Consumer Preferences for Improved Hen Housing: Is a Cage a Cage?

Maurice Doyon,[1] Stéphane Bergeron,[2] John Cranfield,[3] Lota Tamini[4] and George Criner[5]

[1]*Département d'économie agroalimentaire et des sciences de la consommation, Université Laval Pavillon Paul-Comtois, 2425 rue de l'Agriculture Québec, Québec, Canada G1V 0A6 (corresponding author: phone: 418-656-2131, ext. 4546; e-mail: maurice.doyon@eac.ulaval.ca).*
[2]*Département d'économie agroalimentaire et des sciences de la consommation, Université Laval Pavillon Paul-Comtois, 2425 rue de l'Agriculture Québec, Québec, Canada G1V 0A6 (phone: 418-656-2131, ext. 3363; e-mail: stephane.bergeron.4@ulaval.ca).*
[3]*Department of Food, Agricultural and Resource Economics (FARE), University of Guelph, J.D. MacLachlan Building, Guelph, Ontario, Canada N1G 2W1 (phone: 519-767-1510, ext. 53532; e-mail: jcranfie@uoguelph.ca).*
[4]*Département d'économie agroalimentaire et des sciences de la consommation, Université Laval Pavillon Paul-Comtois, 2425 rue de l'Agriculture Québec, Québec, Canada G1V 0A6 (phone: 418-656-2131, ext. 5553; Lota.Tamini@eac.ulaval.ca).*
[5]*School of Economics, University of Maine, Winslow Hall, Office 207, Orono, ME 04469 (phone: 207-581-3151; e-mail: george.criner@umit.maine.edu).*

The rising concern among consumers regarding animal welfare in livestock production has prompted several regions, including California and the European Union to ban the use of battery cage housing systems for laying hens. In Quebec, battery cages are being phased out with new barns required to be equipped with enriched cages or alternative housing system. Since switching housing systems generates costs, it is important to verify consumer receptivity to these changes. This paper examines the results of a discrete choice experiment to understand Quebec consumers' demand for enriched cages and preferences for amenities commonly included in these cages. Results show that each subgroup of consumers provides a positive value for eggs produced in enhanced housing systems but differ in the features that are valued. However, in all subgroups there is low or no valuation associated with increased cage space, as well as the presence of scratch pads and dust baths.

Les consommateurs sont de plus en plus soucieux du bien-être animal. Plusieurs régions, incluant la Californie et l'Europe, interdissent l'élevage de poules dans des systèmes de cages traditionnelles. Au Québec, ce type de cage sera graduellement éliminé, les producteurs ayant collectivement décidé que les nouvelles constructions seront équipées de cages enrichies ou de système alternatif. Puisqu'un système de cages enrichies implique des coûts additionnels pour les producteurs, il est important de vérifier la réceptivité des consommateurs pour les œufs produits dans ce type de système de logement. Les données d'une expérience à choix discret sont analysées, notamment par segment de consommateurs. Les résultats indiquent une valeur positive pour le système enrichi, mais les différentes composantes du système de cages enrichies sont valorisées différemment selon les segments de consommateurs. Toutefois, l'espace supplémentaire, la possibilité de bains de poussières et le coussin de grattage sont peu ou pas valorisés, et ce, pour l'ensemble des segments de consommateurs.

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INTRODUCTION

The rising concern among consumers regarding animal welfare in livestock production has prompted changes in livestock systems. Egg-laying hens have traditionally been housed in battery cages with a high density of the hen stock providing economic efficiencies by optimizing building space (Mench et al 2011). However, animal welfare advocates have criticized the limited space provided to hens. While battery cages remain the main laying hen housing system in the world (IEC 2009), various jurisdictions are phasing out their use. In 1999, the European Union banned use of conventional cages by the year 2012 (Appleby 2003). In the United States, the state of California passed a proposition (on a state referendum with 64% approval) that would see battery cages banned by 2015, with similar propositions later being approved in Michigan and Ohio (Mench et al 2011). In Canada, no legislation has yet been passed to restrict production methods, but the Quebec egg producers have proactively decided to phase out battery cages with new barns required to be equipped with enriched housing systems.

Several alternative housing systems have been developed to increase laying hen welfare, and are categorized as either caged or noncaged. Noncage systems are of three types; floor, aviaries, and free range. Each of these systems can house thousands of hens together and can be furnished with nest boxes, perches, and dust baths. Floor systems house hens on the floor of the barn, while aviaries differ by including several raised platforms allowing for increased space per hen. Compared to conventional cages the aviary and floor systems have similar drawbacks; they are more difficult to manage, and have higher mortality, infection, and cannibalism (Appleby et al 2004; Blokhuis et al 2007). A free-range system is a noncaged system with the additional requirement that hens have access to the outdoors for part of the day. Free-range systems increase mortality and the cost of management. Since it is the most expensive systems to manage it demands a high premium from consumers (Patterson et al 2001).

Cage housing systems are either conventional (battery) or enriched (also called furnished). The main advantage to battery cages, in addition to its economic efficiencies, is that it separates the egg and the hen from hen feces, increasing egg cleanliness and food safety. Enriched housing is characterized by increased space per hen relative to battery cage and is furnished with all or some of the following items: a perch, a dust bath, a nesting box, and a scratch pad. Enhanced cages house between four hens and up to 60 hens in a colony system (Mench et al 2011).

The production cost of eggs under different production systems increases with alternative methods due to lower stocking density and increased management needs. The only study we are aware of that explores the cost of production differential across housing systems is Matthews and Sumner (2015). They compared the commercial cost of production of eggs produced from battery cage system, an aviary system, and enriched cages all situated on the same farm. Their results show that compared to battery cage production cost, the average total cost is 36% higher for the aviary system and 13% higher for the enriched housing system. Since switching housing systems generates costs, it seems important to measure consumers' acceptability and valuation of these alternative housing systems.

There is abundant literature that seeks to value consumer willingness to pay for alternative livestock production systems (Lagerkvist and Hess 2011). For laying hens several studies have examined preference for cage-free systems (Bennett and Blaney 2003;

Chang et al 2010; Andersen 2011; Lusk and Norwood 2011), but little has been done to understand preferences for enriched caged systems.

The goal of this paper is to identify consumer preferences for eggs produced in enhanced cage systems while identifying the features that are most valued. A discrete choice experiment is conducted in Quebec. To account for heterogeneity in preferences a random parameter logit (RPL) model is used. We also consider an RPL model on segments of the sample based on respondent's declared priorities when explaining specialty egg purchases. Our results suggest that subgroups differentiated by these declared priorities have a positive valuation for eggs produced under an enriched cage system, but that the preferred features differ across groups. However, for all subgroups low or no values are attributed to increased cage space, as well as for the presence of scratch pads, and dust baths.

The remainder of the paper is organized as follows. We first provide background research to motivate the study's design. We then discuss the discrete choice experiments survey, the indirect utility model, and the results. Following this we include a discussion on policy implications and end with concluding remarks.

Background

This research follows the study of Wang et al (2015) that measured consumer demand for eggs produced using alternative housing systems. Using a choice experiment they examined Canadian consumer preferences for the following attributes: floor space, if the hen was housed in a cage or open space, if the housing was furnished (i.e., dust bath, nest box, and perch) and whether or not the hens had access to the outdoors. Marginal willingness to pay estimates(MWTP) from a conditional logit over the Quebec[1] subsample of 499 respondents finds that consumers give a \$0.25 premium per dozen when increasing space for increments of 60 sq. in. Access to the outdoor generates the highest premium, as previously found by Patterson et al (2001), and is roughly \$0.60 per dozen. When the housing system is furnished, willingness to pay increases by \$0.25 to \$0.45 cents depending on the information that is included. Finally, respondents negatively valued housing systems that included a cage,[2] independently of the presence of cage furnishings. This is in line with opposition raised by animal welfare advocates toward any type of housing that uses a cage (under the rationale that it restricts hen behavior). Advocacy groups including Eurogroup for Animals, World Farming, and the Royal Society for Prevention of Cruelty to Animals are seeking to get all cage systems, including enriched cages, prohibited completely (Mench et al 2011), despite the fact that numerous studies have confirmed the benefits of enriched cages on hen welfare (Blokhuis et al 2007). This attitude may be caused by a negative stigma associated with the word cage. Prior to this study we conducted an online survey using the «*Survey Monkey*» platform to measure how respondents believed hen's welfare improved based on the name given to the housing systems, without any additional information. In the survey, participants rated the level of comfort given to the hens solely based on 12 different names used to describe the housing

[1] We relate the results for the Quebec subsample since it represent the same population from which the current study sample is taken.

[2] The negative value is not statistically significant at the 5% level.

system.[3] Results indicate that the three names containing the word cage were by far the least preferred option among the 75 respondents (Figure S1, Supporting Information). On the other hand, no name was strictly preferred, although the name Eco-Natural was popular. We elected to use the Eco-Natural name in the survey instead of enriched cage.[4] Nevertheless, these results suggest that consumers have a negative attitude to the word "cage." Therefore, it would be best to avoid the word cage when describing enriched cage housing system.

The current study seeks to complement the Quebec results of Wang et al (2015) by examining preferences for the enriched cage systems and the different features that furnish them. The goal of this paper is not to estimate MWTP to be used in a cost benefit analysis, since the estimates will likely be plagued by hypothetical bias (Loomis 2011). There exist internal validity approaches that mitigate hypothetical bias (Vossler et al 2012). However, these approaches only work on public goods that can have a payment vehicles that is coercive (i.e., tax increase, utility surcharge; Carson and Groves 2007). Eggs produced using alternative housing systems have features that can be interpreted as a public good (Carlsson et al 2007). However, such eggs remain a private good since the decision to purchasing these eggs is a personal choice. Therefore, estimates from our discrete choice experiment could be biased (Harrison 2006; Carson and Groves 2007) and should not be compared to production costs. Nevertheless, the identification of an ordering of preference remains valid since it can be assumed that within the same study the hypothetical bias multiple remains constant (Murphy et al 2005).

Survey Design

A discrete choice experiment was designed to verify if a positive value exists for specific features of enriched caged housing systems. The survey instrument asked respondents to choose between a dozen eggs from either conventional or enriched housing systems. The latter housing method was labeled as "Eco-natural" housing to avoid the negative stigma associated with the word cage. The following six attributes varied for the Eco-Natural eggs: price, space, perch, nesting area, scratching pad, and dust bath, with levels given in Table 1. The "conventional cage" (status quo) kept the same attributes for all choice sets with a cost of \$3.39, 67 sq. in. of space, and no amenities included. For the six attributes of housing system (Table 1) a description of how they improved hen welfare was provided, along with negative side effects that have been raised in the literature. The information was presented objectively based on the recent scientific findings and respondents were informed that it had previously been validated by experts in the field of animal welfare. (For a table of the information used to describe the amenities see Supplementary document Appendix A). The survey used a two block orthogonal design, such that each respondent answered a total of eight choices sets, presented in

[3] A short survey containing 12 names of our creation representing housing systems for laying hens was carried out in Quebec using social media. The participants had to rate the names, without any other information, according to their perceived level of comfort for the hens.

[4] One might wonder if the use of Eco-Natural creates a halo effect. However, in the survey participants saw pictures of the enriched cage as well as of the other housing systems described in the survey, which should reduce the potential halo effect. We also learned, after the Survey Monkey survey, that such a name exists at a commercial level for enriched cage.

Table 1. Attributes and levels used for the enriched cage eggs choice sets

Attributes	Levels
Price ($CDN/dzn)	3.39, 3.69, 4.49, 6.99
Space (sq. in.)	67–93
Perch	Yes – No
Nesting area	Yes – No
Scratching pad	Yes – No
Dust bath	Yes – No

a random order. This design reduces the cognitive burden on respondents but imposes constraints in analysis. Since the attributes are taken as orthogonal, the data cannot estimate models with interaction between variables (Lancsar and Louviere 2008). Therefore, we assume that preference for one cage attribute is independent from the other attributes.

A professional marketing research firm implemented the survey over a large segment of the Quebec population. Table 2 compares key socioeconomic data from the sample with the Quebec population. The sample is well diversified, but is slightly biased regarding the level of education; those with university degrees are overrepresented, while those with a lower level of education are underrepresented. Note that the meta-analysis by Lagerkvist and Hess (2011) suggests that no socioeconomic characteristic except income is a good predictor of individual animal welfare preferences.

The data includes 572 respondents[5] who answered the choice sets and a series of questions on purchase habits and standard socioeconomic information.

For the purpose of this paper it is assumed that utility is a function of price and attributes of the production systems, and that this function is linear. Specifically, the utility of an individual n choosing alternative j is modelled as follows:

$$U_{nj} = \alpha + \beta_n x_{nj} + \varepsilon_{nj} \tag{1}$$

where the deterministic components include the intercept α representing intrinsic preference for the alternative as a whole. The attributes j for individual n are coded in x_{nj} such that the β_n is a vector of coefficient of individual n's preference for each attribute giving $\beta_n = (\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6)$ which are, respectively, the coefficients for price, space, nesting box, perch, scratch pad, and dust bath. The β's are not subscripted by j since it is assumed that preferences for attributes are stable across an individual's choices. The stochastic component of the model is captured by ε_{nj}.

To account for heterogeneity in preferences an RPL model is used, with preferences for the five cage attributes assumed to be taken from a normal

[5] The initial data set had 602 respondents. We removed all the questionnaires that had logical inconsistencies regarding strictly dominating choices, suggesting that these respondents acted like professional survey takers, answering as fast as possible without consideration of the survey objective, in order to get a reward. Nevertheless, the model was run with the full sample ($n = 602$) without any effect on the results, but an improved statistical significance with the reduced sample.

Table 2. Comparison of the socioeconomic data from the sample with that of the Quebec population

	Sample	Quebec
Gender		
Male	45%	50%
Female	55%	50%
Age		
18–24	5%	11%
25–34	19%	23%
35–44	22%	26%
45–54	25%	20%
55–64	20%	12%
65 years and more	9%	7%
Education		
Less than high school	3%	21%
High school	29%	16%
College	22%	42%
University	46%	21%
Income (personal)		
Less than $15,000	9%	13%
$15,000–24,999	10%	21%
$25,000–34,999	12%	22%
$35,000–44,999	13%	18%
$45,000–54,999	11%	
$55,000 and more	32%	26%
No answer	13%	0%
Income (household)		
Less than $15,000	3%	3%
$15,000–$24,999	5%	4%
$25,000–$34,999	7%	7%
$35,000–$54,999	14%	19%
$55,000–$74,999	17%	11%
$75,000–$99,999	15%	17%
100,000 $ and more	24%	38%
No answer	13%	0%

distribution, while price is a nonrandom variable. However, since food choices across consumers are made according to diverse personal concerns (i.e., food safety, environmental impact, animal warfare concerns, and price) the heterogeneity in preferences can be a discrete step (Liljenstolpe 2008). For example, Verbeke and Ward (2001) find diverging values caused by conflicting perceptions regarding food safety and animal welfare. The RPL model is inadequate in identifying discrete heterogeneity.[6] To account for discrete heterogeneity we consider three submodels in addition to the full sample

[6] Theoretically it is possible to account for discrete heterogeneous by interacting explanatory variables with attributes. However, this increases the number of random coefficients and makes the convergence of the model problematic.

model. The observations retained for the submodels come from a segmentation of consumers according to motives explaining past specialty egg purchases. To accomplish this, the discrete choice experiment survey included a question asking respondents who declared having previously purchased free run, free range, or organic eggs to give the main reason they purchased these types of eggs. From these answers we created three subgroup of consumers as follows: (i) the «*self-interest*» group represents consumers that justify their purchase for food safety, nutrition, or for better taste reasons; (ii) the «*for the hen*» group are consumers who buy value-added eggs in consideration for the hens' welfare; and (iii) the «*for the environment*» group who purchase value-added eggs since they believe that they are better for the environment.

Alternatively, one could have considered a latent class model approach, which better handles discrete heterogeneity. However, Martinez-Cruz (2015) warns about the use of latent class analysis if the sample is not significantly large, since it would then likely result in type II statistical errors. One should also note that the classes derived from latent class analysis should not be interpreted as a set of true population subgroups, making results interpretation difficult (Dziak et al 2014), especially for nonspecialists (Martinez-Cruz 2015). Given that our sample is not very large, that the goal of the paper is to provide a straightforward interpretation of the results that can be of use for producer boards and policy makers[7] by providing an ordinal understanding of preferences, we made the choice of not using latent class analysis.

On the other hand, the use of the self-declared motives to establish subgroups is direct and easily interpreted. Most importantly, it provides valuable information to stakeholders on how purchasing priorities directly influence preferences for cage attributes.

The simulation was done using the mlogit package (Croissant 2013) in the R statistical software (R Core Team 2015). The maximum likelihood simulation used 500 draws from a Halton sequence that has been shown to converge faster than random draws (Train 2000). To provide intuitive interpretation, the estimated coefficients are accompanied by their corresponding MWTP obtained by taking the ratio between the attributes coefficients and the coefficient for price.

RESULTS

The results of the estimates on the full sample are presented in Table 3, consisting of 572 respondents with eight choice sets giving 4,576 observations (standard errors and p-values can be found in the supplemental data).

On the full sample we find that increased space per hen is not valued by respondents. The other amenities have statistically positive coefficients with the exception of the dust bath attribute, which is not statistically significant. The price premiums per dozen are \$0.81 for a nesting box, \$0.44 for the perch, \$0.24 for the scratching pad, and \$0.12 for the dust bath. The intercept is statistically significant ($p < 0.001$) and its MWTP is \$0.90. Recall that this value is interpreted as the utility for eggs from hens lodged in the Eco-Natural housing system that cannot be attributed individually to the listed

[7] Although the latent class model may provide a model with a better fit, interpretation is complicated by the fact that the number of subgroups is determined somewhat arbitrarily and membership to subgroups is probabilistic.

Table 3. Selected results of random parameter logit on full sample ($n = 572$) using simulation with 500 Halton draws

	Full Sample ($n = 572$)	
	Estimate	MWTP
Intercept	1.5339***	0.9095
Price	−1.6866***	0.0000
Space	0.0864	0.0513
Nesting box	1.3798***	0.8181
Perch	0.7462***	0.4424
Scratch pad	0.4162**	0.2468
Dust bath	0.2053	0.1217
Standard deviation of random parameter coefficients		
Space	−1.0556***	
Nesting box	3.3922***	
Perch	−1.2589****	
Scratch pad	1.2830***	
Dust bath	0.9915***	
Log-likelihood:		−1,979.48
McFadden R-squared		0.3567
Likelihood ratio test (chi-sq)		2,195.53
(p-value)		0.0000

Note: p-values: ***<0.001; **<0.01; *<0.05.

attributes. This value may arise from some other intrinsic value placed on eggs from the Eco-Naturel system or may represent preferences for combined attributes that the model did not identify. The standard deviation of the random coefficient estimates are statistically significant suggesting high levels of respondent heterogeneity regarding preferences toward attributes.

The results of analysis on the segmentation sample are in Table 4. Due to the lower number of observations the power of the model is diminished, as can be seen in the log-likelihood estimates, yet all estimates remains statistically better than the null model (p-value < 0.001).

Looking at the subgroups we find that the coefficient on the space variable is not statistically significant across all segments. The self-interest group values the nesting box the most, giving it a premium of \$1.70 per dozen, while those with concerns for hens' welfare value the nesting box and perch at \$1.17 and \$0.80, respectively. In addition, the standard deviation on random estimates for nesting box and perch is statistically significant in the self-interest and concern for hens' welfare groups, suggesting that heterogeneity for these attributes remain for these subgroups. However, the "for the environment" group does not have any statistically significant estimates. This may be due to the limited number of observation in this subgroup. Looking at the estimates we can nevertheless assume a positive premium for eggs produced in an Eco-Natural system. Across all subgroups the coefficients on the dust bath and scratch pad variables are not statistically different from zero. Furthermore, the standard deviation on these coefficients are not statistically dif-

Table 4. Selected results of random parameter logit on three segmentations of the sample using simulation with 500 Halton draws

	For self-interest (109)		For the hen (135)		For the environment (31)	
	Estimate	MWTP	Estimate	MWTP	Estimate	MWTP
Intercept	2.1350***	1.2583	1.9002***	1.2041	3.3058	1.4365
Price	−1.6967***		−1.5782***		–2.3014	
Space	−0.2666	−0.1571	0.4305	0.2728	0.3539	0.1538
Nesting box	2.9091***	1.7146	1.8514***	1.1731	1.9137	0.8315
Perch	0.6951	0.4097	1.2734**	0.8069	0.5908	0.2567
Scratch pad	0.2221	0.1309	0.6644	0.4210	0.3523	0.1531
Dust bath	0.4733	0.2789	0.3560	0.2256	0.4653	0.2022
Standard deviation of random parameter coefficients						
Space	0.9700		1.5428***		−0.7899	
Nesting box	5.9252***		3.0620***		6.7947	
Perch	−1.5554**		1.7059**		−0.2836	
Scratch pad	1.0647		0.8600		−1.4383	
Dust bath	−1.3843*		1.0017		2.6705	
Log-likelihood:		−340.79		−432.13		−80.171
McFadden R-squared		0.3928		0.3381		0.4703
Likelihood ratio test (chi-sq)		441.0021		441.3725		142.3364
(p-value)		0.0000		0.0000		0.0000

Note: p-values: $^{***}<0.001$; $^{**}<0.01$; $^{*}<0.05$.

ferent from zero, with the exception of the dust bath attribute for the self-interest group which is small and significant (p-value < 0.05). This suggests that the lack of positive valuation for the dust bath and scratch pad is homogeneous across segmentations.

DISCUSSION

The empirical results from the discrete choice experiment surveys presented in this paper complement the previous results from Wang et al (2015) by showing that Quebec respondents provide a premium for eggs produced in an enriched traditional housing system. The current study finds preference for specific amenities commonly found in furnished cages. The results of the analysis suggest that the nesting box and perch have the highest valuation, respectively. Based on respondent profiles, it appears that respondents perceive the nesting box as providing benefits for the hen's welfare without compromising the safety and the quality of eggs. The inclusion of the perch was only valued by respondents whose main motive was to increase hen's welfare. The lack of value from the self-interest group may be indicative that perches are perceived as increasing egg quality.

Surprisingly, increased space allowance per hen did not receive a positive valuation from any of the consumer groups. In fact, one choice set in the survey included the option of increasing space from 67 to 93 sq. in. at an additional cost of \$1.10 without adding any other feature. Only 34% of respondents were willing to pay this amount, compared to 55% who were willing to pay the same amount for a nesting box, without an increased in space. This is in contrast to previous results that found a positive valuation corresponding to a \$0.25 premium when increasing space by 60 sq. in. (Wang et al 2015); this would translate to a \$0.11 premium for the larger cage in our study.[8] Consequently, since the price premiums are significantly higher than this across choice set we may not have been able to capture MWTP for increased space. Future studies should either provide larger increase in space or smaller price increases.

The observed high values given to the coefficients of the intercepts for all models could be interpreted as the values given to "Eco-Natural" eggs that are not given for an attribute explicitly presented in the choice set. In support of this assumption, we observe that environmentally minded respondents chose the eco-natural housing eggs while being indifferent toward specific features. The researchers are aware that this is a flaw of the current study and should avoid labels from choice set by referring to choices as "System A" and "System B." The high values found for the intercept can also be explained by possible interactions between attributes, for example consumers might value the nesting box when combined with increased space more than when these are offered separately. The current study design used a factorial design that assumes independence across attributes. To remove this constraint the study would need to reduce its number of attributes to conduct an experimental design that allows for interaction of variables while keeping

[8] A potential explanation would be that the increased in space is not judged sufficient to improve hens' welfare. The participants were told that 93 sq. in. represents roughly the size of a regular piece of paper.

the number of choice sets at a level that is acceptable to avoid respondent cognitive burden.

CONCLUSION

The results from this study have several implications for egg policy. First, it shows that consumers have a positive valuation for eggs produced in an enhanced housing system. For the full sample, the premium is $2.59 while it is $4.10 for the group whose main concern is for hen welfare.[9] Recall that these premiums could be impacted by hypothetical bias problems, which cannot be circumvented in this study; therefore, they should not be taken at face value. Nevertheless, these results indicate that consumers are ready to pay a premium for eggs produced in an enhanced housing system. Note that eggs from hens in enriched cages are not currently labeled any differently than battery cage eggs and therefore do not command a premium in the marketplace (Mensch et al 2011). Consequently, areas where battery cage are not being phased out can expect low conversion to enhanced housing systems in the absence of regulation from the industry or the government, due to lack of market differentiability and incentive.

In areas where transition from battery cages is being phased out, as is the case of Quebec, it is foreseeable that the increased cost in production could be transferred to the consumer. If enriched cage systems are to become the new norm, communication campaigns should explain to consumers how the new housing amenities benefit the hens. This should be done with consideration toward the negativity related to the word cage, it might be best to avoid describing this systems as enriched cage, and consider alternative names such as "housing system." In the midst of recent announcements by retailers and major fast food chains to strongly favor free range or free run eggs in a near future, to better explain the enriched housing system seems important. Furthermore, changes toward enriched housing systems can have an impact on how consumers currently perceive egg differentiation and modify the current consumption trends. For example, Bejaei et al (2011) find that free range egg consumption has strongly increased in British Colombia from 2007 to 2009. If future hen housing systems include amenities that are perceived as increasing egg quality (nesting box) and hen welfare (perch and nesting box) then the differentiation with regard to the benefits of cage free eggs might be diminished. Consequently, the demand for cage free and free run eggs might be reduced. This seems to be an interesting avenue for future research.

Finally features commonly included in enriched cages, such as a dust bath and scratch pads, are not valued by respondents. This could be explained by the somewhat negative impact on air quality (dust) and food safety (manure on eggs) associated with these items, as indicated in the information given to participants.

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[9] These values are the sum of the MWTP found in Table 3 for the full sample and in Table 4 for the hen group.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1.
Table S1.
Table S2.