Is Presentation Everything? Using Visual Presentation of Attributes in Discrete Choice Experiments to Measure the Relative Importance of Intrinsic and Extrinsic Beef Attributes

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Abstract

A unique discrete choice experiment (DCE) is used to estimate the relative importance of quality attributes to Australian beef consumers. In the DCE, consumers choose their preferred beef steaks from options varying in a large number of intrinsic (marbling and fat trim) and extrinsic/credence (brand, health, forage, meat standards/quality, and production and process claims) attributes. This study is the only known DCE to present these attributes to consumers visually – in a manner that more realistically simulates the retail choice scenario for beef and allows us to evaluate the relative importance of attributes that consumers use both consciously and unconsciously when making product choices. Respondents' beef choices were analyzed using a latent class scale adjusted choice model. We address two import issues that have potentially strong implications for the validity of estimated attribute values: intrinsic attributes are likely to be underestimated in their importance if not presented visually; and DCEs that exclude important attributes (such as intrinsic characteristics) are likely to overestimate the value of product characteristics. The results suggest that visual attribute level presentation in DCEs results in less biased value estimates. Therefore, it is not only important to consider what attributes to include, but also how you present the attributes.

Keywords: discrete choice experiment, visual attribute presentation, willingness to pay, beef, extrinsic attributes, food labeling

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Introduction

Increasingly, food industry leaders and policy makers are calling on economists to provide insight on the relative importance and value consumers place on certain food production, quality and safety information and attributes. It is particularly important for researchers to be able to provide valid and accurate measures of the relative importance and marginal value of attributes and information to consumers. For example, willingness-to-pay (WTP) estimates from previous beef economic studies have influenced important decisions such as labeling policies (e.g. mandatory country-of-origin labeling), industry investment in R&D to improve quality (e.g. tenderness) and firms' strategic business decisions (e.g. brand development).

Various direct and indirect research methods have been used by economists to ascertain this information, however, discrete choice experiments (DCEs) are being used more frequently. DCEs are often preferred over other more direct measures (e.g. rating scales, contingent valuation) because of their proven ability to simultaneously estimate relative values for multiple product attributes and to predict consumers' actual market behavior (Lusk; Louviere, Hensher and Swait, 2000). The choice sets used in DCEs can be framed to closely resemble purchasing scenarios where consumers are forced to choose from a set of products, each with different attributes. Thus, DCEs are consistent with random utility theory and Lancaster's theory of demand which states that the utility a consumer derives from a good is a function of the multiple attributes of the good. Although DCEs offer advantages over direct methods, several recent studies have shown that WTP estimates from DCEs are strongly influenced by design dimensions such as the number of choice sets, number of

attributes, level of attributes and combination of attributes (Gao and Schroeder, 2009; Hensher, 2006; Hensher, Rose and Greene, 2005; Islam, Louviere and Burke, 2007).

An important design issue that has received very little attention from economists in the DCE literature relates to the fact that researchers typically present attributes to consumers in a *verbal* context with different sets of information depending on the goals of the research. The marketing, psychology and consumer behavior literature suggests that consumers' choice decisions are often influenced unconsciously by product factors and consumers are unable to articulate the importance or value they place on certain product attributes when choosing products (Bargh, 2002; Chartrand, 2005; Dijksterhuis et al., 2005; Fitzsimons et al., 2002; Mueller, Lockshin and Louviere, 2010; Smead, Wilcox and Wilke, 1981). Visual attributes such as brand logo and product package design impact consumers' choices subliminally (Breitmeyer, Ogmen and Chen, 2004). For example, Mueller, Lockshin and Louviere (2010) show that visual presentation of packaging attributes triggers unconscious processing of important cues in wine choice decision making, and consumers are not able to introspect or validly evaluate the importance of these cues when they are presented only verbally. Accordingly, verbal presentation and framing of attributes may be inappropriate when the attributes being evaluated are non-utilitarian, abstract, require a sensory experience, misunderstood or used subconsciously (Fitzsimons et al., 2002).

Although these studies show that consumers unconsciously process and use visual cues when making product choices, the issue of *verbal* versus *visual* attribute presentation has not been previously addressed in any of the recent fresh meat DCE valuation studies in our economics literature. A disconnect remains between the consumer behavior, social psychology and marketing literature on consumer choices and the related economics literature using DCEs to explore consumer choices for fresh food products. Our research contributes to the existing literature on attribute valuation methods and consumer behavior by

addressing the experimental design issues discussed above related to attribute presentation. Specifically, we estimate the relative importance of attributes to beef consumers using data from a unique DCE where consumers choose their preferred beef steaks from options varying in a large number of intrinsic (marbling and fat trim) and extrinsic/credence (branding, health claims, forage, meat standards, and benefit claims) attributes. This study is the only known DCE to present these attributes to consumers *visually* – in a manner that more realistically simulates the retail choice scenario for beef and allows us to evaluate the relative importance of attributes that consumers use both consciously and unconsciously when making product choices.

Many of the product characteristics (mentioned above) that render verbal presentation to be an inappropriate method for attribute framing in DCEs, are relevant when considering evaluations of fresh meat products such as beef. Therefore, verbal presentation of specific 'visual' quality cues when studying their role in consumers' beef purchasing decisions is very likely to lead to biased estimates of their relative importance and value. Consumers use cues like price, marbling, fat content/trim, color and labels to evaluate and predict beef steak quality at the retail meat case (Grunert, 2006; Umberger et al., 2009). In the case of marbling, consumers are often unable to orally or verbally express the importance that these intrinsic attributes play in their purchase decisions for beef. Thus they use marbling sub-consciously when evaluating quality visually. In fact, consumers often do not understand the positive relationship between marbling and eating quality, rather many view marbling as a negative quality attribute. Furthermore, product information related to production, process and safety attributes (credence/extrinsic attributes) is also used by some consumers to evaluate quality (Umberger et al. 2009). Very little is currently understood about how consumers visually process and use this information relative to other visual cues when making product choices at the retail meat counter.

Previous Literature on the Relevant Importance of Attributes in Beef Choices

Meat products such as beef pose an interesting product purchase scenario because quality is multi-dimensional and involves sensory (experience) as well as health, safety, convenience and possibly production or process-related characteristics. Many of these quality characteristics are difficult or impossible for consumers to ascertain at the point of purchase, thus consumers use past experiences and visual cues, to form expectations about quality. Visual quality cues can be intrinsic (e.g. marbling, fat content, lean, size, cut) or extrinsic (e.g. price and other labelling information).

Numerous researchers have explored the factors influencing consumers' beef purchase decisions to determine what information they use to develop expectations about a fresh beef product's quality at the supermarket. Consumers use a combination of intrinsic and extrinsic cues to form quality expectations. As Grunert (2006) and Umberger et al. (2009a and 2009b) point out, consumers are increasingly using extrinsic cues to form perceptions about quality. Consumers' developing interest in extrinsic attributes such as health, safety, origin and production processes (also termed *credence* attributes) is linked to changing lifestyles, safety concerns and the increased weight some consumers place on health when purchasing food (Grunert, 2006). Beef companies are beginning to take interest in how they might use extrinsic information and cues to develop labelling and point of purchase information to strategically market and brand their products to differentiate themselves and target consumers. Policy makers are also interested in information to guide decisions on whether labelling policies need to be established or changed to adapt to the changing demands and use of this information in marketing meat products.

As a result, in the last decade, numerous researchers have conducted studies to gain information on the relative importance of these attributes, as well as an understanding of whether consumers are heterogeneous in their perceptions, use and value of these attributes.

The use and relative importance to consumers of various extrinsic attributes such as health, safety, origin and production processes (also termed *credence* attributes) when purchasing beef appears to vary depending on the country and context of the study. In the remaining paragraphs of this section we focus only on studies which use choice based methods to estimate relative values for attributes.

To our knowledge, Lusk, Roosen and Fox (2003) were the first researchers to use DCE methods to examine consumers' willingness to pay for beef attributes. Specifically, they used mail surveys and a DCE that varied in price and four quality attributes: marbling/ intramuscular fat, tenderness, produced with or without growth hormones, and/or animals fed/ not fed genetically-modified corn to study French, German, British and United States consumers' preferences for beef steaks. An information sheet was provided to consumers explaining (verbally) each of the attributes before they began the choice experiment. In the case of marbling, photographs were also included in the information sheet to illustrate differences in marbling levels.

Lusk, Roosen and Fox (2003) used two modelling approaches to estimate the impact of attributes on consumer choices: a scale-adjusted multinomial logit model, and a random parameters logit model to account for preference heterogeneity amongst consumers. Their results indicated that French and German consumers preferred higher levels of marbling than British and U.S. consumers. Consumers in all four countries were willing to pay relatively large premiums (ranging from US$2.83/pound to US$11.66/pound) for "GM- free" and "hormone-free" beef. French consumers were willing to pay significantly more than consumers from other countries for "hormone-free" beef, and French, German and UK consumers willing to pay more than U.S. consumers for "GM-free" beef. In terms of preference heterogeneity for steak attributes, French and German consumers exhibited relatively homogeneous preferences, but U.K. and U.S. consumers were heterogeneous in

their preferences for "hormone-free" beef and tenderness. As Lusk, Roosen and Fox (2003) discuss, their results could be biased based on the attribute information provided to consumers.

In a similar study, Lusk and Schroeder (2004) used DCEs to examine U.S. consumers' WTP for a slightly different set of quality attributes: tenderness, natural, USDA Choice and Certified Angus Beef. The major contribution of the Lusk and Schroeder (2004) study is that it compares WTP estimates from hypothetical (no payment or purchase required) and non-hypothetical (payment /purchase required) treatments. Although the hypothetical WTP estimates for the differentiated products were higher than the non-hypothetical values, the marginal WTP values were not significantly different. The premiums for quality differentiated steaks relative to unlabeled steaks ranged from around $1.36/pound to $5.20/pound, depending on the model estimated. The highest premiums were for USDA Choice or Certified Angus steaks, and the lowest premiums were for natural and guaranteed tender steaks. The hypothetical values The DCE questions/steak choices were presented to consumers using verbal explanations of each of the attributes and consumers were not presented with visual examples of each of the steaks options.

In the last five years, several other studies have used DCEs to examine consumers' WTP for different beef attributes of particular interest to the beef industry and policy makers (Gao and Schroeder, 2009; Loureiro and Umberger, 2007; Tonsor et al., 2005). Tonsor et al. (2005) used a non-hypothetical DCE with verbal attribute descriptions and an RPL model to determine French, German and British consumers' WTP for "hormone-free," "GM-free," source verified and domestic-origin beef. Although the countries and attributes across studies were similar, their results differed from Lusk, Roosen and Fox (2003) in that they found heterogeneous beef attribute preferences amongst European consumers' and only French consumers were willing to pay a statistically significant premium for "hormone-free" and

"GM-free" beef. Tonsor et al. (2004) attribute the differences in WTP estimates and preferences between their study and Lusk, Roosen and Fox's (2003) study to the non-hypothetical context and the heterogeneity of consumers in their study.

Loureiro and Umberger (2007) examined U.S. consumers' WTP for country-of-origin labelling, traceability, food safety inspection and tenderness guarantees using a DCE with verbal presentation of attributes. Consumers placed the highest premium on food safety inspection, followed by country-of-origin labelled, traceable and tenderness guaranteed. The estimates for these attributes were relatively small compared to other consumer research which using contingent valuation and/or experimental auctions methods. They suggested that the context that attributes were presented in the previous country-of-origin labelling studies, specifically the exclusion of potentially important intrinsic and extrinsic quality attributes (e.g. tenderness or traceability), caused the values for country-of-origin to be inflated. In other words, consumers may have placed a high value on country-of-origin because they used it as cue for food safety or quality. Thus, if consumer WTP for origin is examined in an absolute context, the estimated values may be artificially high and industry and policy makers may be misdirected to focus on costly labelling policy rather than on improving quality or safety.

Gao and Schroeder (2009) confirmed the hypothesis posed by Loureiro and Umberger (2007) and showed that consumers' WTP for certain beef steak attributes varied depending on the number and combination of attributes included in the DCEs. They found that the WTP estimates for country-of-origin, and other extrinsic attributes (e.g. local, organic) that consumers may use to infer information about quality or safety, were affected more by the addition of other attributes than were "independent" attributes such as guaranteed tender. The Gao and Schroeder (2009) study makes an important contribution to the understanding of how WTP estimates from DCEs are influenced by attribute inclusion /exclusion, but similar

to the other previous beef DCE studies discussed, the attributes in their study were presented to consumers verbally and focused primarily on extrinsic cues.

Although extrinsic cues continue to be of great interest to the industry, previous research has shown that consumers also use the intrinsic cues, marbling, fat content/trim and color to evaluate and predict beef steak quality at the retail meat case (Grebitus, 2009; Umberger et al., 2009). As previously discussed, some visual product cues such as marbling are likely to trigger sub-conscious and even automated evaluation processes that consumers are not consciously aware of (Grunert, 2006). In the best case, verbal presentation of visual cues (i.e. stating 'bright red' vs. showing this color) leads to ambiguous interpretation of their importance by consumers. It is unlikely to trigger the same subconscious processing by consumers which occurs in a retail setting where products are typically evaluated visually. Verbal presentation of visual cues is then likely to result in underestimated effects. As far as we know this is the first beef DCE study to visually present all attributes to consumers.

Research Methods and Empirical Analysis

The DCE was part of a larger online survey of regular Australian beef consumers. Respondents were randomly recruited from a reputable national consumer panel during June 2009. A nationally representative sample of consumers was obtained. To qualify for the survey, respondents were required to both purchase beef and do the meat shopping for their household at least monthly, and they could not be directly involved in the beef industry or market research. Prior to completing the DCE, respondents' answered questions which assessed their socio-demographic characteristics, meat and beef shopping behaviour, and their knowledge, attitudes and perceptions of beef quality attributes as well as quality, safety and production certifications and brands.

The DCE purchase occasion was framed by asking consumers to imagine they were shopping at their normal retail outlet for a sirloin/porterhouse beef steak to cook for a

weekend dinner with family or friends. In each choice set respondents were shown photo-realistic presentations of four steaks as they would appear in the retail case. They were asked to indicate which steak they would prefer to purchase by clicking on that steak, and they were then asked to indicate (yes/no) if they would realistically purchase their steak choice. Consumers were told that in the next 16 screens they would be shown 16 shelves, each with four packages of beef steaks. They were told each shelf represented a shopping occasion. They were shown an example "shelf" and asked to proceed through the following 16 screens.

To measure the relative importance/values of the attributes of interest, and still simulate a realistic looking retail beef product, digital graphical enhancement techniques were employed to alter intrinsic steak product attributes and labeling information of interest. Each steak was packaged in an identical black tray with clear overwrapping, and with cut, color, size/weight (400 grams), and "use by" date held constant across all steak choices. The price and non-price attributes and levels included in the DCE were chosen after conducting a substantial literature review, consumer focus groups, and interviews with numerous industry leaders.

The prices of beef steaks in Australia vary substantially at any given time depending on the quality attributes of the beef, retail outlet type and location; thus, eight price levels were used, ranging from $15.99/kg to $43.99/kg. The price was shown on the steak package both as price per kilogram and total price for the 400 gram steak – this is similar to how retailers currently feature price. Intrinsic attributes included marbling (4 levels) and external fat trim (4 levels). Non-price, extrinsic attributes included: brands (national and regional), health (Heart Foundation Approved tick), forage (grass-finished, grain-finished), production (hormone and antibiotic free, environmentally sustainable, certified humane) and quality/safety certifications including Meat Standards Australia (MSA) and Australian certified. The DCE used an 8^4x4^4 OMEP design resulting in 64 choice sets with choice set

size of four and statistical efficiency of 99.7% (Street and Burgess, 2007). To avoid respondent fatigue, respondents were randomly allocated to one of four different versions of 16 choice sets. All of the attributes and their levels are shown in Table 1 and an example of one of the choice sets is shown in Figure 1.

Two general methods are available to researchers for modelling consumer choices: the random parameters logit model (RPL) and latent class (LC) choice models. The two models are related in the sense that the LC model converges to the RPL model when an endless number of classes exists (Greene and Hensher, 2003). When choosing whether to use a RPL or a LC model, the researcher must make assumptions about the underlying preference structures of the consumers. The RPL model is appropriate if consumer preferences are considered to be like DNA and individually unique, however, if preferences are assumed to be "lumpy" in that groups or segments of consumers are assumed to have similar preferences, then the LC model is suitable (Hynes, Hanley and Scarpa, 2008; Provencher and Moore, 2006). Previous research suggests consumer preferences for beef attributes are heterogeneous across groups or segments, rather than individually. Therefore, the LC model was chosen to analyse consumers' beef choices, and to simultaneously approximate scale and part worth utility parameters and class membership from the DCE choices. Boxall and Adamowicz (2002), Louviere et al. (2000) and Swait (1994) provide a complete mathematical derivation of the LC choice model.

Individuals do not typically respond to choices with the same consistency, and error variances may not be constant within or between respondents (Islam, Louviere and Burke 2007; Louviere, 2001). Unfortunately, neither the RPL model nor the LC model account for respondents' inconsistency (error variance) and as a result, the estimated utility parameters are confounded with the unobserved distribution of error variances (Louviere and Eagle,

2006). In other word, these models may overestimate the actual preference heterogeneity (Louviere and Meyer, 2007).

The issues related to the incorrect assumption of identical error variances can be partially overcome using a scale extended LC model (Vermunt and Magidson, 2008). This relatively new development in LC choice modelling considers the error variance of individuals. While each respondent could have an individually specific error variance, the scale extended latent class model approximates a continuous error distribution with a restricted number of scale classes, each with a unique scale parameter. The scale parameter is identical within a scale class, but differs across classes. Consistent respondents are assigned a larger scale parameter than uncertain or inconsistent respondents (Swait and Louviere, 1993). The different scale parameters are accounted for when estimating the class-specific attribute part worth utilities, ensuring that the part worth values are not confounded by consumers' choice uncertainty (Magidson and Vermunt, 2007). To deal with issue of error variance, we used the syntax module of Latent Gold Choice 4.5 as it allows the simultaneous estimation of both part worth utilities and a scale factor (Vermunt and Magidson, 2008).

Results

Consumer Sample

In total, 1881 respondents qualified and completed all questions in the survey. The sample is comparable to the Australian beef market in terms of gender, marital status, children in the household, household size and employment status (Roy Morgan Single Source Australia and Meat and Livestock Australia, 2008). However, our sample appears to have slightly higher levels of household income and to be more educated. Table 2 provides a summary and allows a comparison of the socio-demographics of our sample relative to the Australian population and the Australian beef consumer (Roy Morgan, 2008). It is important to note

that this sample contains a higher share of South Australians than the population – this was done deliberately as one of the agencies funding the research wanted a separate segmentation of the South Australian market.

Chicken and beef are the meat products consumed most frequently with over 60% of consumers purchasing chicken (67%) and beef (60%) weekly. Beef is consumed at home at least once per week by 88% of the consumers. Mince and steak are the most frequently consumed beef products, followed by diced beef (stir fry cuts) and sausages. The majority (69%) of respondents use supermarkets as their primary source of beef. Respondents were asked to indicate their level of agreement (using a 7-point scale, where 1 = strongly disagree and 7 = strongly agree) with statements regarding their beliefs about various aspects of the Australian beef supply system. Roughly 40% of consumers strongly agreed or agreed and with the statement 'I am satisfied with the safety of the beef available'. Over one-half of consumers (53%) strongly disagreed or disagreed with the statement that 'Eating beef is risky to my health'. Consumers' responses to these statements suggest that Australian consumers are generally satisfied with the safety of their beef supply. Interestingly, only 27% of respondents agreed or strongly agreed with the statement: 'I trust the government to ensure that our beef is safe'. Therefore, while consumers are generally satisfied with the safety of their beef, they are not necessarily trusting of the government to ensure safety.

In terms of their perceptions of the quality and consistency of the beef supply, 36% and 10% of consumers, respectively, agreed or strongly agreed with the statements that "I am satisfied with the quality of beef available", and 'The quality of beef available is too inconsistent'. It appears there is still room for the industry to improve the quality and consistency of the beef supplied. Consumers generally were not concerned about issues related to beef production and the environment or animal welfare: 38%, 30% and 29% agreed or strongly agreed, respectively, with statements that buying locally/regionally

produced beef is important, they were concerned about hormones and they were concerned about antibiotics in beef production. Only 10% of consumers agreed/strongly agreed with the statement that "Beef production is harming the environment". Conversely, only 19% and 21% of consumers agreed/strongly agreed with statements that beef production is environmentally sustainable and the welfare of beef animals is as good as can be expected, respectively. Consumers appear to be unsure about their beliefs related to the environmental impact of beef production and welfare of animals.

In terms of knowledge of beef cuts and quality attributes, only 37% of consumers agreed/strongly agreed that they have a good understanding of the most appropriate cut of beef to use for different recipes/cooking methods. When asked to identify 'marbling' in a multiple choice question 73% correctly identified marbling. However, when asked to indicate which statements (out of 5) described their perceptions of marbling and fat trim with respect to steaks, only 45% indicated that believed marbling is good and that they look for steaks with more marbling. Yet 30% indicated that marbling is not good and they want steaks with as little marbling as possible. Only 18% said they do not pay attention to marbling at all. Interestingly, only 23% of consumers indicated they are aware of the origin of their beef, even though country-of-origin is required to be indicated on beef products sold in supermarkets. In fact, the majority of consumers (64%) indicated they are generally *not* aware of the origin of their beef.

Discrete Choice Experiment Results

Respondents' beef choices were analyzed using a latent class scale adjusted choice model. The optimal number of underlying latent classes was chosen after considering the fit statistics (Bayesian Information Criteria or BIC value), the relative size of classes (segments) and significant parameter differences between the classes (Scarpa, Thiena and Tempesta, 2007; Ruto and Scarpa, 2008). Solutions with seven classes, one random class and two scale

classes (λ_1=1, λ_2=2.82, n_{S1}=1,024, n_{S2}=857) were selected based on the Bayesian Information Criteria that favours parsimonious solutions (BIC=48,895). The scale factor, λ_1, of the first class is set to one for identification purposes. It represents the less consistent or more uncertain class, of which 54.5% of respondents were assigned. The second class represents the part of the sample that chose more consistently (45.5%) and thus it has a higher scale factor, λ_2, and a lower error variance (Magidson and Vermunt, 2007). Estimated part worth values for attribute levels for each class are in Table 3. Wald statistics indicate that all attribute effects were significant at conventional levels; attribute level utilities also differ between the classes. To estimate the relative importance of attributes for each class, partial R-squares were calculated using the log-likelihoods associated with each attribute across all levels (Louviere and Islam, 2008).

To determine the relative importance of attributes for the entire sample, a class-weighted average of each attribute's importance was calculated and the weighted average importance of each attribute is displayed in Table 4. Overall, marbling was the most important determinant of consumers' beef steak choices (46.3% of the variance), followed by price (34.7%) and fat trim (10.7%). It is interesting that collectively, the two intrinsic attributes, marbling and fat trim accounted for over one-half (57%) of consumers' variation in beef steak choices. Less than 10% of the variation was accounted for by the extrinsic/ credence attributes: health claims, brand, production claims, quality certifications and forage claims.

Consumers' average marginal willingness to pay for each attribute and attribute level is displayed in the far left column of Table 5. Consumers were willing to pay the largest premiums for the lowest level of marbling and fat trim and on average, they placed large discounts for higher levels (levels 4 and 6) of marbling and fat trim. Considering the extrinsic attributes, the premium for Meat Standards Australia (MSA) quality certified was

largest, followed by the premiums for the brands 1824 and King Island, environmentally sustainable, Heart Tick approved, hormone and antibiotic free, and the Terra Rossa brand. It is interesting that the Australian Beef certification was relatively low and that the premiums for Certified Humane and both forage claims are negative on average.

The results discussed above only represent the sample averages, these values do not account for preference heterogeneity across classes. For three of the seven latent classes marbling was the most important attribute, one was mainly price-driven, one was most strongly influenced by the size of the fat trim and two used marbling, fat trim and price for product evaluation. The WTP values for attributes for each class are provided in Table 5. Consumers WTP for marbling differs fairly substantially across classes, but only one class, Class 3, discounted the lowest level of marbling and was willing to pay a significant premium for level 4 marbling (relatively higher level). Class 3 is also significantly discounted grass-fed beef, and although insignificant, they were willing to pay a premium for grain-fed beef. Furthermore, they were the only segment willing to pay a significant premium for Certified Angus Beef. Based on their WTP values we would expect that Class 3 has relatively higher knowledge and experience about beef and beef quality attributes related to eating quality.

The variation in consumers' premiums and discounts for brands is interesting in that some consumers place large discounts on major retail brands (e.g. Woolworths and/or Coles) and value certain regional and independent brands. Class 5 was willing to pay a premium for relatively well-known independent brands, Terra Rossa, King Island, Coorong and 1824, yet they discounted Coles a major retail brand, CAAB, and the newly developed brand, Dalriada. Class 5 was also willing to pay the largest premium of any segment for MSA certified and environmentally sustainable beef.

With respect to the quality certifications and production claims, the AusQual certification (mostly used at the wholesale level) received significant discounts from nearly

all (six of the seven classes) of consumers. Conversely, the MSA certified beef was valued significantly and relatively high among credence attributes by most consumers. None of the classes were willing to pay significant premiums for Australian certified beef. In terms of the production claims, all classes placed significant discounts on certified humane, and only two of the segments (Classes 6 and 7) were willing to pay significant premiums for hormone and antibiotic free beef. The premiums for environmentally sustainable were positive for all classes and significant for four of the seven classes. The estimated values for credence attributes were relatively small compared to those found in other beef DCEs, particularly those for the country-of-origin, production and forage certifications.

Conclusions and Discussion

The study highlights the importance of understanding how consumers process information when making food choices, and presents insight on the validity of estimates from previous studies using DCEs to determine WTP for food attributes. No known studies have explored the relative importance of such a wide variety of both intrinsic and extrinsic attributes both conjointly and visually. We address two import issues that have potentially strong implications for the validity of estimated attribute values: 1) intrinsic attributes are likely to be underestimated in their importance if not presented visually; and 2) DCEs that exclude important attributes (such as intrinsic characteristics) are likely to overestimate the value of product characteristics.

The WTP estimates found in this study for extrinsic credence characteristics are comparatively small, but intrinsic attributes are found to be very important and premiums for specific levels of marbling and fat trim (low in most cases) are relatively high. While our results may confirm the suggested effects of visual attribute presentation and the inclusion of a large set of attributes, they could also be caused by Australian consumers placing considerably less value on credence attributes than U.S. and/or European consumers. We

contend that our research suggests visual attribute level presentation in DCEs results in a less biased value estimates, and that it is not only important to consider what attributes to include, but also how you present the attributes. Furthermore, the relative importance and value to consumers of the attributes examined in this study is currently of interest to applied researchers, policy makers and industry internationally. As such we expect our paper to draw interest and discussion from a wide variety of meeting attendees, including those interested in food marketing, food policy, DCE methods, consumer behavior and extension.

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Table 1. Attributes and Levels used in the Discrete Choice Experiment

	Price	Brand	Quality Certification	Production Claim	Forage Claim	Health Claim	Marbling	Fat Trim
Levels	8	8	8	8	4	4	4	4
Level 1	$15.99	Woolworths	Australian Quality (Aus Qual)	Environmentally Sustainable	Grass-Fed	Heart Tick	Void (0)	Devoid (2 mm)
Level 2	$19.99	Coles	Meat Standard Australia (MSA)	100% Hormone & Antibiotic Free	Grain-Fed	None	Level 2	5mm
Level 3	$23.99	Terra Rossa	Eating Quality Assured (EQA)	Certified Humane	None	None	Level 4	10 mm
Level 4	$27.99	King Island	Australian Beef	None	None	None	Level 6	20 mm
Level 5	$31.99	Coorong Angus Beef	None	None				
Level 6	$35.99	1824	None	None				
Level 7	$39.99	Dalriada Diamond	None	None				
Level 8	$43.99	Certified Australian Angus Beef (CAAB)	None	None				

Table 2. Socio-demographic characteristics of the sample compared to the Total Australian population and the total Australian beef consumer population (Roy Morgan single source data, 2008).

		Total Population	Roy Morgan	Beef Survey Sample (n= 1,881)	
State	NSW	34.6%	33.9%	NSW	27.2%
	Victoria	24.9%	24.2%	Victoria	19.4%
	Queensland	19.8%	20.7%	Queensland	15.3%
	South Australia	7.6%	7.8%	South Australia	25.5%
	Western Australia	10.1%	10.4%	Western Australia	9.5%
	Tasmania	2.3%	2.3%	Tasmania	1.6%
	Northern Territories	0.7%	0.8%	Northern Territories	0.4%
				ACT*	1.2%
Area	Capital Cities	61.9%	59.6%	Metropolitan areas*	69.0%
	Country Area	38.1%	40.4%	Non-capital city*	31.0%
Gender	Female	50.6%	63.7%	Female	66.0%
	Male	49.4%	36.3%	Male	34.0%
Age	14-24	18.0%	5.7%	18-24*	6.7%
	25-34	16.5%	15.3%	25-34	19.5%
	35-49	26.9%	31.4%	35-49	33.4%
	>50	38.6%	47.6%	>50	40.4%
Marital status	single	36.7%	26.8%	Single/Div/Sep/Widow*	30.0%
	married/ de facto	63.3%	73.2%	Married/ partnership*	70.0%
Children at home	yes	37.1%	35.4%	yes	37.5%
	no	62.9%	64.6%	no	62.5%
Number of children	1	15.5%	14.8%	1	16.4%
	2	14.1%	13.8%	2	15.1%
	3+	7.5%	6.9%	3+	6.0%
People living in HH	1-2 People in HH	40.8%	46.1%	1-2 People in HH	50.2%
	3-4 People in HH	43.0%	41.0%	3-4 People in HH	38.5%
	5+ People in HH	16.2%	13.0%	5+ People in HH	11.2%
Personal income (AUD)	Under $20,000	18.8%	20.6%	Under $20,000	8.6%
	$20,000 to $29,999	11.8%	11.9%	$20,001 to $40,000*	17.2%
	$30,000 to $49,999	25.9%	24.8%	$40,001 to $60,000*	17.1%
	$50,000 to $69,999	18.7%	18.2%	$60,001 to $80,000*	17.1%
	$70,000 or More	24.8%	24.5%	$80,001 or More*	40.0%
Education				Some Secondary*	21.6%
	Some Secondary	17.0%	16.1%	Finished Year 12*	18.0%
	Tech./HSC/Year 12	19.6%	19.2%	Have Dip/Degree or Uni*	49.6%
	Diploma or Degree	33.5%	35.0%	Have Postgraduate Degree*	9.6%
Employment	Full time work	39.3%	36.2%	Full time work	41.8%
	Part time work	20.6%	21.2%	Part time work	21.3%
	Not employed	40.1%	42.7%	Not employed	37.0%

*Category differs from Roy Morgan

Table 3. Estimates of scale-extended Latent Class choice model

	C1			C2			C3			C4			C5			C6			C7		
%	20.3%			7.4%			11.1%			14.3%			14.2%			17.2%			8.4%		
N	382			142			206			266			271			322			153		
R^2	74.0%			46.5%			35.3%			78.6%			42.9%			56.3%			46.5%		
	beta	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**
Marbling																					
void 0	5.84	20.56	0.00	-0.24	-1.08	0.28	-5.17	-9.28	0.00	0.32	1.63	0.10	-1.77	-12.09	0.00	2.68	16.21	0.00	-1.29	-8.30	0.00
level 2	2.04	9.47	0.00	2.91	8.52	0.00	0.10	0.60	0.55	0.94	4.90	0.00	0.76	9.37	0.00	1.46	12.62	0.00	1.16	9.57	0.00
level 4	-2.01	-7.28	0.00	0.88	5.01	0.00	2.55	12.01	0.00	-0.34	-1.81	0.07	1.00	11.41	0.00	-0.77	-7.75	0.00	0.96	7.07	0.00
level 6	-5.87	-10.79	0.00	-3.55	-6.45	0.00	2.51	11.48	0.00	-0.93	-4.89	0.00	0.01	0.16	0.87	-3.37	-13.95	0.00	-0.83	-5.09	0.00
Fat Trim																					
2 mm	0.91	7.13	0.00	0.65	5.88	0.00	0.61	7.19	0.00	0.88	3.94	0.00	0.93	8.91	0.00	0.95	9.22	0.00	3.22	8.86	0.00
5 mm	0.50	4.02	0.00	0.54	5.21	0.00	0.74	9.28	0.00	0.24	1.26	0.21	0.35	4.87	0.00	0.22	2.62	0.01	1.60	6.41	0.00
10 mm	-0.39	-3.16	0.00	-0.18	-1.66	0.10	-0.23	-3.45	0.00	-0.47	-2.15	0.03	-0.35	-3.97	0.00	-0.13	-1.58	0.11	-0.93	-5.20	0.00
20 mm	-1.02	-7.89	0.00	-1.01	-7.10	0.00	-1.13	-10.21	0.00	-0.65	-3.11	0.00	-0.93	-11.07	0.00	-1.04	-8.55	0.00	-3.89	-6.19	0.00
Forage Claim																					
Grass-fed	0.24	3.16	0.00	0.21	2.28	0.02	0.07	1.31	0.19	-0.01	-0.07	0.94	-0.04	-0.66	0.51	-0.16	-2.31	0.02	0.13	1.35	0.18
Grain-fed	-0.17	-2.12	0.03	-0.15	-1.78	0.08	0.06	1.11	0.27	-0.07	-0.43	0.67	0.07	1.23	0.22	0.09	1.33	0.18	-0.19	-2.03	0.04
None	-0.07	-0.85	0.39	-0.05	-0.63	0.53	-0.12	-2.51	0.01	0.08	0.50	0.62	-0.03	-0.51	0.61	0.07	1.29	0.20	0.06	0.82	0.41
Health Claim																					
Heart Tick	0.18	2.93	0.00	0.17	2.49	0.01	0.22	5.04	0.00	0.12	1.09	0.28	0.16	3.47	0.00	0.24	4.66	0.00	0.33	5.27	0.00
None	-0.18	-2.93	0.00	-0.17	-2.49	0.01	-0.22	-5.04	0.00	-0.12	-1.09	0.28	-0.16	-3.47	0.00	-0.24	-4.66	0.00	-0.33	-5.27	0.00
Brand																					
Woolworths	-0.28	-1.74	0.08	-0.15	-0.94	0.35	-0.30	-3.00	0.00	0.11	0.46	0.65	-0.13	-1.16	0.24	-0.08	-0.60	0.55	-0.46	-3.32	0.00
Coles	-0.24	-1.55	0.12	-0.13	-0.76	0.45	-0.21	-2.19	0.03	0.23	0.80	0.42	-0.38	-3.22	0.00	0.00	0.04	0.97	-0.04	-0.25	0.80
Terra Rossa	0.33	2.08	0.04	0.17	1.14	0.25	0.13	1.34	0.18	-0.28	-0.98	0.33	0.09	0.99	0.32	-0.01	-0.04	0.97	0.06	0.43	0.67
King Island	-0.02	-0.11	0.91	-0.02	-0.17	0.87	0.30	2.85	0.00	0.02	0.10	0.92	0.40	3.78	0.00	0.14	1.08	0.28	0.40	2.82	0.00
Coorong	0.22	1.54	0.12	0.10	0.57	0.57	-0.12	-1.23	0.22	-0.25	-0.86	0.39	0.26	2.09	0.04	-0.09	-0.74	0.46	0.02	0.14	0.89
1824	-0.07	-0.49	0.62	-0.02	-0.12	0.90	-0.01	-0.14	0.89	-0.10	-0.39	0.70	-0.06	-0.56	0.58	0.39	3.29	0.00	0.03	0.17	0.87
Dalriada	0.08	0.48	0.63	-0.14	-0.88	0.38	0.02	0.21	0.84	0.45	1.59	0.11	0.02	0.16	0.87	-0.40	-3.11	0.00	-0.06	-0.40	0.69
CAAB	-0.02	-0.13	0.90	0.20	1.33	0.18	0.20	1.92	0.06	-0.18	-0.69	0.49	-0.20	-1.63	0.10	0.03	0.24	0.81	0.05	0.33	0.74

R^2= 0.546; LL =-23,622; BIC(LL) = 48,895, n = 1,881, #parameters = 219; Classification Error = 0.0834, 7 classes, 1 random class (n=139) and 2 Scale Classes

Table 3. Continued. Estimates of scale-extended Latent Class choice model

	C1			C2			C3			C4			C5			C6			C7		
%	20.3%			7.4%			11.1%			14.3%			14.2%			17.2%			8.4%		
N	382			142			206			266			271			322			153		
R^2	74.0%			46.5%			35.3%			78.6%			42.9%			56.3%			46.5%		
	beta	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**	**beta**	**z**	**sign.**
Quality Certification																					
Aus Qual	0.05	0.34	0.74	0.07	0.53	0.60	0.13	1.26	0.21	-0.16	-0.64	0.52	-0.07	-0.69	0.49	-0.12	-1.16	0.25	-0.17	-1.17	0.24
MSA	-0.02	-0.16	0.88	0.42	3.02	0.00	0.06	0.63	0.53	0.53	2.33	0.02	-0.04	-0.44	0.66	0.09	0.82	0.41	0.07	0.50	0.61
EQA	0.10	0.62	0.54	-0.06	-0.40	0.69	-0.04	-0.36	0.72	-0.53	-1.99	0.05	-0.13	-1.22	0.22	-0.31	-2.30	0.02	0.12	0.85	0.40
Australian Beef	-0.03	-0.22	0.82	-0.20	-1.38	0.17	-0.10	-1.05	0.29	0.19	0.70	0.48	0.30	2.69	0.01	0.27	2.49	0.01	-0.01	-0.05	0.96
None	-0.09	-0.88	0.38	-0.24	-2.41	0.02	-0.05	-0.92	0.36	-0.04	-0.22	0.83	-0.05	-0.83	0.41	0.08	1.08	0.28	-0.02	-0.21	0.83
Production Claim																					
Enviro. Sustainable	-0.20	-1.26	0.21	-0.03	-0.23	0.82	-0.14	-1.47	0.14	-0.29	-1.42	0.16	0.00	-0.02	0.99	0.36	3.19	0.00	-0.20	-1.62	0.11
Hormone/ Anti. Free	0.20	1.35	0.18	0.18	1.24	0.21	0.35	3.72	0.00	0.12	0.47	0.64	0.18	1.69	0.09	-0.18	-1.54	0.12	0.19	1.42	0.16
Certified Humane	-0.10	-0.65	0.51	-0.10	-0.69	0.49	-0.03	-0.39	0.70	-0.09	-0.45	0.66	-0.19	-1.92	0.06	-0.23	-1.96	0.05	0.13	0.90	0.37
None	0.10	1.13	0.26	-0.04	-0.47	0.64	-0.17	-2.99	0.00	0.25	1.79	0.07	0.01	0.10	0.92	0.05	0.71	0.48	-0.12	-1.53	0.13
Price																					
$15.99	0.86	5.76	0.00	0.13	0.66	0.51	0.72	6.83	0.00	7.95	17.52	0.00	2.66	15.97	0.00	3.31	15.58	0.00	0.59	3.83	0.00
$19.99	0.58	3.75	0.00	0.39	2.68	0.01	0.65	6.20	0.00	6.01	16.29	0.00	2.16	14.51	0.00	2.62	15.60	0.00	0.77	4.53	0.00
$23.99	0.73	3.91	0.00	0.51	2.94	0.00	0.38	4.03	0.00	3.14	11.10	0.00	1.93	14.01	0.00	1.98	10.08	0.00	0.32	2.39	0.02
$27.99	0.18	0.97	0.33	0.15	0.90	0.37	0.02	0.17	0.86	-0.40	-1.05	0.29	0.39	3.12	0.00	0.07	0.45	0.65	-0.02	-0.11	0.91
$31.99	0.18	0.89	0.37	0.01	0.05	0.96	-0.02	-0.23	0.82	-2.68	-6.06	0.00	-0.45	-3.23	0.00	-0.34	-2.68	0.01	-0.11	-0.49	0.63
$35.99	-0.29	-1.42	0.16	-0.18	-0.89	0.37	-0.48	-4.07	0.00	-4.08	-5.48	0.00	-1.15	-6.68	0.00	-1.64	-9.27	0.00	0.07	0.51	0.61
$39.99	-0.87	-5.77	0.00	-0.42	-2.30	0.02	-0.55	-5.10	0.00	-4.03	-6.62	0.00	-2.28	-9.32	0.00	-2.75	-10.52	0.00	-0.65	-3.55	0.00
$43.99	-1.37	-6.73	0.00	-0.58	-3.70	0.00	-0.72	-5.80	0.00	-5.92	-7.63	0.00	-3.27	-8.90	0.00	-3.24	-11.47	0.00	-0.98	-5.48	0.00

R^2= 0.546; LL =-23,622; BIC(LL) = 48,895, n = 1,881, #parameters = 219; Classification Error = 0.0834, 7 classes, 1 random class (n=139) and 2 Scale Classes

Table 4. Aggregated attribute importance weightings [i]

Attribute	Importance
Marbling	46.3%
Price	34.7%
Fat Trim	10.6%
Health Claim	0.5%
Brand	0.5%
Production Claim	0.2%
Quality Certification	0.2%
Forage Claim	0.1%

[i] Weighted average of class wise importance measured by partial contribution to model fit – LL.

Table 5. Marginal Willingness to Pay Estimates by Latent Class

Size	Average n = 1742	Class 1 22.5%		Class 2 21.6%		Class 3 16.4%		Class 4 11.8%		Class 5 11.7%		Class 6 8.8%		Class 7 7.1%	
Attributes	**WTP**	**WTP**	**z$**	**WTP**	**z$**	**WTP**	**z$**	**WTP**	**z$**	**WTP**	**z$**	**WTP**	**z$**	**WTP**	**z$**
Marbling															
void (0)	3.26	3.62 ***	15.76	3.98 ***	19.49	-2.53 ***	-14.05	5.61 ***	29.70	6.88 ***	47.63	5.74 ***	86.15	0.27	1.02
level 2	1.01	0.50 ***	1.96	1.02 ***	4.11	1.37 ***	5.02	1.12 ***	3.99	1.11 ***	5.02	1.44 ***	4.45	0.91 ***	3.31
level 4	-1.32	-1.78 ***	-7.36	-1.61 ***	-7.33	1.62 ***	6.27	-2.50 ***	-10.90	-2.90 ***	-16.63	-2.20 ***	-17.36	-0.04	-0.16
level 6	-2.95	-2.34 ***	-10.06	-3.40 ***	-17.27	-0.46 ***	-2.15	-4.22 ***	-21.93	-5.09 ***	-35.35	-4.98 ***	-42.37	-1.14 ***	-4.67
Fat Trim															
Devoid	1.78	1.06 ***	3.72	1.79 ***	6.65	2.60 ***	9.87	1.86 ***	5.54	1.92 ***	8.05	2.27 ***	6.58	1.23 ***	4.21
5 mm	0.47	0.19	0.66	0.42	1.52	1.26 ***	4.70	0.06	0.17	0.09	0.36	0.48	1.37	1.02 ***	3.58
10 mm	-0.52	-0.36	-1.31	-0.42 *	-1.63	-1.16 ***	-4.93	-0.41	-1.21	-0.32	-1.32	-0.27	-0.85	-0.67 ***	-2.61
20 mm	-1.74	-0.89 ***	-3.59	-1.79 ***	-7.60	-2.70 ***	-12.46	-1.51 ***	-4.82	-1.69 ***	-7.82	-2.48 ***	-8.94	-1.59 ***	-6.17
Forage Claim															
Grass-fed	-0.30	-0.37	-1.29	-0.24	-0.83	-0.47 *	-1.66	-0.01	-0.03	-0.35	-1.29	-0.48	-1.35	-0.08	-0.26
Grain-fed	-0.03	-0.03	-0.11	-0.22	-0.74	0.44	1.39	-0.53	-1.43	-0.22	-0.76	-0.01	-0.04	0.59	1.80
none	0.33	0.40	1.14	0.45	1.37	0.04	0.10	0.54	1.43	0.56 *	1.79	0.49	1.23	-0.51	-1.45
Health claim															
Heart Tick	0.22	0.29	0.67	0.39	0.95	0.19	0.49	0.00	-0.01	0.00	-0.01	0.23	0.47	0.21	0.48
None	-0.22	-0.29	-0.67	-0.39	-0.95	-0.19	-0.49	0.00	0.01	0.00	0.01	-0.23	-0.47	-0.21	-0.48
Brand															
Woolworths	-0.04	0.16	0.94	0.35 ***	2.09	-1.05 ***	-6.62	0.26	1.15	0.50 ***	3.29	-0.44 ***	-2.67	-0.49 ***	-2.93
Coles	-0.37	0.18	1.01	-0.22	-1.34	-0.83 ***	-5.19	-0.10	-0.48	-1.58 ***	-11.31	-0.54 ***	-3.09	0.30 *	1.64
TerraRossa	0.17	-0.06	-0.38	0.09	0.53	0.49 ***	2.80	0.05	0.21	0.57 ***	3.72	0.08	0.34	0.08	0.44
King Island	0.45	0.80 ***	4.69	0.60 ***	3.70	0.15	0.91	-0.17	-0.84	0.39 ***	2.81	0.94 ***	4.93	0.12	0.71
Coorong	-0.27	-0.78 ***	-4.21	-0.61 ***	-3.51	0.04	0.23	0.04	0.19	0.64 ***	3.78	-0.56 ***	-3.09	0.05	0.27
1824	0.50	0.39 ***	2.30	0.50 ***	2.99	0.46 ***	2.66	0.40 *	1.83	0.95 ***	5.83	0.82 ***	4.66	-0.05	-0.28
Dalriada	-0.27	-0.57 ***	-3.68	-0.40 ***	-2.51	0.43 ***	2.50	-0.28	-1.38	-0.65 ***	-4.64	0.02	0.10	-0.18	-1.07
CAAB	-0.18	-0.11	-0.62	-0.32 **	-1.88	0.30 ***	1.94	-0.20	-0.95	-0.83 ***	-5.42	-0.31	-1.54	0.17	0.98
Quality Certifications															
AusQual	-0.71	-0.47 ***	-2.77	-0.84 ***	-5.10	0.00	-0.03	-1.28 ***	-6.71	-1.48 ***	-9.90	-1.23 ***	-6.23	0.25	1.29
MSA	0.60	0.39 ***	2.07	0.47 ***	2.56	0.10	0.55	1.24 ***	5.51	1.31 ***	7.62	0.83 ***	5.07	0.27	1.40
EQA	-0.16	-0.33 **	-1.92	-0.07	-0.44	-0.05	-0.28	0.12	0.55	-0.11	-0.69	-0.33	-1.66	-0.50 ***	-2.82
Austral Beef	0.04	0.14	0.73	0.01	0.07	0.02	0.12	0.08	0.32	-0.06	-0.36	-0.08	-0.41	0.13	0.67
None	0.23	0.27	0.95	0.44 *	1.61	-0.06	-0.23	-0.16	-0.44	0.34	1.29	0.81 ***	2.67	-0.14	-0.48
Production Claim															
Enviro. Sustainable	0.34	0.35 **	1.85	0.41 ***	2.23	0.32 *	1.69	0.18	0.76	0.61 ***	3.57	0.21	0.92	0.12	0.59
Horm. & Antibiotic Free	0.17	0.12	0.65	0.07	0.41	0.24	1.39	0.17	0.75	0.03	0.21	0.53 ***	2.44	0.31 *	1.73
Certified Humane	-0.64	-0.60 ***	-3.22	-0.62 ***	-3.47	-0.57 ***	-3.28	-0.42 *	-1.75	-0.96 ***	-6.06	-0.86 ***	-3.82	-0.57 ***	-3.01
None	0.13	0.12	0.40	0.14	0.48	0.01	0.04	0.06	0.18	0.32	1.21	0.12	0.34	0.14	0.45

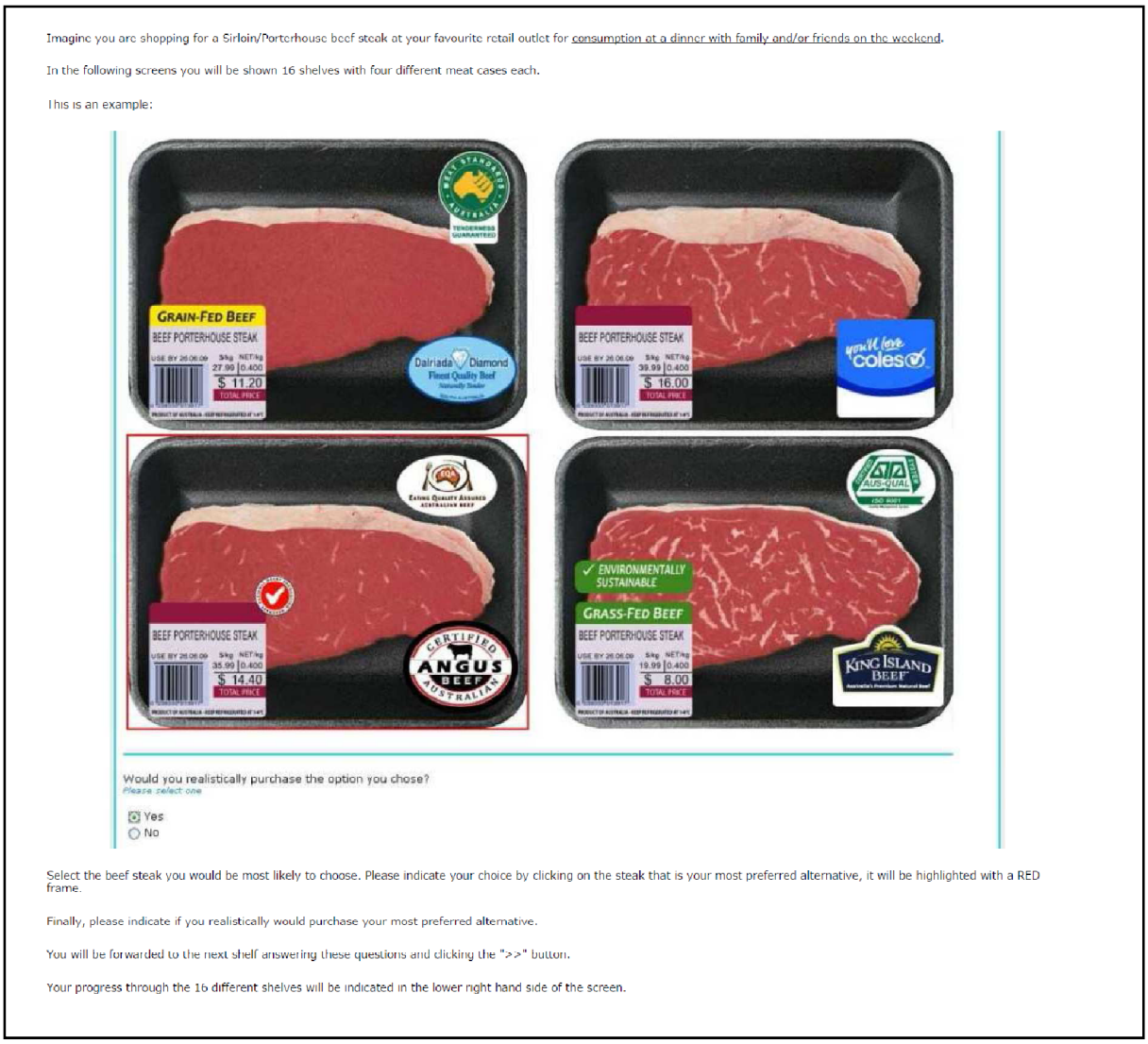

Figure 1. Example of Choice Set