varepsilon_{nj} \tag{1}$$

Moreover, the probability of the event that egg i is chosen over egg j can be written as:

$$\begin{aligned} P_{ni} &= Prob(U_{ni} > U_{nj}) \\ &= Prob((V_{ni} + \varepsilon_{ni}) - (V_{nj} + \varepsilon_{nj}) > 0) \\ &= Prob(\beta' x_{ni} + \varepsilon_{ni} > \beta' x_{nj} + \varepsilon_{nj}) \\ &= Prob(\varepsilon_{nj} - \varepsilon_{ni} < \beta' x_{ni} - \beta' x_{nj}) \ \forall j \neq i \end{aligned} \tag{2}$$

Now the conceptual model has been constructed. An empirical model requires the assumption of distribution of ε_{ni} and ε_{nj}. Following Train (2003), assume that ε_{ni} and ε_{nj} is distributed as a type I extreme value. So we have:

$$P_{ni} = \frac{\exp(\beta' x_{ni})}{\sum_j \exp(\beta' x_{nj})} \tag{3}$$

This is consistent with a logit model, which is the most commonly used since choice probabilities take a closed form solution.

To implement equation 3, we need data on consumer's choices of egg products with

different attributes. Such data is difficult to obtain for real purchase situations (i.e. revealed preference data). For this reason, a survey is developed and implemented to collect stated choice data. The survey development is discussed in detail in the next section.

3 Survey development

There are three common methods to gather stated preference data: the Contingent Valuation Method (CVM), Conjoint Analysis (CA), and a Choice Experiment (CE). The CVM method has been used extensively to get stated preference data (see Bennett, 1997; Rolfe, 1999). CVM provides the possibility of estimating consumer WTP for a good not yet on the market, as well as WTP for a good with a bundle of attributes. However, it is difficult and expensive to estimate the marginal WTP for a certain attribute of a good. Thus CE and CA are better choices for their capacity in estimating individual attribute parameters. (Carlsson et al., 2007).

There are similarities between CA and CE. Researchers need to generate a set of products profiles for both CA and CE. The superficial difference of the two is that CA asks respondents to rank or rate the alternatives, while CE asked respondents to choose one from two or more alternatives. However, the two methods are substantially different in their theoretical basis. As has been argued (Louviere et al., 2010, p.59,p.62), CA is a purely mathematical tool that does not address fundamental issues like human behaviour in the context of choice. CE, on the other hand, is rooted in random utility theory (RUM) and relates back to preferences and trade-offs a consumer might make when choosing. Based on this, Louviere et al. (2010) concluded that researchers using CE can construct better empirical studies within the paradigm of choice. Moreover, food purchasing in real life is closer to "choice" than "ranking" or "rating". Therefore, CE will be used for the purpose of this study.

In order to evaluate consumer preference for individual characteristics of a housing sys-

tem, as well as a housing system *per se*, two choice experiments with different attributes are undertaken. Each choice experiment has two treatments, of which one provides additional information of scientific assessment and consequences of each housing system and one does not.

3.1 Choice experiment specification

3.1.1 Attributes and levels

Choice experiment 1 The purpose of the first choice experiment is to examine respondents' preference for different housing systems. There are four potential housing systems for egg farmers to choose: conventional cage, enriched cage, free run and free range. One advantage of the stated preference method is that consumers' preference for products not in the market can be estimated. Therefore, although enriched cage eggs are not on the market and free run and free range are not clearly differentiated on the retail market, all four housing systems are considered in the choice experiment. Whether verification for housing systems will affect consumers' preference is also of interest to this research. Hence another attribute,"Organization that verifies housing system" is included in the experimental design. The levels for this attribute are: government verification, third-party certifier verification, industry verification and no verification. Again not all of the verifying organizations are available in the current market, yet some have called for verification of housing systems, hence our interest in this attribute.

In order to mimic real choice scenarios in grocery stores, other attributes of the egg, namely price, color, and Omega-3, are included. There are two levels for "color" (White and Brown) and two levels for "Omega-3" attributes (Yes and No). Price is an important factor in evaluating consumers' preference. If price is not a significant factor in a consumer's decision, it is assumed that the consumer has strong preference for non-price attributes.

Table 1: 4-year retail table egg price in Canada (2009 - 2012)[1]

	Large free run/free range eggs	**Large Omega-3 eggs**	**Large eggs**
2009	$4.48	$3.60	$2.33
2010	$4.55	$3.71	$2.39
2011	$4.67	$3.74	$2.56
2012	$4.87	$4.03	$2.77
4-year average price	$4.64	$3.77	$2.51

[1] Author calculation from AAFC: "Weighted Average Retail Table Egg Prices"

The weighted average retail table egg price provided by Agriculture and Agri-food Canada (AAFC) is a main reference when setting price levels for this study. Table 1 gives a summary of retail table egg prices in Canada from 2009 to 2012 [1]. The price of a dozen large Omega-3 eggs and large free run/free range eggs were about $1.25 and $2.00, respectively, higher than that of a dozen regular large eggs. An annual increase in price of each egg category can also be observed. By December 2012, the monthly Canadian price for large egg increased to $2.91 per dozen.

According to the above information, the base level price is set at $2.80 per dozen. This price is around the average price of a dozen large eggs. Accounting for the premium of large Omega-3 eggs and large free run/free range eggs, three other price levels are set at $3.80, $4.80, $5.80 per dozen. $5.80 per dozen may seem high, but note that some eggs can include both Omega-3 and free run/free range, in which case, $5.80 is a reasonable price level. See Table 2 for a list of attributes and levels in choice experiment one.

Choice experiment 2 The purpose of choice experiment two is to evaluate respondents' preference for specific characteristics of different housing systems. After an extensive review

[1]AAFC does not have a separate price for free run and free range eggs. Empirically, the production cost of free range eggs is higher than free run eggs so it is expected that the retail price of free range eggs is higher than that of free run eggs.

Table 2: Attributes and levels in choice experiment 1

Attributes	Level 1	Level 2	Level 3	Level 4
Price ($/dozen)	$2.80	$3.80	$4.80	$5.80
Housing systems	Conventional cage	Enriched cage	Free run	Free range
Organization that verifies housing system	No verification	Industry verification	Third party verification	Government verification
Color	White	Brown		
Omega-3	Yes	No		

of the literature on egg housing systems, the following four characteristics were chosen: space allowance per bird; whether birds are housed in caged; whether birds are allowed outdoor access; and whether nest boxes, perches for roosting and scratching area for dustbathing are present. For the last three attributes, the levels are "Yes" and "No". The attribute levels of space allowance per hen are based on different standards. The base level "69 square inches" is the recommended minimum space allowance for a hen in Canada. The second level is "110 square inch", which is the new European standards for commercial cages. "171 square inches" is around space requirement for free run system in Canada. The last level "252 square inches" is the space requirements for a hen to turn around freely. Choice experiments are used to explore if these attributes are also important to consumers. In addition, the attribute "Price" is included in the second choice experiment and the price levels are identical choice experiment one. See Table 3 for a list of attributes and attribute levels in experiment 2.

Table 3: Attributes and levels in choice experiment 2

Attributes	Level 1	Level 2	Level 3	Level 4
Price ($/dozen)	$2.80	$3.80	$4.80	$5.80
Space allowance per bird	69 $inch^2$	110 $inch^2$	171 $inch^2$	252 $inch^2$
Hens are housed in cages	Yes	No		
Hens are allowed outdoor access	Yes	No		
Nest boxes, perches for roosting and scratching area for dustbathing are present	Yes	No		

3.1.2 Generating the choice sets

Upon identifying attributes and attribute levels, the researcher need to choose the design method and to generate choice sets. The most common designs, as suggested by Hensher et al. (2005), are full factorial design and fractional factorial design. The former uses all the treatment combination, while the latter use a fraction of the full design.

In this study, the first choice experiment has three four-level attributes and two two-level attributes, which yields a total of $4 \times 4 \times 4 \times 2 \times 2 = 256$ treatment combinations for a full factorial design. The second choice experiment has two four-level attributes and three two-level attributes, which yields a total of $4 \times 4 \times 2 \times 2 \times 2 = 128$ treatment combinations for a full-factorial design. In both experiments, the number of treatment combinations would be too large for a respondent to deal with. Therefore, fractional factorial design is adopted.

With a full factorial design, the attributes of the design are statistically independent and statistically efficient, which can rarely be achieved simultaneously in a fractional factorial design. Two types of designs, orthogonal design and D-optimal design, are available to address the two criteria, respectively. Orthogonal design can guarantee no correlations but may not achieve the best statistically efficiency, while optimal design will have correlations but is statistically efficient (Hensher et al., 2005). In this study, the "D-optimal design" is used to achieve statistically efficiency and to allow for some restriction to be imposed on the choice sets. According to Kuhfeld (2005), a commonly used criterion to evaluate the design is the D-efficiency score. When D-efficiency is 0, one or more parameters cannot be estimated. When D-efficiency is 100, the design is balanced and orthogonal.

Each design was coded in SAS 9.3 macro, following Kuhfeld (2005). %Mktex was used to generate the experiment design, i.e., a set of alternatives. %Choiceff was used to allocate the alternatives generated by %Mktex into choice sets and to evaluate the choice design. In the primary design, it is possible for an option to dominate another option. To address this

issue, a restriction macro ensures there are no dominated cases in the choice design.

Thirty-two choice sets were generated for choice experiment one, with a relative D-efficiency score at 71.3. The relative D-efficiency score for a full factorial design was 71.7, only slightly higher than fractional factorial design, which validates the adoption of fractional factorial design. The same applies to choice experiment two. The relative D-efficiency score of a fractional factorial design of choice experiment two was 75.7. Since answering thirty-two choice sets is possibly still a burden for respondents, each experiment is blocked into four blocks. Therefore, a respondent is faced with eight choice questions in the survey. There are two alternative egg products in each choice scenario. An opt-out option (i.e. purchase neither alternative egg products) is also added to prevent "forced choice" (which can cause bias).

3.2 The role of information

Information serves a critical role in this study. In the survey, a number of terms and concepts, such as the name of the housing system and their characteristics may be new to respondents. If those concepts and terms are not explained to respondents clearly and effectively, the results may be misleading. Therefore, how to convey this information is important. A traditional way of providing such information is to provide definitions of technical terms in an information sheet to respondents at the beginning of the survey. For an online survey, this means that respondents have to read and remember all unfamiliar technical terms at once, which may put burden to respondents and may not be efficient. In this study, instead of providing definitions to respondents in the beginning of the survey, the definition of terms and concepts will appear as hover text in the on-line survey. During the survey, a respondent can move their mouse to a technical term or concept wherever necessary throughout the survey, and the definition/explanation will appear in a hovering text box on the screen. A total of nine terms are dealt with as hovering text (see appendix A.1).

Before a respondent does the choice experiment, a table (See appendix A.2) describing and comparing characteristics of each housing system is presented. Each housing system is described by five key characteristics: living environment, space allowance per bird, group size, cage/barn/aviary setting and outdoor access. Note that four out of the five key characteristics are attributes of choice experiment two. The purpose of presenting this table is to give basic knowledge about the housing system to respondents so that respondents can have a good understanding and compare these systems. The description of each housing system is also available as hovering text in the form of bullet points.

One purpose of the study is to compare respondents' choice behaviour with and without additional information on scientific evidence. This will be achieved by dividing each choice experiment into two treatments differentiated by the information sheet. In treatment 1, respondents only see the basic information of the housing systems, while in treatment 2, respondents see both basic and additional information. The incentive of providing such additional information is that the latest scientific evidence suggests that a housing system that gives hens a greater opportunity to exhibit natural behaviours may not be better for hens health, and may not be better for the environment. However, how consumers think or whether the scientific evidence would change consumers' choice behaviour is not known yet. The scientific evidence is presented to respondents in the form of a table, see Table 4.

3.3 Demographic and psychographic questions

Demographic characteristics such as gender, age, income, education level and family size are elicited in the survey. Psychographic questions, such as respondents' attitude toward animal welfare, perception and knowledge of animal welfare, shopping habits, level of trust, etc, are also asked. Respondents' perception of different aspects of animal welfare (basic health, natural behaviour and affective states) are investigated in order to assess the importance of these domains to our subjects.

Table 4: Additional information on scientific evidence

	Cage	Enriched cage	Free run	Free range
Hens have opportunity to exhibit natural behaviours	*	**	***	****
Lowers the likelihood of hens suffering from injury, disease or pain	****	***	**	**
Lowers the likelihood of hens suffering from fear or emotional discomfort	*	**	***	***
Environmentally friendly	***	***	**	*

**** Extremely likely

*** Likely

** Unlikely

* Extremely unlikely

4 Results

The survey was implemented in both English and French by Ipsos, on its *i-Say* online survey system. Respondents were chosen randomly. Pre-screened questions were asked at first to ensure the respondent is a Canadian primary grocery shopper, at least 18 years old, not working in agriculture-related industry and not from North territories. 2,056 complete and valid responses were returned. In this section, the sociodemographic and psychographic statistics of the respondents are reported first, followed by preliminary estimation results.

4.1 Sociodemographic statistics

Table 5 compares the sociodemographic characteristics of the sample with the broader Canada population (the basis of comparison is the 2011 Census of Canada). The younger group (age 18-24) was under sampled compared to the Canadian census data. Other age groups were thus slightly over-sampled, but are broadly representative of the Canadian population. The proportion of females in the sample was larger than that of males. However it

Table 5: Sociodemographic characteristics of respondents

Sociodemographic characteristics		Survey Sample	Canadian Population [1]
Age Group	Age 18-24	2.97%	11.57%
	Age 25-34	17.51%	16.30%
	Age 35-44	21.16%	16.93%
	Age 45-54	22.28%	20.07%
	Age 55-64	17.51%	16.53%
	Age 65+	21.55%	18.61%
Gender	Male	12.94%	49.03%
	Female	87.06%	50.97%
Region	BC	14.64%	13.14%
	AB	10.55%	10.89%
	MB/SK	6.61%	6.70%
	ON	37.79%	38.39%
	QC	24.27%	23.61%
	Atlantic	6.13%	6.95%
Education	Less than high school	4.03%	23.76%
	Graduated high school	30.10%	25.54%
	Graduated from college	25.49%	28.13%
	Some university	8.80%	4.43%
	Undergraduate degree	23.59%	13.54%
	Graduate degree	7.98%	4.60%
Income	Less than $10,000	2.24%	5.06%
	$10,000-$19,999	8.07%	10.21%
	$20,000-$29,999	11.18%	10.46%
	$30,000-$39,999	10.89%	10.97%
	$40,000-$49,999	10.80%	9.93%
	$50,000-$59,999	10.75%	8.80%
	$60,000-$69,999	6.37%	7.90%
	$70,000-$79,999	6.42%	6.82%
	$80,000-$89,999	3.75%	5.75%
	$90,000-$99,999	3.94%	4.73%
	$100,000-$124,999	4.77%	8.25%
	$125,000-$149,999	1.61%	4.52%
	$150,000 or more	2.38%	6.59%
	Prefer not to answer	16.83%	

1 The data are from the 2011 Canadian census except for education, which is from 2006 Canadian census. All the data are obtained from Statistics Canada website.

is understandable as women are more likely to be primary grocery shopper, and non-primary grocery shoppers will be screened out of the survey in the first few questions. The regional distribution of the sample reflects the broader Canadian population. Higher education is generally over-sampled, while lower education levels were under sampled, which is common for an internet-based survey. The income distribution mimicked the to Canadian population, with the low and high household income being slightly under-sampled.

4.2 Responses to key psychographic questions

A number of psychographic questions explored respondents' perception, attitude, knowledge and behaviour towards animal welfare. Tables 6 and 7 present the response of some key psychographic questions. When an individual purchases an animal based food product, many factors could affect their purchase decisions. Whether animal welfare is a consideration, and how important it might be were explored in the survey. Respondents were asked to distribute 100 points to eleven factors (See Table 6) related to food, giving the issues that are more important a greater number of points. Table 6 reports the average score of each factors. Based on the means, the three most important factors were: freshness, food safety, and

Table 6: Relative importance of factors related to animal based food product

Issue	Mean	SD
Price	14.33	15.14
Appearance	5.85	7.38
Taste	11.85	11.00
Freshness	16.58	14.22
Food safety	14.74	14.52
Country of origin	8.44	12.19
Brand name	2.42	4.64
Nutritious content	8.82	10.18
Organic	3.80	8.85
Animal welfare in production process	8.39	13.18
Environmental impact of animal production	4.79	7.40

Table 7: Respondents perception of different aspects of animal welfare

Factor	Mean	SD
Receive ample food and water [1]	18.21	12.00
Receive treatment for injury and disease[1]	13.33	8.67
Are protected from being harmed by other animals [1]	7.44	5.80
Have sufficient space to move around [2]	13.26	8.68
Are allowed to exhibit normal behaviour [2]	8.86	7.90
Are allowed to exercise outdoors [2]	10.32	7.34
Are provided comfortable bedding [3]	7.92	5.72
Are provided shelter at a comfortable temperature [3]	10.52	6.38
Are allowed to socialize with other animals [3]	5.92	5.00
Are raised in a way to keep prices low	4.23	6.65

[1] Basic health and functioning
[2] Natural behaviour
[3] Affective states

price. Animal welfare received a score of 8.39, which ranks seventh out of eleven items.

The framework forwared by Fraser (2008) (see Figure 2) classifies different aspects of animal welfare into basic health and functioning, natural living and affective states. In order to understand respondents' perception of each aspects, a question with similar format to the previous question was asked, only this time, respondents were asked to allocate 100 points across a set of factors related to animal welfare considerations. See Table 7 for average score respondents distribute to each item. Two of the most important factors perceived by respondents are receiving ample food and water and receiving treatment for injury and disease, both of which belongs to basic health and functioning category. These were followed by having sufficient space to move around - an aspect that holds prominence in this study.

4.3 Estimation Results

The section first presents preliminary results of the estimation using a conditional logit model in using data from experiment one and two. Then the WTP for attributes in each experiment is calculated and analyzed. Recall that both experiments have the "opt-out" option, in which case no attribute levels were observed. To account for opt-out option, researchers (Haaijer et al., 2001; Kontoleon and Yabe, 2003; Birol et al., 2006) suggested that an alternative specific constant (ASC) be added to the model. The ASC is specified as 1 for option A and option B, and 0 for option C, the no-purchase option. Except for price and ASC, all the parameters are effects coded. The model was specified so that the probability of selecting a particular egg product was a function of the attribute levels for that product and the ASC. Table 8 presents the coefficients, standard errors and their significance for treatment 1 and treatment 2 in choice experiment one.

The overall model fit, measured by Pseudo R^2, was 0.1385 for treatment one and 0.1328 for treatment two. The likelihood ratio Chi-square test was performed to test the null hypothesis that all the coefficients in the model were equal to zero. The p-value from the LR test for both treatments were smaller than 0.00001. Most coefficients were significant at 0.1%, with the exception of "verified by industry", "verified by third party", and the color attribute. The positive sign on an attribute coefficient means consuming a product containing that attribute will increase one's utility. The positive sign on the ASC implies a positive impact on utility occurs when one chooses purchase option. As expected, respondents generally get more utility from lower price, government verification, free range and free run housing systems, and the Omega-3 attribute. Although the enriched cage system is regarded as an enhanced housing system by animal scientists, the negative sign on its coefficient means purchasing eggs from enriched cage system decrease respondents' utility. Compared across two treatment's models, the sign and significance of attributes are very similar.

Table 8: CE 1 coefficients (standard error): estimation results of conditional logit model

Variables	Treatment1-w/o additional info	Treatment2-w/ additional info
	Coefficient	Coefficient
y = Choice	(SE)	(SE)
Price	-0.5468***	-0.6225***
	(0.023)	(0.024)
ASC	2.3495***	2.6079***
	(0.098)	(0.101)
Enriched cage	-0.1710***	-0.2059***
	(0.042)	(0.042)
Free run	0.3010***	0.1715***
	(0.040)	(0.042)
Free range	0.6273***	0.5374***
	(0.041)	(0.041)
Veri-industry	0.1192**	0.0698
	(0.041)	(0.041)
Veri-third party	0.0855*	0.1116**
	(0.042)	(0.042)
Veri-government	0.3788***	0.3727***
	(0.041)	(0.040)
Omega-3	0.1114***	0.1008***
	(0.022)	(0.022)
Color-brown	-0.0533*	-0.0625**
	(0.022)	(0.022)
N	12432	12288
Log-likelihood	-3921.977	-3902.1079
$\chi^2_{(10)}$	1261.345	1195.62
Pseudo R^2	0.1385	0.1328

* p<0.05 ** p<0.01 *** p<0.001

The results for choice experiment two are reported in Table 9. The Pseudo R^2 values for the models from treatment 1 and 2 in experiment two were 0.1564 and 0.1525, respectively. As well, the p-value for the null of jointly zero coefficients was less than 0.0001. All the attributes were significant at 0.1% level, except for the cage attribute in treatment two. Like experiment one, a positive and significant ASC coefficient indicates that respondents tend to move away from the opt-out option. Respondents prefer lower price, housing systems that are cage free, allow outdoor access, have more space and are equipped with nest, perches for roosting and scratch pad for dustbathing.

Table 9: CE 2 coefficients (standard error): estimation results of conditional logit model

Variables	Treatment1-w/o additional info	Treatment2-w/ additional info
	Coefficient	Coefficient
y = Choice	(SE)	(SE)
Price	-0.6644***	-0.6738***
	(-0.025)	(-0.025)
ASC	1.9886***	2.2770***
	(-0.116)	(-0.114)
Cage	-0.1266***	-0.0524*
	(-0.023)	(-0.023)
Outdoor	0.4213***	0.3850***
	(-0.024)	(-0.023)
Nest perch pad	0.2996***	0.2952***
	(-0.024)	(-0.023)
Space	0.0032***	0.0024***
	(0.000)	(0.000)
N	12288	12336
Log-likelihood	-796.2336	-3828.4807
$\chi^2_{(6)}$	1407.36	1378.03
Pseudo R^2	0.1564	0.1525

* p<0.05 ** p<0.01 *** p<0.001

Marginal willingness to pay (WTP) for attribute i can be calculated by $WTP_i = -\beta_i/\beta_{price}$. The WTP for each attribute in choice experiment one is presented in Table 10. In treatment one, respondents are willing to pay C$0.550 for free run and C$1.147 for free range.

Table 10: CE1: Marginal WTP

	Treatment1-w/o additional info	Treatment2-w/ additional info
Enriched cage	-0.313	-0.331
Free run	0.550	0.276
Free range	1.147	0.863
Veri-industry	0.218	0.112
Veri-third party	0.156	0.179
Veri-government	0.693	0.599
Omega-3	0.204	0.162
Color-brown	-0.097	-0.100

The WTP is lower than the actual premium (around C$2) in the market, see Figure 1. In treatment two, the WTP decreases to C$0.276 for free run and C$0.863 for free range. One possible reason is that the additional information makes respondents aware of all the consequences of each housing system, leading them to have a lower valuation for these attributes. Whether the difference in WTP across the treatments is significant needs further testing and investigation. The WTP for enriched cage system was negative in both treatments, indicating respondents were not willing to pay a premium for eggs from enriched cage systems. Respondents differentiate different verification methods for housing systems, with verification provided by government inducing a WTP of $0.693 and $0.599, which is much higher than verification by industry or a third party.

Table 11 reports the WTP for attributes in choice experiment two. The negative sign on WTP for cage means that respondents are willing to pay C$0.191 (or C$0.078 in treatment 2) for cage-free attribute. As expected, respondents are willing to pay a premium to allowing hens to have access to outdoors, to have nests, perches and scratching pad, and to have more space. Note that for choice experiment two, WTP in treatment 1 is generally higher than WTP in treatment 2, which is consistent with choice experiment one.

As introduced in the earlier section, the difference between free run system and free range system is that hens are allowed to have outdoor access to free range system but not free run.

Table 11: CE2: Marginal WTP

	Treatment1-w/o additional info	Treatment2-w/ additional info
Cage	-0.191	-0.078
Outdoor	0.634	0.571
Nest Perch Pad	0.451	0.438
Space	0.005	0.003

The differences in marginal WTP between free run and free range systems should reflect respondents' WTP for outdoor access. In choice experiment one, the difference between WTP for free run and free range is C$0.597 for treatment 1 and C$0.587 for treatment 2. Note that in choice experiment two, the marginal WTP for outdoor access were measured directly at C$0.634 for treatment 1 and C$0.571 for treatment 2. The WTP for outdoor access calculated indirectly from choice experiment one is very close to that calculated directly from choice experiment two. This means respondents have fairly consistent valuation of free run, free range system, and outdoor access across the two experiments.

5 Discussion

This study evaluates Canadian consumers' preference for eggs from enhanced animal welfare production systems. Stated choice data was collected from online surveys. Two choice experiment were designed. Consumer preferences for housing systems were assessed in choice experiment one, while consumer preferences for specific characteristics of a housing system were assessed in choice experiment two. Each choice experiment had two information treatments; one with additional information on consequences of each housing systems and one without. Preliminary results show that Canadian consumers are willing to pay a premium for eggs from free run and free range systems, but not from enriched cage systems. There are also positive marginal WTPs for cage-free, outdoor access, access to nests box, perches, scratching pads and more space. In both choice experiment, the WTP for enhanced animal

welfare attributes are lower in treatment 2 (with additional information) than treatment 1. Consumer preference for outdoor access was quite consistent across two choice experiments.

The next step of this study is to relax the assumption of independence of irrelevant alternatives, which is required by conditional logit model. The data will be applied to more flexible models, such as mixed logit. We will also investigate whether psychographic characteristics of an individual will affect their choice, and if so, how.

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Appendix A.1

Terminology

Note: These definitions will be provided in the survey on demand. When a respondent comes across a term and their mouse hovers over that term, these definitions will appear.

Laying hen (or "hen" in this survey):
Hens that are kept for egg production.

Aviary:
Aviaries allow birds a larger living space where they can fly. Because they include several levels of perches and/or slatted/wire floors, sometimes with feeding and/or watering appliances, these systems make good use of the cubic space in the barn.

Omega-3:
Omega-3 fatty acids are considered essential fatty acids that human need. Omega-3 enriched eggs are the same as the "classic" egg except they contain higher levels of the polyunsaturated fat and Vitamin E.

Space allowance per hen:
Space per hen refers to both the floor space and space provided on perches and walkways. To help you understand the space requirements for laying hens, consider the following information.

- The body of a hen is approximately 40 square inches when its wings are folded and 180 square inches when its wings are spread open.
- Hens need approximately 67 square inches to stand and lie down comfortably, about 252 square inches to turn around freely (without bumping into other hens), and 300 square inches or more to flap its wings.

Perches for roosting:
Resting and perching are important aspects of birds' welfare. Roosting at night on an elevated perch is a behavioural priority. Perch design and hygiene are important to avoid damage to the foot pad and perch design is also important to minimise keel bone deformation.

Scratching area for dustbathing:
Chickens like to scratch in the dirt and in bedding, enjoy foraging for food in dirt/bedding, and dust bathing (spreading dust over their feathers).

Nest boxes:
Nest boxes are the place where hens can lay eggs. Hens prefer to lay eggs in their own individual nests, but group nests are preferable to no nests

Outdoor access (or free range):
Access to outdoors may be accompanied with shelter and/or protection from predators. Note that regardless of whether free-range access is available, hens will always have access to indoors for protection from the weather.

Community-supported agriculture:
Community Supported Agriculture consists of a community of individuals who pledge support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm, with the growers and consumers providing mutual support and sharing the risks and benefits of food production.

Appendix A.2

THE FOLLOWING DESCRIBES HOW EGGS ARE PRODUCED IN CANADA

All commercial hen housing systems include a climate controlled barn, continuous access to food and water and automated egg collection. Hens are moved into their housing system when they become adults and begin laying eggs. Hens are kept in laying barns for about a year. Hens can be housed either in conventional cages, enriched cages, free-run housing or free-range housing. Eggs from these different housing systems can be substituted with each other. The following chart describes the main differences between these housing systems.

	Cage	**Enriched cage**	**Free run**	**Free range**
Living environment	Wire cage, 30-40 cm in height	Wire cage, slightly taller than 40 cm	Barn or aviary	Barn or aviary with outdoor access
Space allowance per bird	Recommendations are for at least 67 square inches (or 432 square centimeters) per bird	Most enriched cage systems provide at least 93 square inches (or 600 square centimeters) per bird	Recommendations are for at least 132 square inches (or 850 square centimeters) per bird	While there are no minimum space recommendations, many free range systems provide at least 132 square inches per bird in the barn (or 850 square centimeters) and birds have access to the outdoors
Group size	5-8 hens per cage	8-24 hens per cage	A few thousand to over 10,000 birds per barn/aviary	A few thousand to over 10,000 birds per barn/ aviary
Cage/ Barn/ Aviary setting	No nest boxes, perches or scratching area	Equipped with nest boxes, perches for roosting and scratching area for dustbathing	Equipped with nest boxes, perches for roosting and scratching area for dustbathing	Equipped with nest boxes, perches for roosting and scratching area for dustbathing
Outdoor access	No outdoor access	No outdoor access	No outdoor access	Outdoor access where hens can forage and dustbathe, and are exposed to sunlight. Hens have access to shelter from predators and severe weather.