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Consumer Attitudes toward Farm-Animal Welfare: The Case of Laying Hens

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Concerns over laying hens' welfare have led to many different labels for eggs and changes to state regulations. Consumer attitudes toward farm-animal welfare were examined using a national survey in the context of preferences for eggs differentiated by layer management practices. Most respondents perceived caged housing and other conventional management practices as reducing hens' welfare and were willing to pay a premium for eggs produced in cage-free and other nonconventional production systems. Although participants responded to information about environmental consequences of management practices, they placed more weight on animal welfare issues than environmental issues in their egg-purchase decisions.

Key words: animal welfare, cage-free, choice experiment, eggs, environmental concerns, laying hens

Introduction

Producers of animal-based foods, consumers, and policy makers around the world have become increasingly mindful of farm-animal welfare in recent years. European laws have recognized that farm animals can feel, experience, and suffer since the 1960s; these laws are the basis for animal welfare standards in many countries. Increasing awareness of farm-animal welfare in the United States has led to changes in state regulations and industry standards. For example, gestation crates are now banned in Florida and Arizona (International Finance Corporation, 2006; Lusk, Norwood, and Prickett, 2007). In 2002, the United Egg Producers (UEP), representing nearly 90% of U.S. egg producers, launched the UEP Certified Program, which requires increasing stocking space for laying hens from 48 to 67–86 square inches per bird. By 2010, 80% of all eggs in the United States were produced under the guideline (United Egg Producers, 2003).

Concerns over laying hens' welfare have been widely debated in the United States, not unlike in Europe, where laying hens were identified as having the most need for welfare improvement among farm animals (European Commission, 2005). Various groups have developed welfare-related labels—such as "certified humane" and "cage-free"—to indicate the living conditions of laying hens. For example, the label "Animal Welfare Approved," developed by the Animal Welfare Institute, requires cage-free conditions and outdoor access for laying hens to perform their natural behaviors (including nesting, perching, and dust bathing) and forbids forced molting and beak cutting (Humane Society of the United States, 2011). Many universities and restaurants, including Starbucks and Burger King, now request eggs produced using layer-friendly systems (Humane Society of the United States, 2011), and consumers appear to be willing to pay some premium for these welfare-related labels (Sumner et al., 2011).

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State and local governments also play an active role in improving laying hens' well-being. In 2008, California passed the Prevention of Farm Animal Cruelty Act, which requires that by 2015, cages will be large enough for a hen to stand up, turn around, and flap its wings without touching the side of the cage or another laying hen. Michigan passed a similar law in 2009 forbidding battery cages. Similar regulations are being debated in other states, including Ohio and Oregon. The new regulations could increase egg-production costs and considerably reduce the number of eggs produced within each state, increasing egg shipments from other states (Sumner et al., 2010). These regulations could also have potential environmental impacts. Recent studies have found that cage-free systems could generate more air and water pollution and use more energy than traditional cage systems (Xin et al., 2011; Thompson et al., 2011). In order to accurately predict the effects of higher welfare standards on marketing opportunities for egg producers, we first need to understand consumers' knowledge and perceptions of hen welfare and how they might react to the likely tradeoff between hen welfare and environmental consequences.

The objectives of this study were threefold: to determine the state of consumers' perceptions and knowledge about welfare issues pertaining to laying hens, to assess how consumers value various practices for managing laying hens that are related to hens' welfare, and to examine how consumers respond to new knowledge regarding the potential environmental impacts of these practices. To address these objectives, we developed and administered a nationwide online survey. We collected choice experiment responses for eggs produced under different management practices and analyzed the results using a random parameter logit model that accounted for the information effect and heterogeneity in consumer attitudes.

Our findings provide practical implications for U.S. egg producers and a more complete picture of consumer preferences about eggs. Respondents generally regarded the basic living needs of hens as the most important factor in layers' welfare. Over half of respondents perceived management practices such as induced molting, caged housing, and beak trimming as reducing the birds' welfare. Our estimates suggest that the majority of consumers are willing to pay an average premium of $0.21 to $0.49 per dozen for eggs produced in a cage-free environment with outdoor access or without induced molting. The results also indicate that consumers currently place more weight on animal welfare issues than potential environmental issues in selecting eggs.

Literature Review

U.S. egg consumption declined in the decades between the end of World War II and the early 1990s, reflecting consumers' concerns about cholesterol and salmonella. The decline might also have been caused by lifestyle changes that led to more food being consumed away from home (Brown and Schrader, 1990). Lately, eggs have been marketed as a healthy food product and a relatively cheap source of protein and minerals, which has stabilized egg consumption (Thompson et al., 2011); U.S. consumers currently spend about $14.2 billion on eggs annually (U.S. Department of Agriculture, Food Safety and Inspection Service, 2005).

Reflecting a general trend in food, the U.S. egg market has become highly differentiated. Sales of eggs that are differentiated from conventional eggs by nutrient content or the circumstances of raising hens have increased steadily and accounted for nearly 16% of the entire egg market in 2005 (Chang, Lusk, and Norwood, 2010; Brown, 2008). In particular, organic egg sales have grown rapidly at an average annual rate of 19% from 2000 to 2005 (Oberholtzer, Greene, and Lopez, 2006; U.S. Department of Agriculture, Food Safety and Inspection Service, 2005). Researchers have begun to investigate consumer preferences for differentiated eggs. Andersen (2011) found that people were willing to pay a higher premium for organic eggs, which was attributed to consumers perceiving organic eggs as healthier and their familiarity with the "organic" label. Canadian consumers were shown to be willing to pay a premium for Omega-3 eggs (Asselin, 2005). Baltzer (2004), using scanner data on weekly egg sales, found that Danish consumers were willing to pay a significant premium for organic production methods and improvements in animal welfare.

Given increasing concerns about animal welfare, the "cage-free" designation has become an attribute commonly associated with hens' welfare. In the United States, the majority of laying hens are confined in cages that have limited space for each bird. These conventional housing systems have been criticized by animal advocacy groups because hens cannot extend their wings and are unable to exhibit natural behaviors such as nesting and dust bathing (Humane Society of the United States, 2011). Several studies have assessed consumers' attitudes toward animal welfare and demand for related products. Fearne and Lavelle (1996) found that price and animal welfare were valued as two key attributes of egg consumption by consumers in the United Kingdom. Norwood and Lusk (2011) found that people highly valued cage-free systems and were willing to pay a $0.95 premium for a dozen eggs raised in a cage-free system rather than a traditional caged system. On the other hand, Allender and Richards (2010) found only about 20% of households were willing to buy cage-free eggs at average 2007–2008 prices. Another study found that, although consumers were willing to pay a significant premium for cage-free eggs on average, nearly half of the typically observed premium was attributed to egg color rather than better living conditions for hens (Chang, Lusk, and Norwood, 2010). While such inconsistent findings may be attributed to different methods, investigations of whether consumers are willing to pay extra for eggs produced using unconventional systems is far from over.

Several important questions on animal welfare remain unanswered. One such question pertains to consumers' general attitudes toward animal welfare. The concept of animal welfare is complex, and many factors should be considered when assessing animal welfare. People are likely to have different perceptions of these factors. For example, conventional housing systems that confine hens in cages provide clean shelters and comfortable temperatures for birds and help keep production costs low. Hens' beaks are often trimmed to prevent them from pecking and harming other birds. Although these management practices protect hens in some respects, the public has usually viewed these practices as reducing animal welfare because cutting beaks appears brutal and caged hens cannot access the outdoors and have no freedom to nest, perch, or even spread their wings. According to Lusk, Norwood, and Prickett (2007), people value the opportunity for farm animals to exhibit natural behaviors and exercise outdoors more than protection from other animals and comfortable shelter; thus, one goal of our study was to identify what practices consumers perceived to impact laying hens' welfare.

Another question relates to recent studies that reveal the environmental costs of cage-free and outdoor-access systems. Cage-free or other systems allowing outdoor access were reported to generate more air and water pollution, thus placing a heavier burden on the environment than traditional caged-housing systems (Xin et al., 2011). Thompson et al. (2011) concluded that although hen manure is a valuable nutrient resource for crops, its handling can produce significant environmental damage to air and water quality. Moreover, housing systems without cages use 15% more feed and energy to maintain optimal temperatures for layers due to lower stocking densities (Williams, Audsley, and Sanders, 2006). Such tradeoff between welfare enhancement and environmental degradation is likely an issue most consumers have not yet considered, with conceivable impacts on how they value animal welfare. This study evaluates how environmental concerns may influence consumers' valuation of layer management practices.

Survey Design

The survey instrument consisted of a cover letter, screening questions, general questions, choice scenarios, and demographic questions. To ensure that respondents did not self-select based on their views or interest in animal welfare issues, the cover letter of the survey mentioned that the survey pertained to chicken egg consumption, with no mention of animal welfare until several questions into the survey. The screening questions aimed to restrict our sample to experienced egg shoppers. The general questions gathered information on shopping behavior and perceptions of animal welfare as well as knowledge about the environmental impacts of layer management. Demographic

Table 1. Attributes of the Choice Experiment[a]

Attributes	Levels
Price	$1.99, $2.49, $2.99
Color of Shell	Brown (*Color*), White
Feed Type	Organic (*Organic*), Vegetarian (*Vegetarian*), Conventional
Induced Molting	Not induced (*NoMolting*), Induced
Use of Cage	Cage-free (*CageFree*), Caged
Outdoor Access	Yes (*Access*), None
Stocking Density (*Density*[b])	67 sq. inches, 138 sq. inches, 216 sq. inches

Notes: [a] The italicized terms are names of variables specified in the random parameter logit model.
[b] The variable was measured in 10 square inches.

information—including gender, age, education, household annual income, and geographic areas of residence—was collected at the end of survey.

The choice experiment was designed to estimate the marginal values of several attributes of a dozen eggs, including price ($1.99, $2.49, $2.99), shell color (white or brown), feed types (conventional, vegetarian, organic), and four welfare-related attributes (outdoor access, confined in cages, stocking density, and induced molting). The attributes and their levels are summarized in table 1. The lowest level for price was set at the national average for retail prices of regular brown eggs (Grade A, large) during the week of March 9, 2012 (U.S. Department of Agriculture, Agricultural Marketing Service, Poultry Market News and Analysis, 2012). The middle and highest price levels were about 25% and 50% higher than the lowest price level. The three levels of stocking density were set at 67 square inches, 138 square inches, and 1.5 square feet (216 square inches) per bird, where the highest density was chosen based on the UEP standards, the medium density was the average space necessary for hens to fully stretch their wings (Dawkins and Hardie, 1989), and the lowest density followed third-party authorized animal welfare standards, such as Certified Humane and Animal Welfare Approved (Gunther, 2011).

A full factorial design included 216 ($= 3 \times 2 \times 2 \times 3 \times 2 \times 3$) product profiles. After deleting two extreme profiles (i.e., the combination of practices that appear to be stereotypically perceived as superior for hens' welfare [no cage with outdoor access and low stocking density and organic feed associated with the lowest price], and the combination of practices with perceived lowest welfare conditions and conventional feed associated with the highest price), a macro in SAS 9.1 suggested fifty-four profiles for a fractional factorial design, which yielded a D-efficiency score over 99%. The profiles were grouped into eighteen choice scenarios with three products each, which were blocked into three sets of six choice scenarios to minimize response fatigue. For each scenario, respondents were asked to choose from three products with different attributes and a "Not buy any of the three" option. Each egg product was pictured in a generic, dozen-case, paper carton in color to convey shell color.

To examine the effects of possible environmental consequences on consumers' valuation, we administered two versions of the survey with and without additional information on environmental aspects of cage-free systems and providing outdoor access to laying hens. To make the statement objective, we explained the potential environmental burdens of both cage-free and caged systems. The full statement found in Appendix A was presented to a subset of respondents prior to the choice scenarios. We hypothesized that respondents with additional information would become more conflicted about management practices and might value these attributes lower than respondents without additional information. Because the statement mentions that there are environmental costs associated with all types of systems, it is also possible that respondents might increase their valuation premium for welfare-enhancing practices if they believed *a priori* that the environmental costs might be higher for those systems.

The Model

Stated preference methods are based on the theory of utility maximization. When presented with a choice task, respondents are assumed to choose the alternative with the combination of attributes that would provide them with the highest level of utility. When consumers choose among egg products with similar attributes, their preferences for various attributes are expected to be correlated, and thus the Independence of Irrelevant Alternatives assumption of the multinomial logit model is violated. This study uses a random parameters logit model to overcome the multinomial logit model limitation and to examine the heterogeneity of preferences within the population (Hensher and Greene, 2001; McFadden and Train, 2000).

The utility that individual i derives from choosing alternative j can be written as:

$$U_{ij} = \beta_i X_{ij} + \varepsilon_{ij}, \tag{1}$$

where X_{ij} is a vector of observed variables consisting of attributes of the alternatives and individual characteristics. The parameter vector β_i varies across individuals with density $f(\beta|\theta)$, where θ is the parameter vector that defines this distribution and ε_{ij} represents the unobservable, random term assumed to be an independent and identically distributed (i.i.d.) extreme value. Following Hensher and Greene (2001), the choice probabilities are integrals of standard logit probabilities over the parameter densities and can be written as:

$$P_{ij}(\theta) = \int \left(\frac{e^{X_{ij}\beta_i}}{\sum_{k=0}^{J} e^{X_{ik}\beta_i}} \right) f(\beta|\theta) d\beta. \tag{2}$$

The individual's utility was specified for choosing one of three egg products or "none of these three" option with price, product attribute variables, and informational interaction terms, and it can be written as:

$$\begin{aligned} U_{ij} \quad = \quad & \beta_{0ij} + \beta_{1i} Price_j + \beta_{2i} Color_j + \beta_{3i} Organic_j + \beta_{4i} Vegetarian_j + \\ & \beta_{5i} Access_j + \beta_{6i} CageFree_j + \beta_{7i} Density_j + \beta_{8i} NoMolting_j + \varepsilon_{ij}, \end{aligned} \tag{3}$$

where *Color*, *Organic*, *Vegetarian*, *Access*, *CageFree*, and *NoMolting* are dummy variables representing egg product attributes, with a value of 1 indicating their presence. The *Density* variable assumes the values of stocking density in the experiment (measured in 10 square inches). Because this was not a branded design, a single intercept was specified for all egg products. The utility function was normalized by setting the value for the opt-out option at 0.

The conditional means of selected parameters were modeled as functions of individual characteristics, including whether individuals were exposed to additional information about the environmental consequences of layer management practices. That is:

$$\beta_{ki} = \beta_k + \delta_k' z_i + \gamma_k I_i + \sigma_k v_i, \tag{4}$$

where β_k is the population mean for the kth coefficient; δ, γ, and σ are parameters; z_i is a vector of observed individual characteristics; I_i is an indicator of whether the individual received additional information; and v_i is an i.i.d. error term. The parameter γ_k will measure the effect of information on an individual's valuation of egg attributes. Individual i's willingness-to-pay for the kth attribute (WTP_{ki}) can be estimated as the negative ratio between the attribute and price parameters; the attribute parameter is individual-specific (β_{ki}) while the price parameter (β_1) is fixed across individuals:

$$WTP_{ki} = -\frac{\beta_{ki}}{\beta_1}. \tag{5}$$

Results

The survey was administered online in March 2012, several weeks before Easter. A nationally representative sample was provided by Research Now and was stratified by age, gender, region, ethnicity, and household income. The survey was pretested with sixty respondents to ensure clarity of questions and balanced response across attribute levels for statistical reliance. Based on the pretest results—in which a large portion of the respondents chose the two lower price levels—the price intervals between the three price levels were reduced from an initial range of $0.80 to $0.50. The actual launch returned a sample of 1,049 responses. Of these, a total of 924 responses that were completed in more than seven minutes were used for analysis, with 449 completing the version without information on environmental aspects (version 1) and 475 completing the version with information (version 2).[1]

Sample Characteristics

Table 2 compares the demographic profile of the sample to national statistics. The respondent demographics were mostly comparable to those of the general U.S. population, although our survey sample had higher proportions of females and individuals with bachelor's degrees or higher. Because respondents were screened to ensure that they were responsible for at least half of the household grocery shopping, it was not surprising to receive more responses from women. The educational attainment of the survey sample may be reflective of the fact that people with higher education have more interest in taking research surveys and expressing their views about animal welfare. In interpreting the results, we need to consider the impact that this higher proportion of individuals with higher educational attainment has on our sample. We conducted t-tests and found that there were no statistical differences in respondents' demographics between the two versions of the survey.

Perceptions and Knowledge about Farm-Animal Welfare

Respondents were asked to rank seven items related to farm animal treatment in order of importance (table 3). The items are listed in the order of their average rankings, where ranking 7 corresponded to most important and 1 to least important. The results showed the respondents' views were much more divided for the items "Receive fresh and clean food and water" and "Are raised in ways to keep our food costs low" compared to other items. These two items were ranked both highest and lowest according to the average ranking; they were considered most important by the largest percentages of respondents (38.5% and 23.7%, respectively) and least important, also by the largest percentages of respondents (25.1% and 33.2%, respectively).

The views toward other items were more moderate in terms of the percentage of respondents ranking them as most and least important. The items receiving the third and fourth largest percentages of the most important ranking were "Receive treatment for injury and disease" and "Are allowed to exhibit natural behaviors," each from about 8% of the respondents. But the item "Are allowed to exhibit natural behaviors" received the lowest ranking in importance from 11.8% of respondents, resulting in the second lowest average ranking.

Different sets of questions solicited responses using a Likert-type five-point scale that probed respondents' perceptions of foods produced in an animal-friendly environment and the impact of conventional management practices on hens' welfare. As shown in table 4, more than 75% of respondents somewhat or completely agreed that food products from an animal-friendly environment are from happier and healthier farm animals, are healthier for humans, and are of better quality.

[1] Seven minutes was specified as a cutoff because we expected an average respondent to take about fifteen minutes to complete the survey while some quicker readers might spend less time. Among total completions, the average time was twenty-three minutes; most responses were completed in ten to fifteen minutes.

Table 2. Sample Demographics

		Survey Sample	U.S. Population
Gender	Male	41.45%	48.57%
	Female	58.55%	51.43%
Age	18–24	12.55%	12.83%
	25–34	19.59%	17.99%
	35–44	20.24%	17.23%
	45–54	21.97%	19.01%
	55–64	14.29%	16.00%
	65 or above	11.36%	16.95%
Education[a]	Graduate School	15.15%	9.61%
	Bachelor's degree	27.60%	18.14%
	Some college	37.34%	28.49%
	High school degree	18.72%	30.41%
	Lower than high school	1.19%	13.34%
Household Income	$0–10,000	7.14%	7.78%
	$10,000–24,999	20.56%	17.91%
	$25,000–49,999	28.25%	24.72%
	$50,000–74,999	18.83%	17.74%
	$75,000–99,999	9.96%	11.43%
	$100,000–199,999	12.45%	16.52%
	$200,000 or above	2.81%	3.90%

Source: U.S. Census Bureau, Annual Demographic Survey.
[a]Percentages for the U.S. population include only those eighteen years of age and older.

Table 3. Items Related to the Treatment of Farm Animals

Items	Avg. Ranking (7 = Most Important, . . . , 1 = Least Important)	% of Respondents Ranking as Most Important	% of Respondents Ranking as Least Important
Receive fresh and clean food and water	4.41	38.5%	25.1%
Receive treatment for injury and diseases	4.32	8.7%	5.7%
Are provided comfortable shelter	3.97	7.7%	9.6%
Are protected from being harmed by other animals	3.96	6.5%	7.3%
Are allowed to access outdoors	3.93	6.7%	7.3%
Are allowed to exhibit natural behaviors	3.75	8.3%	11.8%
Are raised in ways to keep our food costs low	3.66	23.7%	33.2%

About 65% somewhat or completely agreed that these products are better for the environment, whereas nearly 60% of the respondents believed that these products taste better.

As expected, individuals had different perceptions about how various farming practices may affect the hens' welfare. Average scores suggest that housing hens in cages and trimming beaks were perceived as having slightly negative effects on hens' welfare, but the responses were divided. For example, half of respondents believed that housing hens in cages would somewhat or definitely worsen their welfare, while 22% believed that the practice would somewhat or definitely improve their welfare. The opinions on induced molting were more unified, with over 62% believing that induced molting would somewhat or definitely worsen hens' welfare.

To gauge respondents' knowledge about the environmental impacts of management practices, the respondents were asked to evaluate several statements (see table 5). Over 40% of respondents were neutral with respect to those questions, which likely indicates that they were relatively uninformed.

Table 4. Factors Associated with Attitudes toward Animal Welfare

Factor/Questions	Average Score	% Response	Factor Weight
Perceived Quality of Animal Welfare-Friendly Products (*PQTY*) ($\alpha = 0.91$)			
"I believe that food products produced in an animal-friendly environment:[a]		"Somewhat" or "Completely Agree"	
"…Are from healthier farm animals."	4.34	83.56	0.800
"…Are healthier for humans."	4.20	77.39	0.797
"…Are from happier farm animals."	4.19	77.47	0.773
"…Are of better quality."	4.10	75.69	0.820
"…Are better for the environment."	3.96	65.34	0.766
"…Taste better."	3.79	59.13	0.716
Perceived Impacts of Management Practices on Hen Welfare (*PMNT*) ($\alpha = 0.82$)			
Based on your understanding, how would the following activities affect the welfare of laying hens?[b]		"Somewhat" or "Definitely Worsen"	
Hens are housed in cages, instead of not being caged.	3.42	49.76	0.772
Hens' beaks are trimmed.	3.43	43.87	0.804
Hens are withheld from feeding or given less nutritive diet so that they molt to regulate production of eggs.	3.78	62.47	0.810

Notes: [a]The responses were: 1 = *completely disagree*, 2 = *somewhat disagree*, 3 = *neutral*, 4 = *somewhat agree*, 5 = *completely agree*. [b]The responses were: 1 = *definitely improve*, 2 = *somewhat improve*, 3 = *no impact*, 4 = *somewhat worsen*, 5 = *definitely worsen*.

Table 5. Knowledge of Housing Systems and Environmental Impact

Please indicate the levels at which you agree or disagree with the following statements:[a]	% Incorrect Response	% "Neutral" Response
"Hens that are allowed outdoor access generate less air emissions (for example, ammonia emissions and dust level) than hens that are confined indoors."[b]	49.19	41.66
"Hens that are not caged use less heat and feed than hens that are confined in cages."[c]	46.75	44.59
"Hens that are allowed outdoor access use energy and land less efficiently than hens that are housed inside."[d]	29.06	41.31
	% "Somewhat" or "Completely Agree"	**% "Neutral" Response**
"I would like to purchase animal welfare-friendly products even if the procedure places a heavier burden on the environment."	27.08	48.25

Notes: [a]Responses were on a five-point scale: *completely disagree*, *somewhat disagree*, *neutral*, *somewhat agree*, and *completely agree*. [b]A false statement. Thus, responses of "somewhat agree" and "completely agree" are incorrect. [c]A false statement. Thus, responses of "somewhat agree" and "completely agree" are incorrect. [d]A true statement. Thus, responses of "somewhat disagree" and "completely disagree" are incorrect.

A greater percentage of respondents incorrectly believed that a management practice that contributes to a higher level of hen welfare also places a lower burden on environment. Approximately 50% of respondents were indifferent with respect to the tradeoff between animal welfare and environmental degradation. These responses provide a basis for understanding the information effects.

Table 6. Descriptive Statistics of the Heterogeneity-in-Means Variables

Variable	Definition	Mean	St. Dev.	Min.	Max.
Age	Midpoint of age ranges 18–24, 25–34, 35–44, 45–54, 55–64, 65–84	44.26	16.07	21.00	74.50
Bplus	1 if bachelor's degree or higher, 0 otherwise	0.43	0.49	0.00	1.00
Fem	1 if female, 0 otherwise	0.59	0.49	0.00	1.00
Income	Midpoint of annual household income ranges in $10,000: 0.5–1, 1–2.4999, 2.5–4.9999, 5–7.4999, 7.5–9.9999, 10–19.9999, 20–50	6.37	6.44	0.75	35.00
INFO	1 if received additional information, 0 otherwise	0.51	0.50	0.00	1.00
PMNT	Factor representing "perceived impacts of management practices on hen welfare," average of items included in the factor (see table 4)	3.54	1.01	1.00	5.00
PQTY	Factor representing "perceived quality of animal welfare friendly products," average of items included in the factor (see table 4)	4.10	0.76	1.00	5.00

Model Parameter Estimates

In equation (3), the intercept and the price coefficient were specified as fixed across individuals to simplify the computation of implicit values following convention.[2] All other parameters were specified as random with normal distributions. In addition, the means of the coefficients on the attributes of welfare-related management practices (*Access*, *CageFree*, *Density*, and *NoMolting*) were specified as functions of individual characteristics. The selected respondent characteristics in equation (4) included gender (a binary variable, *Fem* equals 1 for female), age (*Age*), household income (*Income*), educational attainment (a binary variable, *Bplus* equals 1 for a bachelor's degree or higher), exposure to the additional statement regarding environmental impacts, and the respondent's attitudes toward hens' welfare.

Table 6 reports definitions and descriptive statistics of the variables in the analysis. The *Age* variable assumed the midpoint in each age range (i.e., a response of 25–34 was given a value of 30), and the *Income* variable assumed the midpoint in each income range measured in $10,000. Attitudes were measured by eleven items measured on similar scales, as discussed above. A varimax rotation of an initial factor analysis of those eleven items identified three factors, and a Chronbach's α test was conducted to test the reliability and acceptability of each factor (Cortina, 1993). As a result, two factors with α values greater than 0.70 were usable. The first factor represented respondents' perceptions of the quality of food products from an animal-friendly environment, and the second measured their perceptions of the impacts of management practices on hens' welfare (table 4). Responses to questions grouped under each factor were averaged to generate two attitudinal variables that are measured on a scale of 1 to 5. Higher values for *PQTY* correspond to more favorable perceptions toward animal-friendly products. Higher values for *PMNT* relate to more strongly held perceptions that common management practices negatively affect animal welfare. Lastly, a binary variable *INFO* was specified to equal 1 for versions with the additional statement found in Appendix A.

The random parameter logit model was estimated by maximum simulated likelihood using 100 Halton draws using NLOGIT 4.0 (Greene, 2007). Table 7 presents the estimates of the mean and standard deviations of the structural parameter densities. As expected, the intercept is positive, suggesting that egg purchases generate utility, and the coefficient for *Price* was negative and statistically significant, indicating that respondents obtain disutility from higher prices. The coefficients for *Color*, *Organic*, and *Vegetarian* were mostly statistically significant at the 1% level, with small means and large standard deviations that were nearly three- to ten-fold in magnitude,

[2] Identifying parameters in the random parameter logit models can be difficult in practice, and the model may not converge in a reasonable number of iterations (Revelt and Train, 1998; Train and Weeks, 2005). Fixing the price coefficient facilitates a straightforward interpretation of the model and allows the WTP for each attribute to be distributed in the same way as the attribute's coefficient.

Table 7. Estimated Random Parameter Logit Parameter Distributions

Variables	Coeff.	Std. Err.	Variables	Coeff.	Std. Err.
Intercept (fixed)	5.38***	0.18			
Price (fixed)	−2.04***	0.07	*Density* (random)	0.12***	0.03
			Standard deviation	0.06***	0.00
Color (random)	−0.37***	0.06	Heterogeneity-in-mean		
Standard deviation	1.08***	0.07	*Fem*	−0.02**	0.01
			Age	−0.001***	0.00
Organic (random)	0.20***	0.06	*Income*	−0.001	0.00
Standard deviation	0.78***	0.08	*Bplus*	−0.001	0.01
			PQTY	−0.01	0.00
Vegetarian (random)	−0.11*	0.07	*PMNT*	−0.02***	0.00
Standard deviation	1.08***	0.08	*INFO*	0.02**	0.01
Access (random)	0.08	0.32	*NoMolting* (random)	0.26	0.35
Standard deviation	0.71***	0.07	Standard deviation	0.77***	0.08
Heterogeneity-in-mean			Heterogeneity-in-mean		
Fem	−0.16*	0.09	*Fem*	0.35***	0.10
Age	−0.00	0.00	*Age*	−0.00	0.00
Income	−0.00	0.01	*Income*	0.00	0.01
Bplus	−0.05	0.09	*Bplus*	−0.07	0.10
PQTY	0.11*	0.06	*PQTY*	−0.06	0.06
PMNT	−0.00	0.04	*PMNT*	0.22***	0.05
INFO	0.17*	0.09	*INFO*	−0.04	0.10
CageFree (random)	−0.11	0.38	N		5,544
Standard deviation	1.06***	0.07	Log likelihood function		−5,850.63
Heterogeneity-in-mean			McFadden Pseudo R-squared		0.24
Fem	−0.07	0.11	Akaike Information Criterion		2.13
Age	−0.00	0.00			
Income	0.01	0.01			
Bplus	−0.07	0.11			
PQTY	0.20***	0.07			
PMNT	0.11**	0.05			
INFO	−0.10	0.11			

Notes: Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level.

suggesting wide variations in preferences for shell color and feed type. On average, respondents preferred white eggs and eggs from hens raised with organic feed, conventional feed, and vegetarian feed, in that order.

The means for welfare-related attributes *Access*, *CageFree*, and *NoMolting* were statistically not different from zero, but their standard deviations were similar to those for shell color and feed type. The exception was stocking density (*Density*), where the mean coefficient for giving each hen an additional ten square feet was twice as much as its standard deviation, suggesting relatively unified preferences for lower stocking density.[3]

The heterogeneity-in-mean parameters capture the effects of demographic, attitudinal, and informational variables on attribute parameters. Their estimated values indicated that female respondents valued noninduced molting more than male respondents, whereas male respondents placed higher values on lower stocking density and outdoor access than female respondents. Younger respondents, on average, valued lower stocking density more than older respondents. Income levels

[3] Higher values for *Density* indicate more space per bird, or lower stocking density.

or educational attainment did not explain systematic differences in preferences toward attributes associated with management practices considered in the study.

Attitudes toward animal welfare helped explain some variation in how respondents valued management practices associated with hens' welfare. Respondents with favorable perceptions of pro-animal welfare products (*PQTY*) placed higher values on the outdoor-access and cage-free attributes than their counterparts, which suggests that these respondents on average regard cage-free and outdoor access as more important factors influencing the quality of eggs than adjusting stocking density or not inducing molting. Respondents with perceptions that common management practices negatively affect animal welfare (*PMNT*) valued the cage-free and no-induced-molting attributes more highly and lower density less than others, suggesting that these consumers likely perceive caged housing and induced molting as critical violations of animal welfare. The dismissal of stocking density as a valuable practice to enhance welfare diverges from the *PQTY* findings.

Providing information affected valuations of outdoor access and stocking density. On average, respondents who were given information on environmental impacts valued outdoor access and lower stocking density higher than those without the information. The statement might not have changed the minds of those who had already formed opinions about animal welfare issues; rather, the statement, which laid out environmental concerns for all management practices, might have emboldened consumers who already favored these attributes to state higher values.

Willingness-to-Pay Estimates

Individual willingness-to-pay (WTP) estimates for all attributes were simulated according to equation (5). In the interest of space, we report the results for shell color and feed type for the full sample and for the attributes associated with management practices in different groupings in table 8. One grouping further explores the impact of the environmental information, and the other groupings examine the WTP values by respondents' perceptions on the quality of products from an animal-friendly environment and the impacts of management practices on hens' welfare.

The top of table 8 presents statistics for individual-specific WTPs for shell color; feed types (organic and vegetarian) are reported for the entire sample. We found that the average WTP for brown eggs over white was negative (18 cents per dozen), with 29% of respondents willing to pay a premium. This result is different from some previous studies; for example, Fearne and Lavelle (1996) reported that UK consumers preferred brown eggs to white ones, and Chang, Lusk, and Norwood (2010) found that consumers were willing to pay an extra $0.73 for brown eggs. One explanation for the differing results may be that more consumers have realized that color differences are due to breed differences and do not represent higher nutrition or better quality. This fact was stated for respondents before choice experiments. Additionally, because brown shells are commonly associated with organic-fed or cage-free eggs in marketing, the premium for brown eggs in earlier studies may have resulted from these attributes. As Chang, Lusk, and Norwood (2010) suggest, analyses using data from retailers may indicate a higher premium for brown eggs than those estimated from our survey responses because they do not control for the organic-fed or cage-free attributes.

Regarding feed type, average respondents were willing to pay a premium of $0.10 for organic-fed eggs and willing to accept a $0.05 discount for vegetarian-fed eggs over conventional eggs. Approximately 72% and 41% of respondents were willing to pay a premium for organic- and vegetarian-fed eggs over conventional eggs, respectively. This result is consistent with previous studies indicating that organic eggs were generally perceived as healthier (Baltzer, 2004; Anderson, 2009). The standard deviations and ranges of the estimated WTPs suggest considerable heterogeneity in preferences on the color and feed type attributes.

The WTP statistics for the welfare-related management practices are first reported by whether the individuals received additional information. Changes in the WTP distribution for outdoor access and lower stocking density were similar between the informed and uninformed groups, suggesting that

Table 8. Statistics of Simulated WTP Distributions

Attributes	Mean	St. Dev.	Max	Min	Prob (< 0)
All sample (N= 924)					
Color	−0.18	0.33	0.76	−1.26	0.71
Organic	0.10	0.20	0.83	−0.66	0.28
Vegetarian	−0.05	0.33	0.96	−0.96	0.59
Subsamples by information treatment					
Received no additional information (N = 499)					
Access	0.16	0.19	0.76	−0.40	0.19
CageFree	0.51	0.36	1.63	−0.54	0.07
Density	−0.006	0.02	0.05	−0.09	0.57
NoMolting	0.40	0.25	1.17	−0.26	0.06
Received additional information on environmental impacts (N = 475)					
Access	0.25	0.20	0.92	−0.29	0.11
CageFree	0.47	0.35	1.46	−0.53	0.08
Density	0.002	0.02	0.06	−0.07	0.41
NoMolting	0.35	0.25	1.16	−0.34	0.07
Subsamples by quality perceptions of products from an animal-friendly environment					
$PQTY > 3$ (N = 799)					
Access	0.22	0.20	0.92	−0.40	0.14
CageFree	0.51	0.36	1.63	−0.54	0.07
Density	−0.003	0.02	0.05	−0.09	0.50
NoMolting	0.37	0.25	1.17	−0.34	0.07
$PQTY \leq 3$ (N = 125)					
Access	0.14	0.19	0.69	−0.30	0.19
CageFree	0.40	0.33	1.39	−0.33	0.06
Density	0.004	0.02	0.06	−0.06	0.40
NoMolting	0.38	0.24	0.96	−0.28	0.03
Subsamples by impacts of management practices on hens' welfare					
$PMNT > 3$ (N = 587)					
Access	0.20	0.20	0.92	−0.40	0.15
CageFree	0.52	0.37	1.63	−0.54	0.07
Density	−0.008	0.02	0.05	−0.09	0.59
NoMolting	0.45	0.23	1.17	−0.21	0.02
$PMNT \leq 3$ (N = 337)					
Access	0.21	0.19	0.69	−0.29	0.14
CageFree	0.44	0.32	1.41	−0.35	0.08
Density	0.009	0.02	0.06	−0.08	0.31
NoMolting	0.24	0.22	0.88	−0.34	0.13

Notes: The *PQTY* factor is measured on a five-point scale, with higher values indicating more favorable perceptions. The *PMNT* factor is measured on a five-point scale, with higher values indicating more negative perceptions of these management practices.

environmental concerns could boost respondents' WTP for providing outdoor access or additional space for hens. Among those who received additional information, 89% (59%) of respondents were willing to pay a premium for eggs from hens given outdoor access (more space), with a mean premium of \$0.25. In the subsample that did not receive the additional information, the mean premium for outdoor access (more space) was lower, at \$0.16, with 81% (43%) of those willing to pay a premium. The average WTPs for lower stocking density were small in magnitude but were positive for the informed group and negative for the uninformed group. Irrespective of the

information effect, the highest amount an individual was willing to pay for eggs from hens given 138 square inches each compared to the basic UEP standards of 67 square inches per bird was about \$0.35 to \$0.42 and another \$0.40 to \$0.48 for further lowering the density to provide 1.5 square feet per bird.

Information on the environmental consequences apparently shifted the WTP distributions for these attributes to the right because there was little change in standard deviation and range between the two groups. We tested the similarities in demographics between the two groups and the similarities in attitudes toward animal welfare using the *PQTY* and *PMNT* factors. The t-tests showed no significant differences in *PQTY* and *PMNT* between the two groups ($p < 0.0001$ for both). Thus, we confidently attribute the shift to the information effect.

Few differences in WTP for the cage-free attribute are noted between the two subsamples, except that average WTP was slightly higher among the uninformed group (\$0.50 versus \$0.47). Regardless of receiving whether they received the additional information, about 93% of respondents were willing to pay a premium for cage-free eggs. This result is supported by other studies that found the majority of consumers preferred cage-free eggs over conventional eggs (Fearne and Lavelle, 1996; Norwood and Lusk, 2011). Moreover, the average premium for cage-free was the highest among the attributes considered, which reflects consumers' familiarity with cage-free eggs. In our sample, nearly 70% of respondents stated that they were somewhat or very familiar with the cage-free label; the American Egg Board reported in 2010 that only about 30% of consumers were familiar with this attribute (American Egg Board, 2010). Perhaps the familiarity contributed to a preconceived valuation of the attribute, thus yielding a negligible information effect. More than 95% of respondents were willing to pay a premium for eggs from hens that were not forced into molting. The only notable effect of information on the WTP was a decrease in average WTP from \$0.40 among the uninformed to \$0.35 among the informed. This result is slightly surprising because the environmental statement did not directly pertain to molting practices.

The bottom half of table 8 reports WTP statistics by respondents with favorable perceptions of animal-friendly products ($PQTY > 3$) and their counterparts ($PQTY \leq 3$) as well as by respondents who perceive that common management practices would reduce animal welfare ($PMNT > 3$) and those who do not ($PMNT \leq 3$). Although the differences in means between the subsamples are not statistically significant, several trends emerge from the results.

How people perceive the quality of animal welfare-friendly products seems to systematically influence their valuations of egg attributes associated with management practices. In particular, those who have higher opinions of animal welfare-friendly products were willing to pay more than their counterparts to give hens outdoor access and not keep them in battery cages but less for additional space per bird. Among the former group, more respondents were willing to pay a premium for outdoor access (86% versus 81%) and fewer respondents were will to pay a premium for additional stocking space (50% versus 60%).

Regarding induced molting, few differences are seen in the WTP distributions because of perceived differences in product quality, but the difference in the average WTP between those who perceived the harm to animal welfare from common management practices and their counterparts was notable. Specifically, those who believed that common management practices had negative impacts on hens' welfare ($PMNT > 3$) were willing to pay an average \$0.45 per dozen for eggs from hens that were not subjected to induced molting compared with \$0.24 among those who were not as concerned. The percentage of respondents willing to pay a positive premium was 98% among the concerned compared with 87% among those not as concerned. The perceived impacts of management practices had minimal effects on the WTP distributions for hens with outdoor access and cage-free hens, although the average WTP for cage-free hens was \$0.06 per dozen lower among those not as concerned. Those with negative perceptions of management practices were willing to pay less on average for additional space for each hen, which is slightly counterintuitive. Consumers may not value space as much as the other, more tangible attributes. Alternatively, concerned

consumers also may be sufficiently informed to know that hens prefer to flock together; that is, small space will not hurt them as long as they are let out of cages and/or granted outdoor access.

Conclusion

This study examined consumer attitudes and preferences regarding farm-animal welfare in the case of laying hens. Among factors affecting hens' welfare, consumers were divided on the importance of the basic needs of "receiving fresh and clean food and water" and the need to have animals "raised in ways to keep lower costs" than toward other factors that could be considered as enhancing laying hens' welfare. Food cost remains one of the most important factors for over a third of the respondents, suggesting that providing eggs at a low price is critical for producers.

However, the majority of respondents (63.5%) perceived that conventional layer management practices, including housing hens in cages, beak trimming, and induced molting, worsen hens' welfare. A greater majority (86%) had favorable impressions about the quality of foods produced in animal-friendly environment. Indeed, our analysis found that over 85% of respondents were willing to pay a premium to improve hens' welfare attributes, including outdoor access, cage-free housing, and noninduced molting. Of the attributes considered, the cage-free attribute was preferred, with the highest average premium of $0.49 per dozen, which exceeded the estimated increase in cost of $0.40 per dozen from caged systems to cage-free systems (Sumner et al., 2010) and indicated a potentially profitable opportunity for producers to switch. If the other management practices (i.e., providing outdoor access or relying only on natural molting) are not as costly as the estimated premia, producers could be better off if they incorporate these practices. Suitably designed educational campaigns could encourage consumers to seek out products from animal welfare-friendly practices and provide incentives for producers to take advantage of such demand. Consumers were also willing to pay $0.10 per dozen extra for organic-fed eggs relative to conventional eggs. Although organic eggs account for a relatively small share of the market, our results indicate that respondents clearly preferred them and were willing to pay extra for these eggs.

The estimated impact of additional information on the environmental aspect of layer management practices suggests that environmental impact is an issue that consumers would consider when purchasing animal-based food. When provided with the information that different housing systems could cause environmental problems, the distributions of willingness-to-pay for providing outdoor access and more space to hens shifted in a positive direction. Consumer preferences will likely evolve as scientists publish more definitive findings on the environmental costs associated with different management practices. As of now, consumers' valuations of welfare-related attributes likely trump their concerns for any environmental consequences.

Designing a management system that maximizes farm-animal welfare is complex. Although the cage-free system has some negative implications for hens' welfare and the caged system has some managerial advantages, consumer preferences for cage-free eggs appear to be strong and irreversible for the near future. Our value estimates are subject to potential hypothetical bias inherent in the stated preference methods but are consistent with respondents' attitudes toward animal welfare. Our model also did not account for other factors that may systematically impact egg preferences, including ethnicity. For example, our sample underrepresented Hispanic respondents (4.9% compared to 16.9% in the U.S. population). Further research is needed to quantify any WTP differentials across ethnic groups. As various regulations are legislated and debated at the state level, our findings suggest that consumer preferences for hens' welfare would have an impact on intrastate flow of eggs. Such an impact could be large if many consumers value animal welfare concerns over consuming locally produced foods.

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Appendix A: Additional Statement that Appeared in Version Two of Survey Instrument

Housing Systems and Environmental Impacts

Cage-free systems and other housing systems that allow for outdoor access in egg production provide hens with more freedom to move. Lower stocking density (i.e., fewer birds per unit of space) allows hens to exhibit their natural behaviors. Some scientific studies have found that these systems generally contribute to poorer air quality with higher emission levels of ammonia and dust than conventional housing systems. Moreover, these systems require more feed and energy to maintain optimal temperatures. Thus, cage-free and other housing systems that allow for outdoor access likely contribute to larger environmental footprints with greater resource utilization. At the same time, some other studies indicate that traditional housing systems with higher stocking density generate higher levels of environmental degradation, particularly pertaining to waste-related pollution.