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FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

The effects of attribute non-attendance, simple validation questions, and their interactions on willingness to pay estimates for meat choice experiments

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Abstract: During an online survey, respondents were randomly assigned to a choice experiment for either pork chops or chicken breasts and were then explicitly asked which attributes they did not consider while making their choices. A simple validation question, which directed respondents to choose a specific answer, was also included. Accounting for either stated or inferred attribute non-attendance alone had no statistically significant effect on willingness-to-Pay (WTP) estimates. Those who passed the validation question had statistically significant and higher WTP for some attributes of pork chops and chicken breasts when the variable was interacted with inferred or stated attribute non-attendance (ANA). While use of a validation question appears promising, more research is needed on this point before it can be concluded that ANA alone has no impact on the WTP estimates for food choice experiments.

Subjects: Agriculture and Food; Consumer Psychology; Microeconomics; Econometrics; Marketing

Keywords: attribute non-attendance; consumer demand; inferred ANA; stated ANA; validation question

1. Introduction

Choice experiments are frequently used in economics and marketing research to ascertain consumer's value for a product or attribute. Choice experiments mimic real world purchasing decisions where the shopper (respondent) has many choices and (often) an option not to buy. Each product offered in a shopping scenario is comprised of various attributes; in choice experiment analysis, it is

ABOUT THE AUTHORS

This paper explores the use of simple validation questions and attribute non-attendance to determine the potential impacts on consumer willingness to pay estimates. This work employing choice experiments and methods related to estimation of willingness to pay is part of a larger effort to explore the potential impacts of various methods on conclusions that impact firm and industry decision making.

PUBLIC INTEREST STATEMENT

Markets, and the consumers and business interacting in them, are changing rapidly to evolve to ever-changing tastes, preferences, and demands. Often various methods, including simulated shopping experiments and surveys, are being employed by various members of the industry to measure what consumer's desire—and—what they are willing to pay for. This work seeks to explore the potential impacts of various alterations to survey techniques on measurements of consumer demand for product attributes in the market.

typically assumed that respondents consider all of the attributes presented to them when making selections. However, when a respondent ignores an attribute, such as price, when he or she chooses between alternatives in a choice experiment it is called attribute non-attendance (ANA) (Hensher & Greene, 2010; Scarpa, Gilbride, Campbell, & Hensher, 2009; Widmar & Ortega, 2014). Failing to account for ANA may have significant impacts on the willingness to pay (WTP) estimates and the resulting policy and marketing decisions made based on those values (Widmar & Ortega, 2014). Furthermore, failing to account for ANA could lead to biased estimates of coefficients and WTP estimates (Hole, Kolstad, & Gyrd-Hansen, 2013). Scarpa et al. (2009) determined failing to account for ANA in a rural landscape valuation scenario resulted in inflated WTP for rural landscape attributes. Likewise, ANA has been investigated for food products in the context of latent class models (Scarpa, Zanoli, Bruschi, & Naspetti, 2012) and random parameters logit (RPL) models (Caputo, Van Loo, Scarpa, Nayga, & Verbeke, 2014; Widmar & Ortega, 2014).

ANA can either be inferred, where the ignored attributes are calculated mathematically, or stated, where respondents are asked directly if they ignored attributes and what those attributes were (Hole et al., 2013). ANA is inferred when the coefficient of variation (the ratio of the standard deviation to the mean) exceeds a pre-determined cutoff point (Hess & Hensher, 2010). The advantage of the inferred approach is that it does not require additional information, which may not have been collected in the initial survey (Hess & Hensher, 2010; Widmar & Ortega, 2014). Widmar and Ortega (2014) found that accounting for inferred ANA led to small changes (both up and down) of coefficient estimates but accounting for inferred ANA did not alter conclusions for milk or pork products in terms of significantly changing the 95% confidence intervals on the WTP values.

Dealing with stated ANA by using a validation question may improve data quality and WTP estimates because the validation question identifies respondents who answer survey questions imprecisely (Gao, House, & Bi, 2012). WTP can be calculated for each sub-sample, those who passed and failed, to determine if those values are statistically different. Gao et al. (2012) found statistically significant differences in WTP estimates for respondents who passed and failed a validation question. Similarly, Cummins, Widmar, Croney, and Fulton (2016) employed a validation question in a study about pork product attributes utilizing best-worst scaling and found that passing the validation question was a statistically significant predictor of preference shares for all seven pork attributes tested (animal welfare, price, food/pork safety, taste, environmental impacts, locally raised/farmed pigs, locally processed pork).

The goals of this article are to provide insight into the relationship between stated and inferred ANA in the context of meat choice experiments and explore the interaction of ANA with passing or failing a simple validation question with the ultimate goal of improving WTP estimates from discrete choice experiments. This article contributes to the literature by directly comparing inferred (mathematically calculated) and stated (via direct questioning) ANA using US food choice experiment data in a random parameters logit (RPL) model and studying the combined effect of stated/inferred ANA and passing/failing a simple validation question. A respondent who indicates that he or she did not attend to an attribute (or attributes) may also be careless survey takers who failed the validation question.

The specific research objectives of this analysis are to (1) determine the impact both stated and inferred ANA have on WTP estimates for animal welfare attributes of chicken breasts and pork chops, and (2) determine the impact of a simple validation question on estimates of WTP for ANA-corrected and uncorrected models. Based on previous literature, it is expected that WTP estimates for stated or inferred ANA corrected models will not be statistically different from uncorrected models or from each other. It is also expected that WTP estimates from ANA and validation question corrected models will yield statistically different WTP estimates than uncorrected models. Thus, it is suspected that whether a respondent took the survey carefully (e.g. passed the validation question) is more important to improving WTP estimates than accounting for inferred or stated ANA in the context of meat choice experiments.

2. Methods

Respondents in the study were shown a discrete choice experiment for either pork chops or chicken breasts. For the pork chop choice experiment, respondents received information about individual crates/stalls (permitted or not permitted),[1] location (local or no claim was made),[2] and antibiotic use (permitted or not permitted).[3] For the chicken breast choice experiment, respondents were shown information about pasture access (required or not required), location (local or no claim), and antibiotic use (permitted for not permitted). For each product, information was provided about whether the certification entity was the USDA Process Verified Program (USDA-PVP), a retailer certification, or an industry (pork or poultry) certification. Respondents were shown three price levels for each product given in dollars per pound. Pork chops were offered at \$2.49/lb., \$3.89/lb., and \$5.29/lb. Chicken breasts were offered at \$1.89/lb., \$3.15/lb., and \$4.41/lb.[4]

To design the choice experiment and determine the choice scenarios shown to respondents, the SAS OPTEX program was used to create the main effects plus two-way interaction experimental to maximize the D-efficiency (86.84) design (Lusk & Norwood, 2005). This design yields 24 choice sets which were divided into three blocks so that respondents were randomly assigned to only one of the blocks of eight choice sets (Tonsor, Schroeder, Fox, & Biere, 2005). Each choice set contained three options consisting of two hypothetical pork chops (or chicken breasts) and an option to opt out or purchase neither pork chop (or chicken breast) offered. A “cheap talk” strategy was utilized to reduce the potential for hypothetical bias by informing respondents of the potential bias before they complete the choice experiment (Lusk, Roosen, & Fox, 2003).

Following the choice experiment blocks, respondents were asked what attributes they did not take account of in their decisions (Hole et al., 2013).[5] Stated ANA data was collected to enable comparison against the results of the inferred ANA method proposed by Hess and Hensher (2010) and employed by Widmar and Ortega (2014). ANA is inferred when the coefficient of variation exceeds a pre-determined cutoff point (Hess & Hensher, 2010). In this case, respondents were considered to have not attended to an attribute when the coefficient of variation exceeded 2, following Hess & Hensher, 2010). The coefficient of variation is calculated from individual-specific parameter estimates to infer which attributes have not been attended to (Hess & Hensher, 2010; Widmar & Ortega, 2014). The model was re-estimated accounting for the attributes that were either stated or inferred to have been non-attended.

A validation question was also included that directed respondents to select a specific answer and respondents were classified as passing if they correctly selected the designated answer (Cummins et al., 2016; Gao et al., 2012). Finally, a standard choice experiment model was modified to account for the effect of passing or failing the validation question on the marginal willingness to pay estimates and WTP estimates were calculated for each sub-sample to determine if they are statistically different.

3. Conceptual framework and empirical model

Choice experiments are designed to replicate real world purchasing decisions where respondents are presented with products with different attributes and asked to select the product they would purchase (or opt not to purchase). Respondents were randomly assigned to complete choice experiments for either pork chops or chicken breasts. Choice experiments are based on random utility theory where utility is composed of a deterministic component V_{nit}, which depends on the attributes of an alternative, and a stochastic component, ε_{nit}, as:

$$U_{nit} = V_{nit} + \varepsilon_{nit} \quad (1)$$

Respondent *n* will choose alternative *i* when $U_{nit} > U_{njt} \; \forall j \neq i$ in choice situation *t* where *i* and *j* are two attributes in the same choice set. Therefore, the probability of respondent *n* choosing alternative *i* can be written as:

$$P_{nit} = Prob\left(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt}; \forall j \in C, \;\; \forall j \neq i\right) \quad (2)$$

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Given the assumed underlying distribution of the error term, the logit choice probability in closed form can be represented by:

$$P_{nit} = \frac{\exp(V_{nit})}{\sum_j \exp(V_{njt})} \tag{3}$$

Previous research has found that consumers display heterogeneous preferences, and the random parameters logit (RPL) model is frequently used to represent this heterogeneity in a random utility framework (Alfnes, 2004; Lusk et al., 2003; Train, 1998; Widmar & Ortega, 2014). To simplify the problem, assume the deterministic portion of utility, V_{nit}, is linear in its parameters. Thus, it be can be written as:

$$V_{it} = \beta_1 x_{it} + \ldots + \beta_k x_{it} \tag{4}$$

where x_{it} is the vector of attributes associated with the *i*th alternative, and the β's are the parameters associated with those attributes. The models are estimated using NLOGIT 5.0.

The basic model of the deterministic portion of utility for pork chops used in this analysis can be expressed as:

$$v_i = \beta_1 Price_i + \beta_2 Crate\_Free_i + \beta_3 Local_i + \beta_4 Antibiotic\_Free_i + \beta_6 Industry_i + \beta_5 USDA_i + \beta_7 OptOut \tag{5}$$

where $Price_i$ is the price of the boneless, center-cut pork chop in the presented choice set and *OptOut* is a constant representing the negative utility of not having the pork chop in the choice set. The coefficients, the β's, on all variables except *Price* and *OptOut* are assumed to vary normally across consumers. To allow for both positive and negative WTP estimates, random parameters are assumed to be drawn from a normal distribution (Lusk et al., 2003; Tonsor et al., 2005). A standard logit model exhibits independence from irrelevant alternatives; random parameters logit models do not. Revelt and Train (1998) identified the possibility for correlated taste parameters to form general patterns. To gain a better understanding these potential correlations, Revelt and Train (1998) suggest constructing a Cholesky matrix Ω. Allow β to be a $k \times 1$ vector of the coefficients on the attributes and η a $(k{-}2) \times 1$ vector of coefficients on random attributes in β. Then specify $\eta \sim N(\bar{\eta}, \Omega)$, the result can be expressed as $\eta = \bar{\eta} + LM$ where L is the lower triangular Cholesky factor such that $LL' = \Omega$. Following Revelt and Train (1998), the M-vector contains independent normal deviates. Estimates of the Cholesky matrix exhibiting statistical significance supports interdependence in tastes and of potential correlations in preferences across attributes in the choice set (Scarpa & Del Giudice, 2004).

This analysis utilizes effects coding (assigning values 0, 1 or −1) to avoid confounding effects of opting out with selecting an option where the attribute is not present (Olynk, Tonsor, & Wolf, 2010; Tonsor, Olynk, & Wolf, 2009). All variables except price and opting out were effects coded. To calculate mean WTP estimates, one must account for the effects coding on the interaction terms as follows:

$$WTP_k = -\left(\frac{2 \times \beta_k}{\beta_1}\right) \tag{6}$$

where β_k is the coefficient of the *k*th attribute and β_1 is the price coefficient. The coefficient, β_k, on the attribute of interest, is multiplied by two to account for the effects coding (Lusk et al., 2003). Confidence intervals were estimated using the Krinsky and Robb method (1986). Hole (2007) found the delta, Fieller, Krinsky and Robb and bootstrapping methods of constructing confidence intervals for WTP estimates produce similar results (Hole, 2007).

3.1. Model adjustments for ANA and validation

The base model is estimated taking into account the attributes that were either stated or inferred to have been non-attended to by respondents. Re-coding non-attended to attributes was accomplished per Greene (2012) and implemented by Widmar and Ortega (2014) where the non-attended attribute is given the "ignored value code" of −888. This code represents a value that is omitted from the data because the individual respondent did not consider (or non-attended to) the attribute (Greene, 2012; Widmar & Ortega, 2014).

Once the various ANA specifications are performed and calculated the base model can be modified to account for the interaction between ANA and passing or failing the validation question. Following their responses to choice experiments tasks, respondents were asked what attributes they did not take account of in their decisions similar to Hole et al. (2013). To account for passing or failing the validation question each of the components except price of v_i and *optout* will be multiplied by a dummy variable, *Validation*, that indicates whether or not the respondent passed or failed the validation question (*Validation* = 1 if passed, *Validation* = 0 if failed). The dummy variable for passing or failing the validation question was interacted with the choice experiment attributes in the same manner as the demographic variables in Olynk et al. (2010) to account for the interaction of different factors with the decision to stop producing milk in a survey of dairy farmers. The deterministic portion of v_i can now be represented as:

$$\begin{aligned} v_i = {} & \beta_1 Price_i + \beta_2 Crate\_Free_i + \beta_3 Local_i + \beta_4 Antibiotic\_Free_i + \beta_5 USDA_i + \beta_6 Industry_i \\ & + \beta_7 OptOut_i + \beta_8 OptOut_i \times Validation + \beta_9 Crate\_Free_i \times Validation + \beta_{10} Local_i \times Validation \\ & + \beta_{11} Antibiotic\ Free_i \times Validation + \beta_{12} USDA_i \times Validation \\ & + \beta_{13} Industry_i \times Validation \end{aligned} \tag{7}$$

The equation to calculate WTP is modified for the new specification. For example, to calculate the WTP for crate free production the equation is:

$$WTP_k = -2\left(\frac{\beta_2 + \beta_9 \times Validation}{\beta_1}\right) \tag{8}$$

where *validation* is equal to 1 if the respondent passed the validation question, 0 if the respondent failed the validation question. This allows separate WTP values to be calculated for those who passed the validation question, those who failed the validation question, and across the entire sample.

Confidence intervals for mean marginal WTP estimates were found using the Krinsky and Robb method (1986).[6] Two methods were used to evaluate whether accounting for passing a validation question and ANA resulted in statistically different results. First, results can be compared by determining if 95% confidence intervals overlap; this method allows for a quick visual inspection (Olynk et al., 2010; Schenker & Gentleman, 2001).[7] Statistical comparisons between the 95% confidence intervals on the WTP results were conducted following the complete combinatorial method proposed by Poe, Giraud, and Loomis (2005). This test is a one sided test of significance to compare two independent empirical distributions (Poe et al., 2005). A total of 1,000 observations were drawn from a multivariate normal distribution which was parameterized using the coefficients and variance estimates from the multinomial logit (MNL) model; simulated coefficients were used to test for differences in the distributions of the WTP estimates.

4. Data

An online survey was used to obtain data regarding respondents' socio-demographic characteristics, concern for animal welfare and food safety, and meat purchasing habits. Internet surveys are a popular means of gathering data because they have lower costs and quicker collection timeframes than traditional surveys (Olsen, 2009; Olynk et al., 2010). Internet survey results have been found not to differ significantly from conventional survey results such as mail or phone surveys (Fleming & Bowden, 2009; Marta-Pedroso, Freitas, & Domingos, 2007). In order to participate in the survey, respondents had to indicate they were 18 years of age or older. A total of 825 respondents completed the survey. Lightspeed-GMI, which specializes in maintaining a large opt-in panel of consumers, was used to recruit and contact survey respondents. The online survey platform Qualtrics was used to administer the survey.

The sample demographics are shown in Table 1. The sample was comprised of 49% male and 51% female respondents. In the US, 85.7% of American over 25 years of age have graduated high school, and 28.5% of respondents have a bachelor's degree or higher (US Census Bureau, 2014). This sample is slightly more educated with 97% of respondents graduating high school and 43% completing at least 4 years of college. A total of 77% of respondents passed the validation question. Previous studies found that 85% Cummins et al. (2016) and 92% Gao et al. (2012) passed the validation question.

Table 1. Respondent demographics

Demographic variable	Percentage (%) of respondents
Male	49
Age	
18–24	13
25–44	34
45–64	34
65+	19
Education	
Did not graduate from high school	3
Graduated from high school, did not attend college	22
Attended college, no degree earned	26
Attended college, associates or trade degree	15
Attended college, bachelor's degree earned	23
Graduate or advanced degree (M.S., PhD., Law school)	10
Annual household pretax income	
Less than $20,000	19
$20,000–$39,999	29
$40,000–$59,999	23
$60,000–$79,999	12
$80,000–$99,999	7
$100,000–$119,999	3
$120,000 or more	6
Region	
Northeast	17
South	33
Midwest	27
West	23
Passed validation question	77

5. Results and discussion

Table 2 presents the percentage of attributes that were either stated or inferred to have been non-attended to. For inferred ANA, the method proposed by Hess and Hensher (2010) was utilized; the coefficient of variation was calculated and values of 2 or more were inferred to not attend to the attribute. For both products, the percentage of stated ANA was highest for price. One possible explanation is that the products are relatively low priced, only a few dollars, and are a small portion of a consumer's budget so it is possible respondents feel price is relatively less important or influential in this particular scenario.

Table 3 reports the WTP estimates for pork chops for passing and failing the validation question and accounting for stated and inferred ANA.[8] Ninety-five percent confidence intervals for passing and failing overlap for all attributes of pork chops indicating no significant differences between those who passed and failed the validation question. Table 4 reports mean marginal WTP estimates and 95% confidence intervals for the chicken breast choice experiment. Visual inspection of confidence intervals for overlap indicates there were no significant differences in WTP for these attributes.

Table 5 (pork chops) and Table 6 (chicken breasts) also report the WTP estimates from the models correcting for stated and inferred ANA in the column titled "mean over entire sample" and for passing or failing the validation question. For both pork chops and chicken breasts, in all cases 95% confidence intervals overlap when comparing the estimates for passing the validation question to those estimates for failing the validation question. Thus, accounting solely for passing or failing the validation question does not result in statistically significant differences in WTP estimates. When the "mean over entire sample" columns for stated and inferred ANA are compared to the mean column from the validation row, all confidence intervals overlap; thus accounting for either stated or inferred ANA does not change WTP estimates for pork chops when compared to the base. Thus, only accounting for either inferred or stated ANA does not result in statistically different WTP estimates for either pork chops or chicken breasts.

In the case of antibiotic use for pork chops when stated ANA was corrected for, those who failed the validation question have a mean WTP that is statistically different from those who passed the validation question. However, there are no other statistically significant differences between passing or failing the validation question and accounting for either stated or inferred ANA for pork chops. For chicken breasts, when inferred ANA was accounted for, those who passed the validation question had statistically higher mean WTP estimates for antibiotic use than did those who failed the validation question.

Table 2. Percentage of attributes stated or inferred to have been non-attended to by respondents

	Pork chop (n = 413)		Chicken breast (n = 412)	
	Inferred (%)	**Stated (%)**	**Inferred (%)**	**Stated (%)**
OptOut	12		11	
Price	32	36	17	34
Individual crate	35	20		
Pasture access			14	25
Location	4	25	8	18
Antibiotic use	16	25	25	22
USDA certification	60	23	18	17
Industry certification	60	23	18	17

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Table 3. Pork WTP and 95% confidence intervals

	Mean over entire sample		Pass		Fail	
	WTP	95% Confidence interval	WTP	95% Confidence interval	WTP	95% Confidence interval
Validation question						
OptOut	($4.97)	[−$6.18, −$3.91]	($4.97)		($4.97)	
Individual crate	$0.68	[$0.14, $1.27]	$0.83	[$0.21, $1.54]	$0.19	[−$0.82, $1.18]
Antibiotic use	$2.68	[$1.89, $3.61]	$3.11	[$2.21, $4.31]	$1.38	[$0.01, $2.80]
Location	($2.24)	[−$2.96, −$1.64]	($2.42)	[−$3.24, −$2.45]	($1.64)	[−$2.70, −$0.75]
USDA certification	$3.29	[$2.51, $4.38]	$3.58	[$2.62, $4.79]	$2.43	[$1.15, $3.82]
Industry certification	($0.48)	[−$1.41, $0.28]	($0.41)	[−$1.41, $0.48]	($0.71)	[−$2.30, $0.80]
Stated ANA						
OptOut	($3.75)	[−$5.16, -$2.55]	($3.75)		($3.75)	
Individual crate	$0.87	[$0.21, $1.58]	$1.10	[$0.39, $2.01]	$0.14	[−$1.10, $1.50]
Antibiotic use	$2.13	[$1.17, $3.31]	$2.92	[$1.77, $4.36]	($0.33)	[−$1.90, $1.32]
Location	($2.28)	[−$3.34, −$1.52]	($2.51)	[−$3.63, -$1.74]	($1.58)	[−$3.09, -$0.44]
USDA certification	$2.57	[$1.56, $3.97]	$2.93	[$1.86, $4.46]	$1.44	[−$0.20, $3.09]
Industry certification	($0.11)	[−$1.28, $1.00]	$0.03	[−$1.35, $1.16]	($0.52)	[−$2.49, $1.63]
Inferred ANA						
OptOut	($2.44)	[−$6.18, −$3.91]	($2.44)		($2.44)	
Individual crate	$0.92	[$0.36, $1.51]	$1.11	[$0.47, $1.76]	$0.35	[−$0.67, $1.50]
Antibiotic use	$2.69	[$1.94, $3.60]	$3.07	[$2.25, $3.93]	$1.52	[$0.17, $2.87]
Location	($1.81)	[−$2.37, −$1.34]	($1.93)	[−$2.51, −$1.41]	($1.47)	[−$2.23, −$0.76]
USDA certification	$3.34	[$2.49, $4.37]	$3.51	[$2.55, $4.56]	$2.81	[$1.59, $4.21]
Industry certification	($1.16)	[−$2.31, $0.14]	($1.19)	[−$2.50, $0.08]	($1.07)	[−$3.03, $0.84]

In all cases examined, accounting for either stated or inferred ANA alone did not significantly change the WTP estimates for attributes of pork chops or chicken breasts. This gives support to the initial hypothesis that accounting for stated or inferred ANA did not significantly impact WTP estimates for meat choice experiments and is consistent with the findings of Widmar and Ortega (2014). A possible explanation is that ANA is simply not a significant problem in terms of yielding significantly different WTP estimates in the type of experiment considered. Pork chops and chicken breasts are two meat products that are likely to be regularly purchased and these two products represent a small portion of consumers' budgets. It is also possible that ANA is not a significant problem for these particular attributes which were largely animal welfare in nature. Past research concluded that accounting for inferred ANA among similar animal welfare attributes in pork products (pasture access, antibiotic use, individual crates) and dairy products (pasture access, antibiotic use, rbST use) did not have statistically significant impacts on the WTP estimates based on the examination of 95% confidence intervals (Widmar & Ortega, 2014).

Contrary to expectations, accounting for passing or failing the validation question alone did not result in statistically different WTP estimates when overlapping confidence intervals were examined. However, when accounting for both ANA and passing the validation question, there were some

Table 4. Chicken WTP and 95% confidence intervals

	Mean over entire sample		Pass		Fail	
	WTP	95% Confidence interval	WTP	95% Confidence interval	WTP	95% Confidence interval
Validation						
OptOut	($3.49)	[−$4.21, −$2.79]	($3.49)		($3.49)	
Pasture access	$1.54	[$1.19, $1.91]	$1.69	[$1.35, $2.10]	$1.00	[$0.40, $1.65]
Antibiotic use	$1.51	[$1.09, $1.99]	$1.78	[$1.31, $2.28]	$0.58	[−$0.29, $1.41]
Location	$0.98	[$0.67, $1.28]	$1.07	[$0.73, $1.44]	$0.69	[$0.07, $1.28]
USDA certification	$1.72	[$1.29, $2.25]	$1.81	[$1.37, $2.28]	$1.42	[$0.66, $2.27]
Industry certification	($0.60)	[−$1.08, −$0.14]	($0.74)	[−$1.31, −$0.25]	($0.10)	[−$1.01, $0.81]
Stated ANA						
OptOut	($2.49)	[−$4.21, −$2.79]	($2.49)		($2.49)	
Pasture access	$1.43	[$1.04, $1.89]	$1.49	[$1.07, $1.99]	$1.21	[$0.51, $2.04]
Antibiotic use	$1.25	[$0.74, $1.88]	$1.52	[$0.95, $2.17]	$0.28	[−$0.71, $1.29]
Location	$0.73	[$0.36, $1.15]	$0.66	[$0.25, $1.08]	$0.97	[$0.18, $1.84]
USDA certification	$1.54	[$1.08, $2.19]	$1.59	[$1.05, $2.17]	$1.59	[$0.54, $2.35]
Industry certification	($0.45)	[−$1.03, −$0.10]	($0.55)	[−$1.23, −$0.13]	($0.55)	[−$1.30, $0.92]
Inferred ANA						
OptOut	($2.68)	[−$4.21, −$2.79]	($2.68)		($2.68)	
Pasture access	$1.43	[$1.19, $1.69]	$1.56	[$1.30, $1.86]	$0.97	[$0.55, $1.42]
antibiotic use	$1.86	[$1.42, $2.33]	$2.19	[$1.70, $2.71]	$0.71	[−$0.27, $1.62]
Location	$0.99	[$0.76, $1.25]	$1.04	[$0.80, $1.29]	$0.81	[$0.42, $1.24]
USDA certification	$1.47	[$1.13, $1.81]	$1.55	[$1.18, $1.95]	$1.20	[$0.56, $1.80]
Industry certification	($0.59)	[−$0.98, −$0.18]	($0.72)	[−$1.14, −$0.32]	($0.13)	[−$0.83, $0.69]

Table 5. Results of poe testing for pork chop

Base	ANA				Validation question			
	Inferred ANA		Stated ANA		Passing		Failing	
	p-value	Significance	*p*-value	Significance	*p*-value	Significance	*p*-value	Significance
Accounting for each separately when compared to the base estimate								
Individual crate	0.9905		0.9923		0.9921		0.9920	
Antibiotic use	0.9997		0.9997		0.9992		1.0000	
Location	0.0000	***	0.0006	***	0.0000	***	0.0000	***
USDA certification	0.9998		0.9998		0.9998		1.0000	
Industry certification	0.1287		0.1229		0.1263		0.1269	
Accounting for the combination of passing/failing the validation question and ANA								
Individual crate	0.9889		0.9940		0.9930		0.9950	
Antibiotic use	0.9994		1.0000		0.9991		1.0000	
Location	0.0006	***	0.0008	***	0.0009	***	0.0000	***
USDA certification	0.9991		0.9999		0.9995		1.0000	
Industry certification	0.1229		0.1359		0.1529		0.1229	

***Indicates significance at the 1% level.

Table 6. Results of poe testing for chicken breast

Base	ANA				Validation question			
	Inferred ANA		Stated ANA		Passing		Failing	
	p-value	Significance	*p*-value	Significance	*p*-value	Significance	*p*-value	Significance
Accounting for each separately when compared to the base estimate								
Pasture access	0.9996		0.9999		0.9990		0.9994	
Antibiotic use	0.9991		1.0000		0.9990		1.0000	
Location	0.9996		1.0000		0.9990		0.9997	
USDA certification	0.9993		0.9996		0.9996		0.9995	
Industry certification	0.0048	***	0.0056	***	0.0057	***	0.0000	***
Accounting for the combination of passing/failing the validation question and ANA								
Pasture access	0.9998		1.0000		0.9990		0.9990	
Antibiotic use	0.9990		1.0000		0.9996		1.0000	
Location	0.9996		1.0000		1.0000		1.0000	
USDA certification	0.9992		0.9995		0.9990		0.9940	
Industry certification	0.0017	***	0.0040	***	0.0024	***	0.0020	***

***Indicates significance at the 1% level.

statistically significant differences. Thus, passing a validation question (in conjunction with account for ANA) could help identify careful survey takers who are more likely to follow choice experiment directions, such as the "cheap talk" statement, and make thoughtful choices that reflect their real purchasing habits. Thus, a validation question may be a low-cost way, in terms of survey design, to identify those respondents giving the most thoughtful responses and improve overall data quality (Gao et al., 2012).

Additional testing for statistically significant differences was undertaken using the complete combinatorial method (Poe et al., 2005). These tests were performed to determine if account for passing/failing the validation question, displaying stated or inferred ANA, or their combinations resulted in statistically different distributions of the mean WTP estimates for each attribute when compared to the base case. For pork chops, the distribution of mean WTP estimates for the local attribute were statistically different from the base case for all scenarios tested. For chicken breasts, the distribution of mean WTP estimates for the industry verification attribute were statistically different from the base case for all scenarios tested. This indicates that WTP estimates that did not account for passing/failing a validation question and/or displaying stated/inferred ANA could significantly alter the results for some attributes.

6. Conclusion

An online survey was used to administer discrete choice experiments and collect data on stated and inferred ANA for pork chop and chicken breast choice experiments. Consistent with Widmar and Ortega (2014), accounting for inferred ANA did not change the overall conclusions surrounding consumer WTP estimates. Furthermore, WTP estimates for either pork chops or chicken breasts were not statistically different when stated ANA alone was accounted for. On the other hand, those who passed the validation question had statistically significant and higher WTP for some attributes of pork chops, such as if it was produced locally, and chicken breasts, such as if it was industry verified when interacted with inferred or stated ANA.

Because choice experiments are widely used to assess consumer demand for various product attributes, it is important to consider the accuracy of their results. Here accounting for stated and inferred ANA alone did not significantly alter the WTP results. This suggests that previous research results in similar products are likely correct. Similarly, previous works have explored using a validation question to improve data quality. While passing the validation question alone did not lead to significant differences in WTP estimates, interacting them with stated and inferred ANA did reveal some statistically significant differences. The potential exists that ANA may be present for other (food) products or other attributes. Further research is needed into the use of simple validation questions to improve data quality at a low cost to researchers and marketers. Specifically, determining which types of products or categories of attributes may be susceptible to ANA on the part of the respondent. These results also warrant further investigation into the relationships between passing and failing a validation question and inferred and stated ANA. Future research could also consider the proportion of respondents whose WTP is over a threshold for each attribute before and after accounting for stated ANA, inferred ANA, and/or passing a validation question.

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Notes

1. Individual Crates/Stalls refers to the use of practices individually confining animals, where “not permitted” meant the animal was raised on an operation certified to not confine animals in individual crates, stalls, or cages.
2. Location refers to the proximity of the source farm to your home, where “local” meant the pork was produced on a farm that was near your home’s location.
3. Antibiotic use refers to the use of antibiotics on animals, where “not permitted” meant the animal was raised on an operation certified to not administer antibiotics to animals.
4. The prices shown were comparable to retail prices for pork chops and chicken breasts at the time of survey administration.
5. Respondents could choose from price, crate free (pork chop), pasture access (chicken breast), location, antibiotic use, certification entity, took account of all factors.
6. Hole (2007) determined the delta, Fieller, Krinsky and Robb and bootstrapping methods to construct confidence intervals yielded similar results.
7. Examining 95% confidence intervals for whether or not they overlap is more conservative than standard significance testing (Schenker & Gentleman, 2001).
8. A table of parameter and standard error estimates from the correlated RPL model is available upon request.

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