Effect of Advocacy Information on Consumer Preferences for Cage Free Eggs: A Neuroeconomic Analysis

Brandon R. McFadden, Jayson L. Lusk, John M. Crespi,
J. Bradley C. Cherry, Laura E. Martin, and Amanda S. Bruce

Corresponding author: Brandon R. McFadden
Department of Agricultural Economics
Oklahoma State University
Stillwater, OK 74078-6026
Tel: (405) 744-9812
Email: brandon.mcfadden@okstate.edu

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Brandon R. McFadden is a PhD student and Jayson L. Lusk is a professor and Willard Sparks Endowed Chair, both in the Department of Agricultural Economics, Oklahoma State University. John M. Crespi is a professor in the Department of Agricultural Economics, Kansas State University. Laura E. Martin is the Associate Director of fMRI at the Hoglund Brain Imaging Center, University of Kansas Medical Center. J. Bradley C. Cherry is a research associate and Amanda S. Bruce is an assistant professor, both in the Department of Psychology, University of Missouri-Kansas City.

1. Introduction

Consumer concerns about farm animal welfare have increased in recent decades, leading to retailers offering "animal friendly" varieties and to policies banning certain agricultural production practices. The European Union passed legislation in 1999 to establish minimum standards for the protection of laying hens. A key component of the legislation was to phase out battery cage confinement systems; a policy that went into effect in 2012. In the U.S., Californians passed a state-wide ballot initiative, the Prevention of Farm Animal Cruelty Act, in 2008 that established minimum space requirements for laying hens.

Despite the passage of such laws, it remains unclear exactly what consumers know about egg production practices. It remains just as unclear how consumers' behavior might change in response to information about those practices. Norwood and Lusk (2011), for example, report that consumers believe a much higher share of eggs are produced in cage free systems than actually are. Lusk (2010) also showed that media surrounding the aforementioned California ballot initiative led to an increase in demand for organic and cage free eggs; a phenomenon likely related to the fact that consumers are relatively unknowledgeable of the issue and are responding to social cues.

Understanding how consumers respond to information about animal production systems is important both for animal activist groups and for agricultural producers alike. This is particularly true as information conveyed over platforms such as YouTube both decrease the cost of communication and increase the speed at which interested parties can communicate with the public. Video, taken by a device as readily available as a cell phone, can be uploaded to the Internet and viewed in seconds. Undercover videos released by animal activists documenting poor treatment of some farm animals are routinely made available, and are often quite effective in provoking change. For example, videos showing laying hens in battery cages living in extremely poor conditions. However, all video information regarding caged egg production is not necessarily negative. *Feedstuffs* – a news provider for agribusiness – produced a video that displays images of a sanitary caged egg production system and highlights the advantages of a caged egg production system. The extents to which these videos serve as new information or an echo chamber are largely unknown. Tonsor and Wolf (2011) studied the effects of positive and negative depictions of U.S. milk production through video information. They concluded that consumer perceptions were sensitive to video information but stated preferences for milk attributes were unchanged.

The emerging field of neuroeconomics, which integrates the findings of economics, psychology, and neuroscience, can provide unique insights into consumer responses. Consumers face complex, conflicting, and incomplete information related to the treatment and quality of care given to hens for egg production. Previous research has addressed this challenge by using experimental methods to determine consumers' willingness to pay (WTP) for hen welfare, and how WTP changes with information, but thus far little is known about *why* some people respond differently than others or what factors motivate consumer choices. Neuroeconomics can help researchers peer into the "black box" to better understand the decision-making process and the determinants of food choice.

The purpose of this research is to enhance understanding of consumers' perceptions of farm animal welfare by capitalizing on recent developments in economics and neuroscience. Specifically, this research seeks to determine: 1) consumers' preferences for hens and eggs in free-range and cage production systems; 2) how information from online videos influences WTP; 3) the relationship between the responsiveness of consumers' WTP to video information and neural activity in response to controversial food technologies.

The results presented in this paper are preliminary, and describe outcomes witnessed in the initial state of a larger project. Collecting functional magnetic resonance imaging (fMRI) data is costly and time intensive. The ultimate goal of the project is to collect fMRI data from approximately 100 subjects. This paper relies on only the first 29 observations collected, and the fMRI data. Moreover, we note that the fMRI data collected to date has not been in relation to animal welfare issues *per se* but rather to other controversial food technologies (cloning and artificial growth hormones). While the relationship between animal welfare and controversial food technology may appear indirect, both are animal production issues. Therefore, these issues may be viewed by consumers as departures from what is "natural," therefore having a negative connotation towards the industrialization of the agricultural sector.

2. Methods

2.1 Study Design

Participants underwent fMRI scanning. During the scanning session, participants viewed images of a jug of milk labeled with a controversial attribute (either cloning or use of growth hormones), a price attribute, both attributes, or a Gaussian-blurred low-level baseline image. See Figure 1 for an example of what participants viewed while in the fMRI. At the time of electronic submission, 29 participants had viewed images of a gallon of milk with cloning being the controversial food technology. The relevant variable from the fMRI scan is the percent signal change in blood flow to regions of interest as a result of viewing milk with price, technology, or combined. Our *a priori* regions of interest (ROIs) included the prefrontal cortex, anterior cingulate, insula, and striatum. Percent signal change was calculated from price versus technology, and price versus combination contrasts and values were then imported into SAS® for use in this analysis. More details on the fMRI scan are provided in the appendix.

Upon completion of the fMRI scan, participants were seated at a computer on which they answered a series of questions. Each survey was coded so that fMRI scan data from a participant could be matched with his/her survey data. The survey was developed to elicit preferences for free-range and caged egg production methods. This was accomplished by eliciting participants' WTP for a dozen eggs from the two production methods, and asking hypothetical WTP questions related to moving hens between the two production methods. After participants answered the WTP questions, they viewed one of three short videos and immediately answered the same WTP questions. A change in any of the WTPs after viewing a video can be interpreted as the impact of the video on a consumer's preference.

2.1.1. Egg Production WTP

Participants' WTPs for a dozen free-range and caged eggs were measured both by contingent valuation open-ended questions and a conjoint analysis where participants ranked profiles of eggs described by different attributes. The egg attributes in the conjoint analysis included price ($1.00 or $2.50), production method (free-range or caged), size (small or large), and color (white or brown). An orthogonal main effects design was used to create 8 egg options which individuals ranked from most to least preferred. The open-ended question asked, "How much are you willing to pay for a dozen eggs from a free-range chicken?" and, "How much are you willing to pay for a dozen eggs from a caged chicken?" We expected the average participant's WTP to be greater for a dozen eggs from a free-range chicken and this is referred to as the premium for free-range eggs. After answering the open-ended questions and ranking the egg attribute profiles, participants viewed one of the three videos. Participants then immediately answered the open-ended question and ranked the egg attribute profiles.

2.1.2 Hen Welfare WTP

Similar to the questions for egg production methods, participants were asked open-ended questions to elicit WTP for hen welfare. A difference is that the participants were asked not how much they were willing to pay for eggs but rather how much they were willing to pay to move the hen from one system to another. For example, participants were shown a picture of a caged chicken and asked, "How much are you willing to get this chicken out of the cage?" and then shown a picture of a free-range chicken and asked, "How much are you willing to pay to keep this chicken free-range?" These questions were also asked before and after the video to ascertain the impact of the video images. We expected the average participant's WTP to be greater to get the chicken out of the cage.

2.1.3 Video Treatments

Participants were shown one of three videos. The three videos are referred to as "Free-Range (Idealistic)", "Caged (Animal Activist)", and "Caged (Industry)". All videos were retrieved from YouTube.com for the purpose of measuring the impact of videos that are readily available to anyone with Internet access. For an idea of how viewed these video are, at the time of submission the Free-Range (Idealistic) video had 185,269 views, the Caged (Animal Activist) video had 41,816 views, and the Caged (Industry) video had 27,242 views. The web addresses for the videos can be found in the references.

The Free-Range (Idealistic) video displays what can be considered the ideal free-range egg production scenario. The video runtime is two minutes and forty-five seconds. The chickens roam a fenced area and have more than enough room to exhibit natural behavior. There is a raised house in the fenced area for shelter. There is no narration and the video production resembles a home-made video without professional editing.

The Caged (Animal Activist) video is an undercover video displaying a caged production system in extremely poor condition. The video runtime is two minutes and thirty-seven seconds. Multiple chickens are in each cage and there is not enough room to exhibit natural behaviors such as dust bathing. The cages are covered with feces and the hens have patches with missing feathers and some of the hens looked diseased. The video ends with what appears to be an

undercover individual exhuming a nearly dead hen out of a pile of hen carcasses and feces. There is some narration at the end and the video production resembles a semi-professional video with a few edits.

The Caged (Industry) video is produced by *Feedstuffs* and displays what can be considered the ideal caged egg production system. The video runtime is three minutes and thirty-seven seconds. There are multiple chickens in each cage, however, the chickens are not as crowded as in the Caged (Animal Activist) video. The cages are clean and the chickens appear healthy. An interviewer asks questions to an egg producer, therefore there is commentary throughout the video. The commentary is educational information about the benefits of a caged egg production system – the educational information includes the benefits of increased hen welfare (e.g. protection from predators) and decreased cost to consumers. The video production is professional and edited.

2.2 Subjects

A diverse sample of healthy adult participants were recruited from the Kansas City metropolitan area using local advertisements including university broadcast emails. Interested participants underwent a brief phone screen to determine eligibility for the study. Based on the participant's responses to questions and their agreement or lack of agreement with the inclusion/exclusion criteria, potential participants were scheduled to meet with project personnel at which time the study was fully explained, questions answered, and informed consent was obtained. Scanning took place at the Hoglund Brain Imaging Center, part of the University of Kansas Medical Center.

A quota-based recruitment method was used to ensure that the final sample is matched on demographic variables such as gender, age, education, race, and ethnicity. All participants were matched on handedness (right-handed), a standard requirement of functional neuroimaging studies. Inclusion criteria also include English-speaking adults between the ages of 18-55. Exclusion criteria included current psychotropic medication use, current substance dependence, and participant report of diagnosis of severe psychopathology (e.g. schizophrenia). Summary statistics for the survey participants in the three video treatments can be found in Table 1. There were ten observations in the Free-Range (Idealistic) and Caged (Animal Activist) treatments and nine observations in the Caged (Industry) treatment.

Beyond the summary statistics for the participants, Table 1 includes a measure of participants' perceptions of the accuracy of each video. After the participants viewed the assigned video treatment, they were asked how representative the production system displayed in the video is of the typical production system on a scale of one to five. Answers were coded so that the closer the score is to one, the more believable the participants found the video information.

2.3. Data Analysis Methods

2.3.1 Contingent Valuation Open-Ended WTP

Treatment WTP means were calculated for the open-ended questions. To test the hypothesis that mean WTP responses are the same before and after the video treatments, parametric *t*-tests and nonparametric Wilcoxon signed-rank tests were conducted using PROC UNIVARIATE in SAS®.

2.3.2 Conjoint Analysis

WTP for egg attributes were elicited by asking participants to ranked egg attribute profiles. Rather than estimating the model in "preference space" we estimate the model in "willingness-to-pay" space so that the coefficients obtained can be discussed in dollar terms.

The utility of egg option *j* in video treatment *t*, and information condition *v* is:

$$U_{jtv} = \beta_{1tv} * \alpha_{1tv} + \beta_{1tv} P_j + \beta_{1tv} * \beta_{2tv} FR_j + \beta_{1tv} * \beta_{3tv} LG_j + \beta_{1tv} * \beta_{4tv} W_j$$

where P_j is price of egg option *j*, FR_j equals one if the production method of option *j* was free-range, LG_j equals one if egg size was large, and W_j equals one if the egg color was white. When estimating utility in WTP space, the coefficients of the variables are directly interpretable as the WTP for that attribute over the attribute not used in estimation. For example, β_{2tv} is the WTP for free-range eggs compared to caged eggs, or the premium for free-range eggs. Likewise, β_{3tv} and β_{4tv} are the premia for large eggs and white eggs, respectively. The model was estimated using non-linear least squares using PROC MODEL in SAS®, in which the ranking of the product profile was taken as a proxy for the utility of the option.

Once the utility equations were estimated for a video treatment, the hypothesis that the premia for free-range eggs were the same before and after video information was tested. Wald tests were calculated to test if the coefficients were statistically different using the TEST statement in PROC MODEL.

2.3.3 fMRI Neuroeconomic Analysis

To examine if consumers who are responsive to controversial food attributes are also responsive to animal welfare and video information, the fMRI functional scan data was combined with the survey data. Data from the fMRI functional scan are converted into variables measuring the percent signal change, an indicator of how a particular region in the brain responds to a particular stimuli contrast (price label vs. controversial technology label). Table 2 defines the five percent signal change fMRI variables and shows some descriptive statistics. The first two variables reflect significantly greater brain activation when a participant is looking at price label relative to a controversial technology label. Regions measured were the right insula and right dorsolateral prefrontal cortex; let *RI* and *RC* denote the percent signal change for these variables. Figure 2 illustrates greater activation in the right dorsolateral prefrontal cortex to price vs. technology. The next three variables reflect significantly greater brain activation when a participant is viewing a price label relative to viewing both price and a controversial technology simultaneously. *A priori* regions measured were the right superior frontal gyrus, left medial frontal gyrus, and left anterior cingulate; let *RG*, *LG*, and *LC* denote the percent signal change for these variables. The survey data are not separated by video treatment for this analysis. If

consumers are responsive to video information, the change in the premium for free-range eggs from the contingent valuation open-ended questions should indicate responsiveness; let *PC* denote the change in premium for free-range eggs after viewing video information. Association between brain activation and responsiveness to video information was measured by estimating a linear regression model. The estimated model can be expressed by:

$$PC_i = \gamma + \delta_1 FV_i + \delta_2 FV_i * RI_i + \delta_3 FV_i * RC_i + \delta_4 FV_i * RG_i + \delta_5 FV_i * LG_i + \delta_5 FV_i * LC_i \\ + \theta_1 CV_i + \theta_2 CV_i * RI_i + \theta_3 CV_i * RC_i + \theta_4 CV_i * RG_i + \theta_5 CV_i * LG_i + \theta_5 CV_i * LC_i + \varepsilon_i$$

where *FV* equals one when the Free-Range (Idealistic) video has been viewed, *CV* equals one when the Caged (Animal Welfare) video has been viewed, and ε_i is a normal iid error term. The model was estimated in SAS® using PROC REG.

3. Results

3.1 Egg WTP Results

Means and standard deviations from the open-ended WTP questions are reported in Table 3. As expected, before the video information, mean WTP was greater for a dozen free-range eggs than a dozen caged eggs. The mean premia for a dozen free-range eggs were $1.17 for the Free-Range (Idealistic) treatment, $0.34 for the Caged (Animal Activist) treatment, and $0.64 for the Caged (Industry) treatment. After participants viewed the Free-Range (Idealistic) and Caged (Industry) videos, the mean premia for a dozen free-range eggs increased to $1.61 and $0.66, respectively. However, after viewing the Caged (Animal Activist) video, the mean premium for a dozen free-range eggs decreased to -$0.36. This is unexpected, and is due to one participant increasing WTP for caged eggs to $9.16 after viewing the video.

The WTP values derived from the conjoint analysis are reported in Table 4. Similar to the open-ended questions, there is a positive premium for free-range eggs before the video information. The estimated premia for a dozen free-range eggs were $1.62 for the Free-Range (Idealistic) treatment, $0.47 for the Caged (Animal Activist) treatment, and $0.44 for the Caged (Industry) treatment. Not observable from the open-ended questions, participants in the Caged (Animal Activist) and Caged (Industry) treatments placed a higher value on egg size than the method of production, $1.75 and $0.85, respectively. Participants in the Caged (Animal Rights) treatment placed the same value on egg color and production method, however, the premium for white eggs variable is not significant after video information for all video treatments. The Premium for free-range eggs decreased to $0.34 after video information for the Caged (Industry) treatment; which is intuitive as the information highlights the benefits of a caged production system.

The changes in WTP for eggs due to video impact are reported in Table 5. Video information had no statistical impact at an alpha level of 0.05 on WTP elicited using the open-ended questions. The change in the WTP for a dozen free-range eggs in the Free-Range (Idealistic) treatment was $0.44 and the only change in WTP for any of the treatments with a p-value below 0.10. After participants viewed the Caged (Animal Activist) video, the mean premium for free-range eggs decreased by $0.70 for the open-ended WTP question. However,

change in the premium for free-range eggs from the conjoint analysis for the Caged (Animal Activist) treatment was $0.87 and significant. The Caged (Industry) video information had the smallest changes in the WTP values for all measurements.

3.2 Hen Welfare WTP Results

Table 6 shows that WTP to keep a chicken free-range was greater than to get a chicken out of a cage for all treatments, both before and after the videos. This was not expected. At the outset of the study, the hypothesis was that WTP to get a chicken out of the cage would be greater. The intuition was that participants would feel more sympathetic towards the chicken in the cage, and therefore be willing to pay more for the chicken in the cage. It may be that participants did not want to be responsible for putting a chicken in a cage; however, participants did not feel responsible for the welfare of a chicken that was already in a cage. Alternatively, participants may be more motivated to avoid a loss (freedom of the free-range hen) than a gain (freedom of the caged hen); which concurs with prospect theory.

The changes in WTP for hen welfare due to videos are reported in Table 7. The Free-Range (Idealistic) video increased WTP to get a chicken out of the cage by $0.41, which was significant at the p-value 0.10 level. This indicates that viewing a free-range production system may move consumers to become more sympathetic towards caged chickens. Viewing hens in poor conditions had an impact on participants WTP for hen welfare. Parametric *t*-tests for both changes in WTP for the Caged (Animal Rights) treatment have p-values below 0.10, and the Wilcoxon signed-rank tests p-values are below 0.05. Interestingly, both values increased by $1.40. Thus, viewing poor treatment of hens may cause consumers to become more sympathetic to hen welfare in general. The Caged (Industry) video had a larger effect on WTP for hen welfare than for a dozen eggs, however, the WTP had large variances, so neither of the changes of WTP for hen welfare were significant.

3.3 fMRI Neuroeconomic Results

The linear regression results relating the fMRI data and the WTP data are in Table 8. There is little statistical significance, which may be due to the small sample size (N=29); or there simply may not be not a strong association between brain activation and responsiveness to video information. The parameter *CV* - indicating a participant viewed the Caged (Animal Activist) Video - is significant, however, the coefficient is not directly interpretable due to the interaction terms. This confirms the conjoint analysis result, where the WTP premium for free-range eggs over cage eggs significantly increased after viewing the video activist video.

Two of the fMRI interactions with the Caged (Animal Activist) treatment were also significant. The first significant interaction is right dorsolateral prefrontal cortex percent signals change (*CV*RC*) - where there was significantly greater brain activation when looking at price relative to a controversial technology. The dorsolateral prefrontal cortex which is known to be involved in deliberate thought and decision-making. Thus, participants who demonstrate greater brain activation in this region of the prefrontal cortex may be more responsive to new information presented to them. The other significant interaction is left medial frontal gyrus percent signals change (*CV*LG*) - where there was significantly greater brain activation when

viewing a price label relative to viewing both price and a controversial technology simultaneously. The left medial frontal gyrus is in an area of the brain involved in cognitive control, inhibition, and self-discipline. This may indicate that participants who demonstrate greater cognitive restraint are still more likely to increase their willingness to pay for free-range eggs

4. Conclusions

We found video information can impact consumers' WTP for free-range vs. caged eggs, and may cause consumers to become more sympathetic to hen welfare despite our small sample size. However, not all videos had the same impact. The Free-Range (Idealistic) and Caged (Animal Activist) treatments both significantly increased WTP for free-range eggs and hen welfare. Willingness to pay for a dozen free-range eggs increased by $0.89 in the open-ended question for the Free-Range (Idealistic) treatment, and by $0.87 in the conjoint analysis for the Caged (Animal Activist) treatment. Willingness to pay to keep a hen free-range increased by $1.40 in the Caged (Animal Activist) treatment, and WTP to get a hen out of a cage increased by $0.41 and $1.40 for the Free-Range (Idealistic) and Caged (Animal Activist) treatments, respectively. These findings are interesting because they demonstrate two different types of information can affect consumers WTP. The Free-Range (Idealistic) video simply displays a free-range farm; there is not a positive or negative slant in how the video information is presented. Even though these two videos likely were produced with separate intentions, the end results were similar. Therefore, if free-range producers were to produce a video to increase consumer WTP, videos displaying a free-range production system or a caged production system in poor conditions will likely increase consumer WTP. Combining both sources of video information may be even more effective.

The Caged (Industry) video had no effect on participants WTP for any of the measurements. This may be due to participants not believing the information in the video. Respondents indicated their belief that the Caged (Industry) video was believed to be the least accurate at depicting actual hen living conditions of the three types of videos. It may be that the participants are naturally skeptical of industry information, or the professional quality and editing of the video may actually discredit its sincerity.

At this point, results from the neuroeconomic analysis may raise more questions than it answered. However, there is a possible relationship between brain responses to controversial food technologies and a person's reaction to new information about hen welfare. The survey and fMRI results may be more easily interpreted when the fMRI paradigm includes stimuli of eggs instead of milk. However, initial results indicate that the fMRI paradigm is both reasonable and feasible. As a parting reminder, these results are very preliminary and should be interpreted accordingly.

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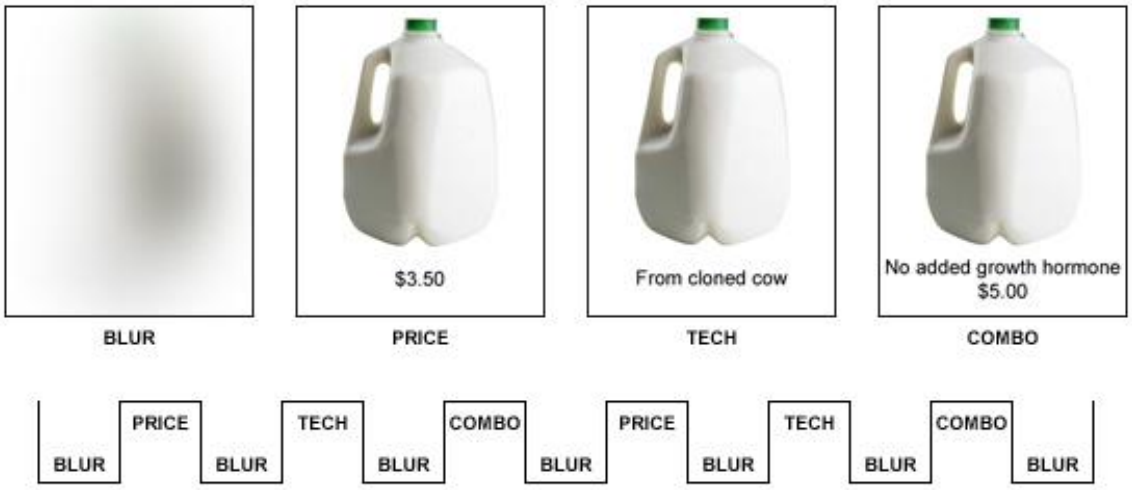

Figure 1. fMRI Paradigm

Figure 2. Dorsolateral prefrontal cortex (Price > technology)

Table 1. Summary Statistics for the Three Video Treatments

Variable	Definition	Free-Range (Idealistic)	Caged (Animal Activist)	Caged (Industry)
Age	Age in years	32.50[a]	30.70	31.30
		(10.08)[b]	(11.72)	(10.30)
Education	1 if obtained a Bachelor's Degree or higher; 0 otherwise	0.60	0.40	0.80
		(0.52)	(0.52)	(0.42)
Female	2 if female; 0 otherwise	0.60	0.60	0.40
		(0.52)	(0.52)	(0.52)
Income	Household income ($1,000)	42.00[c]	50.00	36.00
		(32.93)	(40.00)	(23.19)
Validity	Scale of how valid the conditions in the video are for the typical	2.00	2.70	3.11
	production system shown (1=”Strongly Agree” to 5=”Strongly Disagree”)	(0.82)	(1.06)	(1.45)
		n = 10	*n* = 10	*n* = 9

[a] Sample means for video treatment
[b] Standard deviations of sample means are in parentheses
[c] Sample mean of income categorical mid-points

Table 2. Brain Activation (Percent Signal change) Variable Definitions and Descriptive Statistics

Variable	Brain Region	Function	Mean % Change	Min, Max % Change	Interpretation
Price vs. Technology					
RI	Right Insula	Self-monitoring, emotions (e.g. disgust); taste-processing	.0503%	-.09% , .19%	Right insula showed increased activation to price labels compared to cloning/growth hormone labels
RC	Right Middle Prefrontal Cortex	Decision-making Cognitive/self-control	.0583%	-.09% , .22%	Right mPFC showed increased activation to price labels compared to cloning/growth hormone labels
Price vs. Combination of Price and Technology					
RG	Right Superior Prefrontal Cortex	Decision-making Cognitive/self-control	.0666%	-.05% , .36%	Right PFC showed increased activation to price labels compared to combination labels
LG	Left Medial Prefrontal Cortex	Cognitive control, self-monitoring, self-discipline	.1197%	-.15% , 1.11%	Left mPFC showed increased activation to price labels compared to combination labels
LC	Left Anterior Cingulate	Decision making, choices, and reward anticipation	.0414%	-.22% , .37%	Left ACC showed increased activation to price labels compared to combination labels

Table 3. Contingent Valuation Willingness to Pay for Eggs both Before and After Video Information

WTP Parameters Before Video Information	Contingent Valuation Open-Ended WTP: Free-Range (Idealistic)	Caged (Animal Activist)	Caged (Industry)
Free-Range Eggs	2.53[a]	2.42	2.89
	(1.38)[b]	(0.73)	(1.55)
Caged Eggs	1.36	2.08	2.25
	(0.81)	(0.45)	(0.97)
Premium for Free-Range Eggs	1.17	0.34	0.64
	(1.70)	(0.79)	(1.44)
WTP Parameters After Video Information			
Free-Range Eggs	3.41	2.59	2.90
	(1.47)	(0.47)	(1.85)
Caged Eggs	1.81	2.95	2.24
	(0.74)	(2.29)	(0.96)
Premium for Free-Range Eggs	1.61	-0.36	0.66
	(1.60)	(2.38)	(1.76)

[a] Sample mean WTPs for video treatment ($/dozen)
[b] Standard deviations of sample means WTPs are in parentheses

Table 4. Conjoint Analysis Willingness to Pay for Eggs both Before and After Video Information

	Conjoint Analysis WTP		
WTP Parameters Before Video Information	Free-Range (Idealistic)	Caged (Animal Activist)	Caged (Industry)
Premium for Free-Range Eggs	1.62***	0.47**	0.44***
	[0.45][b]	[0.19]	[0.11]
Premium for Large Eggs	1.22***	1.75***	0.85***
	[0.39]	[0.28]	[0.13]
Premium for White Eggs	0.65*	0.47**	0.17
	[0.33]	[0.19]	[0.11]
WTP Parameters After Video Information			
Premium for Free-Range Eggs	2.27***	1.34***	0.34**
	[0.48]	[0.24]	[0.17]
Premium for Large Eggs	1.09***	1.40***	0.71***
	[0.32]	[0.25]	[0.18]
Premium for White Eggs	0.20	0.19	0.05
	[0.26]	[0.18]	[0.17]

[a] Sample mean WTPs for video treatment ($/dozen)
[b] Standard errors of estimated WTPs are in brackets
* p-Value < 0.10, ** p-Value < 0.05, *** p-Value < 0.01

Table 5. Change in Willingness to Pay for Eggs due to Video Impact

	Contingent Valuation Open-Ended WTP								
Change in WTP Parameters	Free-Range (Idealistic)	*t*-Test[a]	Wilcoxon Signed-Rank Test[b]	Caged (Animal Activist)	*t*-Test	Wilcoxon Signed-Rank Test	Caged (Industry)	*t*-Test	Wilcoxon Signed-Rank Test
Free-Range Eggs	0.89[c]	0.16	0.07	0.16	0.36	0.10	0.01	0.98	1.00
	(1.93)[d]			(0.74)			(1.92)		
Caged Eggs	0.45	0.22	0.44	0.87	0.27	0.30	-0.01	0.69	0.73
	(1.09)			(2.34)			(1.02)		
Premium for Free-Range Eggs	0.44	0.29	0.43	-0.70	0.39	0.67	0.02	0.96	0.81
	(1.90)			(2.47)			(2.16)		

	Conjoint Analysis WTP					
	Free-Range (Idealistic)	*t*-Test	Caged (Animal Rights)	*t*-Test	Caged (Industry)	*t*-Test
Premium for Free-Range Eggs	0.65	0.32	0.87	<0.01	-0.09	0.65
	[0.66][e]		[0.31]		[0.20]	

[a] *p*-Values for a two-tailed *t*-test of H_0: pre-video WTP = post-video WTP

[b] *p*-Values for a two-tailed Wilcoxon signed-rank test of H_0: pre-video WTP = post-video WTP

[c] Sample mean changes in WTPs for video treatment ($/dozen)

[d] Standard deviations of sample mean changes in WTPs are in parentheses for the Contingent Valuation Open-Ended WTP values

[e] Standard errors of changes in estimated WTPs are in brackets for the Conjoint Analysis WTP values

Table 6. Willingness to Pay for Hen Welfare both Before and After Video Information

	Contingent Valuation Open-Ended WTP		
WTP Parameters Before Video Information	Free-Range (Idealistic)	Caged (Animal Activist)	Caged (Industry)
Keep a Chicken Free-Range	5.04[a]	3.19	4.55
	(3.78)[b]	(4.99)	(4.34)
Get a Chicken Out of a Cage	4.70	3.05	4.55
	(3.45)	(4.97)	(4.45)
WTP Parameters After Video Information			
Keep a Chicken Free-Range	5.18	4.59	4.16
	(3.48)	(5.57)	(4.74)
Get a Chicken Out of a Cage	5.10	4.45	4.05
	(3.47)	(5.55)	(4.80)

[a] Sample mean WTPs for video treatment ($/hen)

[b] Standard deviations of sample means WTPs are in parentheses

Table 7. Change in Willingness to Pay for Hen Welfare due to Video Impact

	Contingent Valuation Open-Ended WTP								
Change in WTP Parameters	Free-Range (Idealistic)	*t*-Test[a]	Wilcoxon Signed-Rank Test[b]	Caged (Animal Activist)	*t*-Test	Wilcoxon Signed-Rank Test	Caged (Industry)	*t*-Test	Wilcoxon Signed-Rank Test
Keep a Chicken Free-Range	0.14[c]	0.66	1.00	1.40	0.05	0.02	-0.39	0.55	0.81
	(3.86)[d]			(5.70)			(4.95)		
Get a Chicken Out of a Cage	0.41	0.06	0.06	1.40	0.06	0.02	-0.47	0.56	0.84
	(3.65)			(5.68)			(5.12)		

[a] *p*-Values for a two-tailed *t*-test of H_0: pre-video WTP = post-video WTP

[b] *p*-Values for a two-tailed Wilcoxon signed-rank test of H_0: pre-video WTP = post-video WTP

[c] Sample mean changes in WTPs for video treatment ($/hen)

[d] Standard deviations of sample mean changes in WTPs are in parentheses

Table 8. Neuroeconomic Analysis Results

Parameters	Estimate	Standard Error	*p* -Value
Intercept	0.02	0.53	0.97
FV	-0.17	1.02	0.87
FV*RI	4.65	14.36	0.75
FV*RC	8.45	10.62	0.44
FV*RG	6.15	5.60	0.29
FV*LG	-1.95	2.47	0.44
FV*LC	4.90	5.78	0.41
CV	-5.91	1.83	<0.01
CV*RI	1.00	5.92	0.87
CV*RC	36.39	13.00	0.01
CV*RG	4.25	11.57	0.72
CV*LG	14.18	5.89	0.03
CV*LC	10.18	6.44	0.13

Appendix

A.1 fMRI Data Acquisition and Analysis

A.1.1 fMRI Data Acquisition

Scanning was performed at the University of Kansas Medical Center's Hoglund Brain Imaging Center (HBIC) on a 3-Tesla Siemens Skyra (Siemens, Erlangen, Germany) scanner. Functional scans involved two repetitions of each block of each stimulus type (price labels, technology labels, combined labels), alternated between blocks of blurred images. Stimulus presentation time was 2.5 seconds with an interstimulus interval of 0.5 seconds. The two functional scans consisted of 13 blocks of stimuli presentation. The order of category presentation was counterbalanced across participants. Visual images were back-projected to a screen mounted on the back of the magnet, and participants viewed the images through a mirror on the head coil. Foam cushions were placed around the participants' heads to minimize movement.

A.1.2 fMRI Data Analysis

fMRI data was analyzed using the BrainVoyager QX 2.4 statistical package (Brain Innovation, Maastricht, Netherlands, 2012). Preprocessing steps include trilinear 3D motion correction, sinc-interpolated slice scan time correction, 3D spatial smoothing with 4-mm Gaussian filter, and high pass filter temporal smoothing. Functional images were realigned to the anatomic images obtained within each session and normalized to the BrainVoyager template image, which conforms to the space defined by the Talairach and Tournoux's (1988) stereotaxic atlas. Only one functional run out of 60 was discarded due to motion greater than 3mm along any axis (x, y, or z). Activation maps were analyzed using statistical parametric methods (Friston et al 1995) contained within the BrainVoyager QX software. Statistical contrasts were conducted using multiple regression analysis. Regressors representing the experimental conditions of interest and regressors of non-interest (e.g. head motion) are modeled with a hemodynamic response filter. Next, group analysis is performed by entering data into the multiple-regression analysis using a random-effects model. Contrasts between conditions of interest are assessed with t statistics and ANOVA. Statistical parametric maps are then overlaid on three-dimensional renderings of an averaged-group brain (after stripping the skull).