Putting Bambi in the Firing Line:

Applying Moral Philosophy to Environmental and Economic Attitudes on Deer Culling

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Abstract

Whilst the field of behavioural economics has comprehensively demonstrated the frequent inability of rational choice models to replicate empirical action, few studies offer clear and consistent hypotheses regarding the underlying reasons for these systematic differences. The role of intent could form one explanation, and this study explores how the role of procedural intention may impact upon the preferences of individuals. Using discrete choice experiments, we test the theoretical conjectures of the Trolley Problem and Doctrine of Double Effect by applying this notion to deer culling and woodland management scenarios in East Anglia, UK. The results indicate that procedure and intentions-based considerations may hold as great an importance as outcome-based or ethical ones in this context. Furthermore, human attitudes to animal death may be fuelled by a complex combination of moral opinion, environmental engagement and economic efficiency. The implication is that both behavioural economists and policy-makers must exercise great caution when addressing ethically contentious issues. They must seriously contemplate the context-specific attitudes which agents may hold over procedure and justification in order to derive effective and socially-optimal outcomes.

Keywords: doctrine of double effect, role of intentions in behavioural economics, discrete choice experiment, nature connectivity, local wildlife valuation

JEL codes: Q26, Q57, H42, C35, D63, D71

1. INTRODUCTION

The field of behavioural economics has comprehensively shown that expecting individuals to behave in accordance with a model describing the fully rational and utility maximising agent will consistently fail to deliver results which coincide with empirical findings. Indeed, the associated literature is vast, with examples of such 'bounded rationality' famously presented in areas such as myopia and inadequate self control (Fudenberg & Levine, 2006), gambling fallacies (Huff & Geis, 1959), consumer inconsistencies (Strotz, 1956) and risk aversion (Pratt, 1964). In some situations, people do make suboptimal or erroneous choices as they deviate from the rational choice model. Yet it is equally true that many of these alternative preferences are not systematic errors, but instead represent a genuine preference construction which standard economics has been unable to incorporate into its utility maximising function. These systematic differences can often be reinforced

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by experimental studies. Relative to empirical data analysis, experiments hold the advantage of creating specific treatments in order to exemplify more cleanly the alternative hypotheses which they are testing.

Whilst huge advances have been made proving that humans consistently display choices disparate from those which traditional economics would estimate, far fewer studies attempt to illustrate *why* such differences are observed. Whilst it is insightful to show whether people hold alternative preference structures, it is surely of equal importance to discover a reason for this. If this can be achieved, the field can begin to assess transferability of a given study's findings and make more accurate projections regarding if, and if so to what extent, individuals will deviate from standard economic theory in a given situation or scenario.

Intention is one area which behavioural economists propose might drive us to exhibit boundedly-rational choices. In human psychology, we may not focus as heavily on the outcome which a method delivers *per se*, but instead contemplate the procedure by which that result has been achieved and whether the intentions of the agent responsible correspond to those which are judged as just or ethical. A classic case from the literature in experimental economics involves the perceptions an individual regarding procedural fairness. Work by Fehr & Schmidt, 1999 and Bolton & Ockenfels, 2000 clearly show how constructing a utility function that incorporates such aspects readily improves the predictive nature of a model designed to replicate the real actions of laboratory participants. Many other studies, including those of Ajzen, 1991; Terry et al, 1999; Falk at el, 2003 and Bolton et al, 2005 have considered the role of intention and procedure and the potentially important role this plays in determining one's choices.

This study focusses more specifically on how intentions may impact upon our choice structures through ethical reasoning. Using discrete choice experiments, we test the attitudes of respondents to animal culling, comparing our results to those which exist both theoretically and experimentally from the field of moral philosophy and The Doctrine of Double Effect. This hypothesis, which uses 'Trolley Problems' as its instrument of demonstration, proposes that human attitudes are not purely defined by outcomes, but instead by perceptions regarding whether associated harm is created as a direct consequence of action, or whether it is an unintended but unavoidable secondary impact. We shall return to this underlying theory and its existing applications.

We apply the framework of moral opinion and procedural intention to the field of environmental economics. The first reason for this concerns how humans derive subjective well-being. The current literature advocates activities where humans receive a sense of responsibility, dependence and/or repeated interaction (see Diener & Biswas-Diener, 2008 for an overview). This literature has advocated practices like interaction through communal groups, religious activity and family, all of which enable the individual us to feel interconnected and give stability and routine to their life. Engagement with out local environment holds the potential to improve our life satisfaction through the same channels. This relationship, which could be termed 'Nature Connectivity' (Dutcher et al, 2007) has seemingly proved utility-enhancing for humans in areas like pet care (Johnson, 2011), gardening (Rappe, 2005) and bird feeding (Brock, Sugden & Perino (2014); forthcoming). In each case, humans derive satisfaction from the 'warden' role they assume in relation to the wildlife, and derive pleasure from the qualities of repetitiveness and protective

responsibility which arise from this engagement. Furthermore, this value appears to be unique to local nature, and forms a distinct and disparate worth from that of conservation or preservation which people establish through classic donation mechanisms.

Studying the role of procedure and intention in this setting affords us the opportunity to test how the role of engagement with local wildlife might conflict with long-term environmental sustainability. In the aforementioned examples, warden tendencies typically complement wider environmental objectives. For example, the desire to feed garden birds in order to attain well-being through these channels simultaneously raises the survival chances of these species, benefitting long-term conservation efforts. This is not so when we consider the role of nature connectivity for species where culling is required. In many cases, the cull is seen as 'necessary' because the species' population is sufficiently high to detrimentally impact upon the wider ecosystem, local economy or another social aspect. This gives a justifiable reason for humans to intervene in the natural environmental balance. This can especially be true if, as in many circumstances, humans are at least partially responsible for the population explosion through predator removal or species introduction. Despite this, the act of culling conflicts with our human desire to act as a warden and this associated action, even if 'well-intended' for long term environmental sustainability, might be opposed by a human who places a strong emphasis upon nature connectivity.

A second reason why intentions-based reasoning might be particularly insightful for environmental situations relates to the highly context-specific nature of this subject. Environmental attitudes and perspectives are often driven by emotive or moral perspectives, meaning that outcomes *per se* may not always form the primary consideration. Assessing procedural attitudes through environmental examples might not hold a greater impetus relative to other fields, but could correspond nicely to associated policy implications regarding if and to what extent caution must be paid by decision-making authorities when forming associated proposals.

The remainder of the paper is set out as follows. Section 2 outlines the theory and associated literature on the Doctrine of Double Effect and Trolley Problems; Section 3 gives a comprehensive overview of the survey design, methodology and implementation; Section 4 presents the results whilst Section 5 then proceeds with a discussion of these. Section 6 concludes, and offers some recommendations for the field in light of these findings.

SECTION 2: THE DOCTRINE OF DOUBLE EFFECT AND TROLLEY PROBLEMS

The Doctrine of Double Effect (hereafter DDE) gives an illustration of how moral attitudes can alter given the perception held regarding an individual's intention from their action. The ethical exploration of DDE was first approached by Philippa Foot in 1935, who investigates how the human attitude to moral permissibility can adjust by using a combination of theory and empirical examples. Perhaps the most famous (and certainly most intensely scrutinised) of these examples is that of the 'Trolley Problem'. Whilst various strains of this ethical dilemma have been concocted since Foot's initial discussion, its basic underpinnings are detailed below:

Story 1: *Whilst stood next to a rail track you notice an out-of-control trolley hurtling down a hill. In its path are five individuals. The sides of the track are steep and so the five have no way of escaping. There is also no way of stopping the trolley, which means that if you do nothing it is sure to hit and kill all five with certainty. You happen to be stood next to a lever which you can push. By doing so, you will divert the speeding trolley onto an alternative track, preventing the death of the five. However, on this other line is one individual who again has no means of escape. If the trolley is switched onto the other line, this individual will be killed with certainty.* ***Should you push the lever?***

Story 2: *Whilst stood on a bridge overlooking a rail track, you notice an out-of-control trolley hurtling down a hill. In its path are five individuals. The sides of the track are steep and so the five have no way of escaping. There is also no way of stopping the trolley, which means that if you do nothing it is sure to hit and kill all five with certainty. You happen to be stood next to large man, also watching this event unfold from the bridge. You realise that if you push this man into the path of the speeding trolley then his size will be sufficient to de-rail the trolley, preventing the death of the five. However, the force of the trolley hitting the large man will kill him with certainty.* ***Should you push the large man?***

Foot's predicts that people typically believe the action of pushing the lever to be ethically permissible, but that of pushing the large man not to be so. Yet from an outcomes perspective we see no distinction between stories 1 and 2 - the consequence of either action is the sacrifice of one to prevent the death of five. This creates the 'Doctrine of Double Effect'.

Foot states that the opposing moral stances taken in each case are due to differences in the intentions of one's action. In Story 1, pushing the lever directly intends to save the five individuals, and under different circumstances the same action could have achieved this without causing any death (i.e. had there been no individual on the alternative line). Therefore, the death of the one is a foreseen but unavoidable side-effect of the initial action. By contrast, the death of the large man which occurs through your action in Story 2 is a direct and necessary means by which you achieve saving the five. Foot understands it to be this aspect of Story 2 which creates the ethical objection, with distaste being expressed even when the 'good' final outcome from your action might appear justifiable.

Following Foot's construction of the Trolley Problem and its relation to DDE, many philosophers and theorists have revisited and extended the dilemma. Notable contributors include Thompson, 1976; 1985, Ungur, 1992 and Kamm, 1996. These authors have elaborated upon the ethical reasoning which surrounds the Trolley Problem by including aspects of anonymity, settings-based additions such as loop effects and other social considerations. More recently, this theoretical literature has been complemented by experimental philosophy, and research by Lanteri et al, 2008 and Liao et al, 2012 have examined, and generally reinforced, the conjectures of Foot and others by running hypothetical laboratory treatments.

DDE is potentially troublesome for standard economic theory to accommodate. This branch of economics believes a utility-maximising agent should only ever consider the outcome or pay-off of an event. Because the results from Story 1 and Story 2 are identical, Rational Choice Theory has no way to attenuate the ethical disparity and corresponding switch in preference which occurs when moving from one to the other. As a research area, experimental philosophy is still relatively infant, and another reason this study may be important is that it can seek to maximise the synergies which exist between the two disciplines. Indeed, the experimental skills which behavioural economists have sharpened considerably over the years could aid revealing answers to the strong theoretical ethical quandaries of DDE which the field of philosophy have thrown into the academic sphere.

We assess DDE through the conduct of discrete choice experiments, evaluating people's attitudes to deer culling and its use in facilitating effective woodland management. This research contributes to the literature in a number of ways. To the best of our knowledge, it is the first study which applies discrete choice models to the Trolley Problem, and certainly the first to do so in order to explore animal death. To this end, the paper looks not only to assess how and to what extent people's moral perceptions on non-human harm correspond to those for our own species, but also exploit the benefits of applying economic modelling to long-standing philosophical dilemmas.

The main objective of this study will assess if, and to what extent, humans apply the ethical reasoning of Trolley Problems when forming preferences over wildlife culling. Whilst forming the primary goal of this paper, subsidiary aims also exist when conducting these experiments. One such aim is to identify whether nature connectivity plays an important role in determining preference construction and, if so, how this might conflict with long term environmental sustainability. In relation to economic factors, the experiment also includes attributes (or aspects) which test people's desire for efficiency and cost-effectiveness. It is quite plausible that only by analysing the combined influence of these aims that the most complete picture can be derived regarding how respondents formulate preferences over a topic that challenges economic optimisation, environmental degradation and our ethical standpoints.

3. SURVEY DESCRIPTION AND METHODOLOGY

Designing the Survey

The respondent survey contained two sections; the choice modelling exercise and a questionnaire gauging information regarding each individual's topic-specific attitudes and socio-demographic details.

a) The Choice Experiment

Based on Lancaster's Characteristics Approach (Lancaster, 1966), discrete choice experiments assume that a good's value can be established through its constituting attributes. Not only do the characteristics carry value, but these are formed independently from the way in which they are bundled. We describe each of the attributes used in the study below and explain not only how each were characterised and defined to respondents, but also their assumed importance in achieving answers to the aims of the paper outlined above. An example choice set, providing a visual interpretation of a given choice set's design and layout, can be found in Appendix A.

Woodland Quality

Respondents were told that the choice experiment was about woodland management attitudes and so presenting this aspect first seemed logical. Each option held an associated woodland score, an example of which is shown in Figure 1. This attribute was by far the most lengthy to describe, and this was another reason for introducing it first. Explanations of all attributes were provided through tutorial-style instructions that a respondent received prior to the choice tasks (see Appendix B and below).

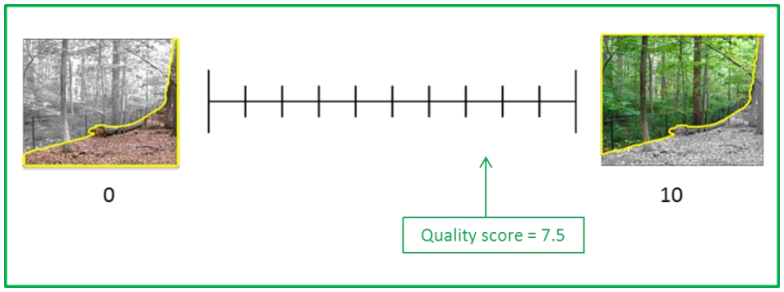

Figure 1: A Typical 'Woodland Quality' Attribute

Each participant was informed that all alternatives had a corresponding woodland quality score, ranging from 0 to 10. The yellow-bordered sections of Figure 1 showed how this scales' extremes related to a previously shown image that had depicted the impact of a deer-proof fence on woodland vegetation. The description of 'Quality' was left deliberately vague, and the instructions simply suggested that higher quality scores achieved a forest whose healthiness with regards to biodiversity was superior. This aimed to prevent heterogeneous users from forming different and complicating notions of 'quality'. For example, if the tutorial had described quality to mean overgrown, cyclists or photographers may have been dissuaded by high quality options to a greater extent than walkers or nature-lovers. An integer scale was deemed the easiest way for respondents to comprehend the scoring system, and this was confirmed by presenting a range of alternative scoring mechanisms at the pilot testing stage.

Respondents were told that a woodland quality could be achieved through either exclusive or mixed policies of fencing and culling. It was also suggested that forest mangers might use other methods to establish a certain grade of forest, like constructing designated cycle tracks. This held two purposes. From the respondent's perspective, we hoped this would prevent them speculating too deeply on how quality changes might occur between cases. More importantly, this enabled us to derive orthogonal choice sets with greater ease and credibility.

Pilot surveys were used to gauge the comprehension of this scale-based mechanism. Focus groups seemed to grasp the concept fairly well, although to mitigate against and confusion the tutorial text was complemented by a verbal prompt, reiterating that the further scores were to the left-hand side of the scale, the greater the forest's degree of degradation.

In relation to DDE, it was important that this element was introduced first. From an intentions standpoint, the enhancement of woodland quality is the 'well-intended' objective of an agent, like saving the five. Therefore, before the methods of achieving high quality woodland were conveyed (i.e. through deer population reduction), it appeared essential to primarily instil the policy-based objective to the topic.

Deer Populations

East Anglia's deer populations were the next attribute to be described in the tutorial. This description appeared in the form given by Figure 2.

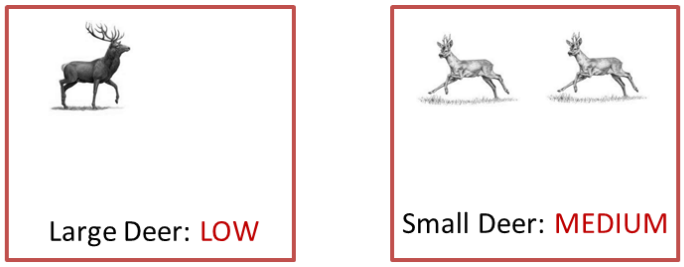

Figure 2: The Deer Populations Attribute

Participants were given some background information regarding 'Large' and 'Small' deer. This included species names and the associated destruction that each might typically cause. It was conferred that each population could exist at Low, Medium or High thresholds, and a key gave a visual and written representations of these levels. In relation to the latter, it was described how each population level might compare with a 'use value', stating the likelihood of seeing a deer of each species.

Respondents were told that any deer population change was relative to Option C and would happen over a two-year period. Reiterated in the next subsection of method of population change, instilling that changes should be compared to the constant Option C was deemed important as this was the area of pilot testing which respondents had struggled to comprehend the most.

Although six species of deer reside within the East Anglian region, there were two reasons for defining deer through just two 'types'. The first relates to simplicity; we held no information of a respondent's depth of deer knowledge (i.e. whether species were native, common, destructive etc.) and so a broad categorisation prevented a requirement to relay this detail, which could have led to instances of survey disengagement and/or unnecessary cognitive burden. Nevertheless, we wanted to disaggregate deer values through the most salient of characteristics for our study. Given our aim to explore nature connectivity, deer size formed this most salient feature. By suggesting that both 'Large' and 'Small' deer could be equally destructive, any elevated value elicited for smaller deer

could pertain to warden-type preferences. Roe and Muntjac (small) deer certainly constitute species which appear more vulnerable and dependant on human aid than the more physically robust Fallow or Red (large) species. Furthermore, these two groupings vary in their behaviour and Roe and Muntjac deer will typically frequent people's local areas more often, affording greater opportunities for repeated interaction. Of course, it is feasible that a respondents' historical experiences of species-related destruction could interfere with this valuation profile and, as such, we approach these interpretations with caution.

Deer Population Change

The tutorial introduced deer population reduction mechanisms as its third attribute. Table 1 illustrates how each method relates to both the Trolley Problem (and thus DDE) and intentions-based reasoning:

		Trolley/DDE Equivalent	Intentions Perception
1	Licenced Hunter Culling	Story 2 (Unethical)	Bad Intention
2	Forestry Commission Culling	Story 2 (Unethical)	Good Intention
3	Fencing	Story 1 (Ethical)	Good Intention

Table 1: How Deer Population Reduction Methods relate to DDE and Intentions

Licenced hunting most closely resembles Story 2 (the bridge version) of the Trolley Problem. By telling people that hunters undertook culling as a leisure activity, this implied that the deer's death was both a necessary and intended component of their action. Furthermore, licenced hunters cull for 'bad' reasons. By this, a hunter typically shoots deer with little regard to the positive externality this has for environmental sustainability and its affiliated benefits for woodland management. Instead, they are motivated in order to fulfil their private desire to kill. It is this intentions-based component which distinguishes licenced hunter and Forestry Commission culling methods. Commission culling still involves shooting deer and therefore conforms to Story 2 and retains 'DDE immorality'. However, from an intentions standpoint, a Forestry Commission huntsperson is employed to ensure long-term woodland preservation. Consequently, it is credible to believe that whilst reducing deer numbers through 'unethical' means, Commission workers possess a more palatable justification for this action.

The third method, fencing, coincides with Story 1 of the Trolley Problem. The action of erecting a fence is done primarily to ensure long-term woodland sustainability. A foreseen but secondary consequence of this action is that deer starve, yet their death was not a necessary condition for the fencing to have achieved its primary aim. Through the rationale of DDE, it is feasible to assess this action as ethically permissible.

Figure 3a illustrates how this attribute was portrayed to survey participants. Again, it was explained that adjustments were relative to Option C. Because populations could rise or fall, the wording altered to that of Figure 3b for the latter situation.

Of every additional 100 deer which die:	
90	are culled by the Forestry Commission
10	are culled by Licenced Hunters
0	starve from fenced woodland

Figure 3a: Method with Deer Population Falling

Of every 100 deer which no longer die:	
100	are not culled by the Forestry Commission
0	are not culled by Licenced Hunters
0	do not starve from fenced woodland

Figure 3b: Method with Deer Population Rising

Because the adjustment to this wording was so slight, a verbal prompt was issued by the experimenter for every participant whenever the first case of Figure 3b appeared in the choice task. Alongside this, each alternative included a box which explicitly indicated whether populations were projected to "Rise" or "Fall" relative to Option C (see Appendix A). The combination of these two factors seemed sufficient to ensure respondents recognised when each scenario was being presented.

A detailed slide within the tutorial explained each method. Whilst maintaining ethical impartiality was key to this experiment, the tutorial had to draw attention to factors such as the enjoyment which licenced hunters would yield from culling and the deer starvation that would occur should a policy advocating a high degree of fencing be pursued by the woodland management organisation. These might have appeared as emotive prompts to participants, influencing any subsequent findings. However, a failure to explicitly include these facets could mean a significant proportion of respondents failed to fully appreciate or distinguish between the various consequences of each methodological action. One mitigation strategy was to intersperse these statements with other method-specific aspects, such as the associated cost advantages and drawbacks to each system. This should dilute any potential interviewer or framing biases which might have occurred through our descriptions.

Regarding general task comprehension, very few problems appeared to arise and respondents actively engaged with the method-based attribute. This was assumed through the many instances of verbal reasoning which participants would express as they made their decisions.

Meat Sales

This comprised a very simple attribute to include and describe but as we shall later see holds great relevance for our sample. It was explained that the venison meat would be sold only for deer which had died via culling methods, and that the beneficiary of the corresponding revenues would be whichever party had undertaken the cull.

Once again, it was made clear that there were financial advantages should this were the Forestry Commission, and this could reduce the costs of delivering a woodland management scheme. Technically, it seemed wise to confer this so as to retain consistency with previous cost-related cues. However, from an intentions-based standpoint, this also hoped to test our sample's attitude toward licenced hunters selling the venison. A raised tendency to support this form of culling could represent an ethical judgement that the licensed hunter now has an alternative and more permissible justification for shooting deer. Likewise, these hunters profiteering from their ill-intended deed might actually decrease instances of agreement with this method. We shall return to this in our results section.

Cost Attribute

The final attribute, vital to any choice modelling exercise, is the payment vehicle. One of the greatest obstacles when choice modelling methodology is applied to fields such as environmental management is to ensure that this payment mechanism instils both credibility and realism in both its magnitudes and format of delivery.

Given that the Forestry Commission is a Government-funded organisation, we were able to credibly use taxation as this study's payment instrument. Of course, we remain wary of the ethical or cognitive disadvantages which accompany the use of taxation in this way, but given the topic and the magnitudes of change expressed here, did not feel these impacts would occur to any vast extent.

The use of taxation potentially holds a greater impetus than if described for other services. This is because in the UK there has been a relatively intense and well documented debate on how public forests are financed (www.independent.co.uk). Advantageous from our perspective, this has meant that people are now better informed of how woodland management is funded and the plausibility that taxation alterations may be enforced due to ongoing funding pressures.

Once again, respondents were informed that cost changes were expressed relative to Option C. We wanted to ensure that each respondent felt financial impacts would impact upon them personally, and so worded the tutorial so that cost changes comprised a flat annual levy placed upon each and every resident of East Anglia. This simultaneously looked to dampen any ethical protests from respondents who felt they were already over-burdened with taxation. In terms of magnitudes, consultations took place with the Forestry Commission regarding associated training, staffing and monitoring costs so as to derive reasonable attribute levels. These took four possible tiers, namely for an option to cost £5.00 less, yield no change in cost or impose an additional £5.00 or £10.00 payment.

b) The Socio-demographic Survey

The survey's second section required the completion of a questionnaire. This invited a range of answers regarding one's environmental attitudes, associated behaviour and demographic status. These were chiefly posed to assess if and to what extent these aspects held explanatory power for valuations, with the latter also ascertaining the degree of sample representation. Respondents were informed that all questionnaires were anonymous and that disclosed information would be used solely for data analyses. A sample questionnaire is provided in Appendix C.

Attitudinal and Behavioural Questions

Forming six of the eleven questions asked these comprised a mix of action and opinion-based questions. Participants were asked how they interacted with woodlands, enquiring as to their visit frequency (question 1) and the range of activities they undertook (question 2). Questions 4 and 5 respectively asked if a respondent had contributed to an animal welfare and/or environmental charity within the last 12 months, or whether they regularly fed birds in their garden. Question 5 was of particular interest, partially through previous work conducted in this field (see Brock, Sugden & Perino (2014); forthcoming). More specific to the aims of this paper, we perceived that those who engaged in bird feeding place a value upon local nature connectivity and this may impact upon the preferences they gave regarding deer management.

Questions 3 and 6 invited opinions-based answers from participants. Question 3 asked whether participants agreed (in principle) with culling and fencing as schemes for population control. For culling, we asked this in relation to both deer and badgers in the knowledge that the latter is a highly topical and contentious UK initiative. The justification for badger culling (namely to prevent the spread of tuberculosis in cattle) is based upon questionable scientific evidence. Relative to the more proven reasons for deer culling, this seemed a relevant and interesting facet to include within our study. For all three policies, respondents could select a 'Don't Know' option, deliberately designed to make no distinction between those possessing a lack of knowledge and those who, in view of the current evidence, felt unable to actively express an opinion. Question 6 offered a (1 – 5) Likert Scale which asked respondents for their strength of agreement with whether they believed (a) in effective forest management, (b) culling deer was preferable to starvation and (c) that educating children in environmental studies was important. We expected a general agreement these fairly innocuous statements, but gave some measure for people's notions of nature connectivity and its role in providing sustainable resources for future generations.

Socio-demographic Questions

Forming the final five questions of our study, these requested standard demographics of gender (question 7), brackets for age (question 8) and income group (question 9). Around 15% of respondents chose not to disclose their income bracket, although anecdotally many explained this was due to a lacking knowledge of their annual household income as opposed to any form of protest.

The final questions asked whether those surveyed had participated in shooting or fishing (question 10) or were vegetarian or vegan (question 11), both of which have a clear transferability to the topic itself. Confirmed by the response distributions contained in Appendix D, the small sample size for those responding positively to question 10 meant only question 11 was fit for this purpose.

The Empirical Model

The data is analysed using a Logit model. Algebraically, this means that the utility person n derives from alternative j is assumed to take the form characterised by (1) below (taken from Train, 2009; p.137)

$$U_{nj} = \beta_n' x_{nj} + \varepsilon_{nj} \qquad (1)$$

Here, x_{nj} constitutes the variables which are observed by a participant for any given choice option and which are pre-determined by the researcher through the survey's design. β_n then relates this to the person n's personal preferences over the attributes at these particular levels. These models apply a Gumbel distribution to the random element of people's utility (ε_{nj}), which is deemed appropriate when included, as above, as an additive element to the utility function (McFadden, 1974; Louviere et al, 2000; Hoyos, 2010). Consequently, it is possible establish the projected probability change for a participant's selection of a given alternative i based upon the rule that person n will only select option i if that derives them the greatest utility relative to any other option (j) available to them in a given and fixed choice set. A formula demonstrating this is again shown below (Train, 2009; p.138):

$$Prob\ (ni) = \int \left(\frac{exp^{\beta' x_{ni}}}{\sum_j exp^{\beta' x_{nj}}} \right) f(\beta) d\beta \qquad (2)$$

Attribute coefficients are then established through a conditional logit regression. These represent the respondent's change in probability for choosing an option if, *ceteris paribus*, there is a unit change in that attribute's level when described as a discrete variable, or through its presence relative to a base case for dummy (0-1) coded attributes (Bennett & Blamey, 2001). The coefficient on price (β_{price}) represents the marginal utility of income and is assumed to remain constant and negative (Hanley et al, 1998a). Presuming that product characteristics act as normal goods, determining any attribute's marginal valuation then involves taking a ratio of its coefficient against that of price (Hoyos, 2010).

$$WTP_x = \frac{-\beta_x}{\beta_{price}} \qquad (3)$$

Because they were asked to state both their top and second preferences, individuals were essentially ranking the three alternatives for each choice set. It is then possible to run our analyses through a conditional logit format. This can then account for the fact that each individual is making multiple choices and therefore can identify any participant-specific patterns in decision-making. Our regression does just this and groups responses by choice set whilst clustering these over individuals

Conduct and Execution of the Survey

The survey gave respondents 16 choices. The optimal number of cases to give a participant is widely debated, and considerably different stances exist within the field (Swait & Adamowicz, 1997; Adamowicz et al, 1998; Scheufele & Bennett, 2012). Sixteen choices are certainly towards the upper bound of the suggested range, but given our beliefs regarding topic-familiarity, this number seemingly aligns to the literature.

Presenting a three-alternative set it believed to improve model robustness (Bennett & Rolfe, 2009), and so each choice screen presented two management alternatives and the constant Option C baseline, characterised as the 'currently intended plan'. By asking respondents to indicate both their first and second preferences, we could establish a complete preference structure for each and every choice set the individual faced. A description of the baseline was given in the instructions, and a copy was available on each respondent's desk for them to review if necessary. Whilst answer sheets were paper-based, the instructions and survey were presented on computer screens. A

researcher read these tutorial-style instructions aloud to subjects, overcoming any issues of illiteracy or ambiguity. Provided in Appendix B, a laminated copy of the (albeit abbreviated) tutorial was made available for those surveyed. Participants seldom referred to either desk-based aid, suggesting task comprehension was good.

All 200 surveys took place through February 2014, and the average completion time was approximately between twenty and thirty minutes, inclusive of the ten to fifteen minute tutorial. Half were conducted at a Norwich garden centre with the remainder held at a country park in Thetford Forest, Suffolk. These locations were deliberately selected in order to offer an meaningful contrast. Based near Norwich city centre and therefore away from woodland of any substantial magnitude, the garden centre constitutes a region of East Anglia where deer populations are typically low. Conversely, the Thetford site should provide respondents who, if local, live within close proximity to dense forest and therefore deer. This could create preference structures which convey different practical understandings of woodland management, or mean that these groups on average possess disparate use value for forestry. By the same token, in either location it was reasonable to assume that people would hold an accentuated interest in outdoor and environmental issues. We appreciate that subsequent valuations might be inflationary through this form of sample-selection bias. On a practical note, these sites both seemed sensible non-obligatory environments in which to conduct the survey, ensuring that any potential respondent felt they could decline to partake in the survey if they wished.

As reward for participation, each respondent was issued with a voucher for a hot drink and snack at the respective cafes each location boasted. This incentive scheme seemed highly suitable for the study. Firstly, it made no financial promise which could influence participant responses through a form of 'interviewer bias' (Bowling, 2005). Secondly, the average redemption value came to approximately £4.00, which is judged as adequate compensation given the survey completion time, but which did not then offer a somewhat meagre cash reward. Furthermore, this appeared a wise way to ensure each location benefitted from hosting the survey. Given the positive responses from participants and host establishments alike, we were pleased with this reward mechanism and would advocate other such surveys to consider this monetary-alternative incentive method if both the topic's nature and survey's duration permits.

SECTION 4: RESULTS

Surveys were collected through face-to-face interviews. We felt that this would not restrict our sample to those with computer literacy. Furthermore, this also enabled participants to engage orally with the researcher with respect to the topic, providing complementary qualitative data to accompany that established through quantitative analyses. The response rate was very good, particularly at the Thetford location, and averaged from between 50 and 80% across the two sites. Reasons for decline typically consisted of time constraints as opposed to miscomprehension or subject disengagement. Whilst uptake was roughly consistent across genders, 110 (55%) of respondents were female.

Given the taxation-based payment vehicle, and to assist in the retention of realism, the study hoped to predominately survey those responsible for household budgeting. Table 2

decomposes the age profile of participants, comparing this to the 2011 Census-derived Norfolk population data (www.norfolkinsight.org.uk). Wilcoxon Mann- Whitney U tests confirm no significant differences exist between these two groups (z = -0.85, $p(z)$ = 0.3955).

Age Bracket	Sample Population (%)	Norfolk Representation (%)
18-25 years	23/200 (11.5%)	52/681 (7.6%)
26-35 years	25/200 (12.5%)	96/681 (14.1%)
36-45 years	26/200 (13%)	105/681 (15.4%)
46-55 years	35/200 (17.5%)	118/681 (17.3%)
56-65 years	44/200 (22%)	114/681 (16.7%)
Over 65 years	47/200 (23.5%)	196/681 (28.7%)

Table 2: Age Profile Comparison

Table 3 provides a similar picture for our sample's income profile. 15% of respondents opted not to give this information. The sample's income distribution adequately represents that of the Norfolk region (z = 1.295, $p(z)$ = 0.1952), with the slight under-representation of those from lower income brackets potentially resonating with our below-average proportion of pension-age respondents. This group showed a reluctance to categorise their pension as 'income', instead often selecting the non-disclosure option. This may explain the low income under-representation.

Income Bracket	Sample Population (%)	Norfolk Representation (%)*
Under £20,000	54/200 (27%)	39%
£20,000 - £29,999	37/200 (18.5%)	21%
£30,000 - £39,999	21/200 (10.5%)	24%
£40,000 - £49,999	23/200 (11.5%)	
£50,000 - £59,999	10/200 (5%)	
£60,000 - £69,999	9/200 (4.5%)	
£70,000 - £79,999	5/200 (2.5%)	16%
£80,000 - £89,999	6/200 (3%)	
Above £90,000	5/200 (2.5%)	
Preferred not to disclose	30/200 (15%)	N/A

Table 3: Income Profile Comparison

**Data approximations from Norfolk Insight (CACI), 2010*

Regarding other behavioural data, aggregated responses to Question 4 confirm that 78 (39%) and 85 (42.5%) of the 200 questioned had donated to an environmental or animal welfare charity within the last 12 months respectively. No restrictions were imposed upon people's interpretation of this statement, and 'donating' could be understood as direct payment, environmental membership or engagement in conservation work. In contemplation of this broad definition, these ratios appear fairly reasonable. The bird-feeding enquiry in Question 5 yielded a 63.5% positive response rate. Whilst not exceptionally disparate from factual statistics for bird-feeding and related activities (Saggese et al, 2011; Fuller et al, 2008), it is encouraging that this affirmation level almost

identically matches that of our previous study posed from a similar demographic (Brock, Sugden & Perino (2014); forthcoming).

Regarding woodland management attitudes, Table 4 summarises the sample's aggregated perceptions on whether various animal population control policies were acceptable.

	Fencing to Control Deer (%)	Culling to Control Deer (%)	Culling to Control Badgers (%)
Yes *(Agreed it was legitimate)*	62	76.5	26
No *(Disagreed it was legitimate)*	25.5	12	41
Don't Know *(was unsure or not sufficiently informed)*	12.5	11.5	33

Table 4: Overview of Animal Population Control Question

We should be cautious when assessing these deer reduction distributions. This is because this question was posed after the choice exercise, where we had explicitly informed respondents that fencing woodlands caused deer starvation. Nevertheless, it is interesting to see how high the general consensus is for each case, with nearly two thirds agreeing with a principle of fencing and over three quarters with that of culling. Such rates of agreement could reflect an above-average level of environmental understanding from our sample, especially given their decision to partake in a woodland management survey. However, these rates confirm the widespread realisation for the necessity to reduce deer populations in order to safeguard forestry in the long term.

This conjecture could also explain the difference between the "don't know" responses for deer and badger questions. The latter is more contentious and less scientifically-proven, which means a higher proportion of respondents feel a disinclination to give a definite viewpoint. However, an equally plausible explanation pertains to the familiarity our sample hold with deer and woodland processes, enabling the vast majority to issue an opinion in both cases. On a broader note, this response profile exemplifies the importance of policymakers and environmental managers to issue credible, factual information regarding why animal populations need to be reduced in order to receive a strong and unified backing to pursue their proposal.

Regarding frequency and type of use, 54% of respondents stated that they accessed forestry at least once per month, with only seven participants never visiting woodlands. The most popular use was for walking (75%), with lower rates for nature watching (42%) and cycling or sport (26%). Stated "Other" uses included general recreation, spending time with family and photography. A full set of aggregated survey responses can be found in Appendix D. Given the host survey locations, particularly that of the Thetford site, our frequency of use distribution is unsurprising. Indeed, most participants here either used the park on a weekly basis, or visited on a regular and purposeful basis (e.g. with children to coincide with school holidays). Data collected on forest usage is potentially

quite insightful. Not only does this provide direct linkages to aspects of nature connectivity, but certain users may hold particular preferences regarding both the population levels of specific deer types and associated reduction methods. Take the example of cyclists. For these users, large deer being more prevalent is concerning as this increases the risk of personal injury in the event of collision, yet this group would voice concerns over the widespread use of fencing given that this would provide a physical barrier to the their own recreational usage.

	Full Sample *(n=200)*		**Associated Valuation** *(£)*
	Coef.	*P>|z|*	**£**
Quality Level	0.319	0.000	**3.88**
Large Deer	0.349	0.000	**4.25**
Small Deer	0.741	0.000	**9.02**
Commission Culling	0.010	0.000	**0.12**
Licenced Hunter Culling	0.001	0.494	**0.01***
Meat Sales	1.086	0.000	**13.21**
Cost	-0.082	0.000	
Model Fit (χ^2)	2288.03	0.000	
Pseudo R^2	0.1068		

** Insignificant Coefficient (p>0.05)*

Table 5: Regression Results from the Choice Experiment

Table 5 displays the results from our Conditional Logit model, which estimates the responses from our complete sample of 200 participants. The fact that fully ranked preferences were derived from all sixteen choice sets enables a rich dataset to be assessed. Models (2) and (3) regress the same explanatory variables from particular subgroups, with the former analysing those from the lowest and highest age brackets and the latter doing likewise over income.

Model 2	**Full Sample Valuations** *(n = 200)*			**Youngest (Aged 18-25) Respondents** *(n= 23)*			**Oldest (Aged 65 +) Respondents** *(n=47)*		
	Coef.	*P>|z|*	**£**	*Coef.*	*P>|z|*	**£**	*Coef.*	*P>|z|*	**£**
Quality Level	0.319	0.000	**3.88**	0.478	0.000	**5.98**	0.229	0.000	**3.84**
Large Deer	0.349	0.000	**4.25**	0.880	0.000	**11.00**	0.323	0.000	**4.14**
Small Deer	0.741	0.000	**9.02**	0.861	0.000	**10.76**	0.515	0.000	**6.61**
Commission Culling	0.010	0.000	**0.12**	0.003	0.256	**0.04***	0.011	0.000	**0.14**
Licenced Hunter Culling	0.001	0.494	**0.01***	-0.008	0.026	**-0.10**	0.000	0.837	**-0.01***
Meat Sales	1.086	0.000	**13.21**	0.802	0.000	**10.03**	1.356	0.000	**17.42**
Cost	-0.082	0.000		-0.080	0.000		-0.078	0.000	
Model Fit (χ^2)	2288.03	0.000		328.30	0.000		543.11	0.000	
Pseudo R^2	0.1068			0.1435			0.1093		

** Insignificant Coefficient (p>0.05)*

Table 6: Regression Results from the Choice Experiment, Comparing Age Groups

For each regreesion, the columns in bold give the implied monetary worth, expressed in pounds sterling (£). Whilst not all regression outputs are presented here, many further and similar analyses were conducted in this way, isolating a certain subset of respondents who held particular characteristics. A matrix containing these valuations is contained within Appendix E.

Model 3	**Full Sample Valuations** *(n = 200)*			**Low Income (<£20,000) Respondents** *(n= 54)*			**High Income (>£40,000) Respondents** *(n=58)*		
	Coef.	*P>|z|*	**£**	*Coef.*	*P>|z|*	**£**	*Coef.*	*P>|z|*	**£**
Quality Level	0.319	0.000	**3.88**	0.305	0.000	**5.24**	0.327	0.000	**3.39**
Large Deer	0.349	0.000	**4.25**	0.497	0.000	**8.76**	0.359	0.000	**3.73**
Small Deer	0.741	0.000	**9.02**	0.632	0.000	**10.85**	0.803	0.000	**8.33**
Commission Culling	0.010	0.000	**0.12**	0.007	0.000	**0.13**	0.010	0.000	**0.10**
Licenced Hunter Culling	0.001	0.494	**0.01***	-0.004	0.049	**-0.07**	0.001	0.635	**0.01***
Meat Sales	1.086	0.000	**13.21**	1.464	0.000	**25.15**	0.981	0.000	**10.18**
Cost	-0.082	0.000		-0.058	0.000		-0.096	0.000	
Model Fit (χ^2)	2288.03	0.000		729.48	0.000		681.14	0.000	
Pseudo R^2	0.1068			0.1276			0.1108		

** Insignificant Coefficient (p>0.05)*

Table 7: Regression Results from the Choice Experiment, Comparing Income Groups

Across all samples, the 'quality' attribute remains positive and significant. This illustrates that, holding all else constant, participants place greater worth upon a management policy which can raise the woodland's quality score. This is logical, particularly considering the high use value and type of engagement many respondents then expressed. Reviewing Tables 6 and 7, we see quality valuations increase by around 50% for both young and low income respondents. A range of explanations exist for this relationship. One is that those on low incomes have a greater restriction upon the set of activities they can engage in, and thus may place an extra emphasis on public forestry being of high quality. Another is that younger respondents would on average use woodland for a wider variety of physical and aesthetic uses, and consequently value this area holding a higher quality grading. From the view of sustainability, young people also have the greatest private motivation for forests to retain a high quality because a longer time-span remains for them to enjoy the woodlands through their lives, forcing them to adopt less myopic views towards woodland quality than older users.

The coefficients on both large and small deer species are also positive and significant. Absolute values are interesting and are again elevated among young and low-income respondents. Relative differences between these two attributes are perhaps of greater interest given the relation this has to nature connectivity and the disposition to engage with local wildlife. Large deer are fairly rare and elusive, and they are typically confined to remote and/or extensive regions of woodland. Furthermore, their physical structure infers dependency on man is not necessary. By contrast, small deer possess many 'warden-inducing' qualities. Their size and appearance convey a greater sense of

vulnerability, and their tendency to regularly and repeatedly encroach into people's gardens make them more likely candidates to enhance people's wellbeing through local nature interconnectedness. It is for these reasons that we tentatively suppose that subgroups who express particularly elevated values for small deer (relative to large ones) do so through the enhanced degree of 'nature connectivity' they derive from engaging with local wildlife. Relative to the full sample, this influence seems greatest for older respondents and those who gave to animal welfare charities, and is less pronounced for younger participants and men.

Analysed fully in the next section, the culling attributes describe an interesting story. These describe the projected probability change for selecting an option which replaces a policy of fencing with the respective culling alternative. By way of example, Table 5 suggests that, on average, people would pay £0.12 for a one percentage point swing away from fencing in favour of Forestry Commission culling. Across both the main sample and many of our analysed sub-groups a fairly consistent pattern forms. This proposes a small yet significant preference for moving from fencing to Commission-based culling, with no statistically significant difference placed upon a similar swing instead directed toward licensed hunter culling. Exceptions to this rule include those who agreed with badger culling, who express a positive and significant preference for either version of culling relative to fencing, and respondents of the lowest age bracket, who place a negative and significant value upon licensed hunting, yet state indifference between fencing and Commission culling.

Finally, 'Meat' and 'Cost' variables hold intuitive signs. Regarding the former, respondents appear to strongly value the efficiency of selling meat from deer which have been culled. Contained in the next section of the paper, we reveal a complexity exists behind this story, and meat valuation seems highly sensitive to who the beneficiary from these revenues is. The cost parameter's negative sign follows intuition, and retains a fairly consistent magnitude across sub-samples.

Overall, our results seemingly adhere to any *a priori* intuitions held within the standard literature. The primary aim of this paper sought to discover if, and to what extent, the preferences people formed for deer reduction programmes aligned to the conjectures within moral philosophy the Doctrine of Double Effect. Secondary objectives wished to explore the underpinnings of their valuation within the contexts of Subjective Well-Being and economic optimisation. Valuations for both the deer species and meat sales appear to confirm the presence of relationships concerning these latter goals, yet regarding the first our findings are not so affirmative. This requires a more thorough exploration of the data in an attempt to explain this apparent deviation from the existing literature. The following section will also delve deeper in to our secondary motivations, and seek to understand more comprehensively what drives our preferences for both environmental engagement and economic efficiency.

SECTION 5: DISCUSSION

Deer population reduction and The Doctrine or Double Effect

The main target for this paper was to use choice experiments in order to provide evidence that would either support or refute the theoretical conjectures contained within the Doctrine of Double Effect, most famously told through 'Trolley Problems'. When these conjectures are

translated into our subject of focus, deer reduction mechanisms, DDE should predict the following preference structure:

Culling by Licenced Hunters ~ Culling by the Forestry Commission < Fencing (1)

In a brief recap, 'Fencing' constitutes an action which does not require deer death as a necessary means to achieve the desired outcome of preserving woodland for long-term environmental sustainability. Instead the death, through starvation, is simply a foreseen and regrettable side effect from erecting fences. Thus, moral philosophers would assume individuals to find this method ethically permissible. By contrast, culling is morally unjust. Here, you must have to incur deer death in order to achieve the sustainable woodland. From the perspective of DDE, it is irrelevant who conducts the cull (Commission worker or hunter) because the action of firing the gun is equivalently unethical in either scenario.

However, we may wish to introduce *intention* into this profile because behavioural economists have regularly demonstrated that intentions can play a vital determining role in the way people make decisions. By doing this, it may be possible to segregate the culling methods and issue an adjusted preference profile:

Culling by Licenced Hunters < Culling by the Forestry Commission < Fencing (2)

The hierarchy above suggests the possibility for participants to state a clear preference for a Commission employee to conduct a cull as opposed to a licensed hunter. This is because the former is 'hired' by society to maintain and preserve public woodland. Their intention for pulling the trigger is to enable long-term woodland sustainability. Put another way, they are not assumed to derive any private pleasure from the culling action itself, but view this procedure as a means to achieve their target of providing well-managed forestry. Conversely licenced hunters, who pay for a permit to hunt deer for pleasure, cannot be assumed to cull with these same 'good intentions'. Unlike the Commission employee, they primarily cull to feed the private satisfaction they yield from shooting, as opposed to doing so for the sake of environmental preservation.

In light of these theoretical assertions, let us now apply our empirical findings to this preference-based mechanism. When doing so, we see our rankings structure fails to fully adhere to either of the aforementioned hierarchies:

Culling by Licenced Hunters ~ Fencing < Culling by the Forestry Commission (3)

The ranking structure above represents that not only for our full sample, but also the majority of our 'extracted' sub-samples. In each case, Commission culling is preferred to fencing, yet the insignificance of the "Licensed Hunter Culling" variable in Table 5 infers no difference exists between the values held for fencing and those for licensed culling. Exceptional sub-samples include those who agreed with badger culling, low income and young respondents. These latter two groups instead express a weakly significant distaste for licensed hunting relative to either alternative method, between which they express indifference.

An initial response might question the robustness of DDE, claiming that people do not always adhere to the ethical conjectures proposed by Foot and others. Another first conclusion

could claim that human perspectives to animal harm does not correspond to that for mankind, bringing into question our permissibility to expand our moral attitudes towards death more widely.

Of course, we certainly cannot dispel these possible conclusions, either of which could prove valid assessments. However, one major difference between this study and DDE-based ethics is that the latter cleanly matches the cause and nature of death which occurs from each eventuality. Whoever suffers the death in our Trolley Problem stories, human death is always through collision with a truck. Respondents can more easily construct a preference because these will be devoid from any empathetic or emotive differences that may arise from the *way* in which death occurs.

However, our study potentially produces a confound; the way in which deer die through a policy of fencing (i.e. starvation) may be emotively received very differently to death by shooting, as occurs with the culling methods. Whilst one might argue to the contrary, starvation suggests a deer's suffering will be more drawn out and thus less appealing when compared to the almost instantaneous impact from a bullet when deer are culled. This is particularly true given our tutorial's insistence that both sets of hunter would be sufficiently trained, lessening concerns that deer might be shot a way which prevented immediate death.

The consequence of this is a need to contemplate the impact which different *methods of death* may hold alongside those stated above, and the implications this has for people's moral perspectives. We summarise this blend of action, intention and consequence in Table 8:

	Good Action *(As seen by DDE)*		Good Intention *(as seen by economics)*		Good Consequence *(shown by method of deer death)*	
Fencing	Yes	L	Yes	M	No	0
Commission Culling	No	0	Yes	M	Yes	N
Hunter Culling	No	0	No	0	Yes	N
	(1)					
	(2)					
	(3)					

Table 8: A matrix to illustrate how perceptions appear over deer reduction methods

Table 8 signals how this wider incorporation of factors translates to the previous preference hierarchies. By purely considering DDE reasoning, we need only concentrate upon the second column of Table 8, and this leads us to profile (1). If we introduce intentions, a combination of columns 2 and 3 must be considered. This facilitates the disentanglement of the two culling methods and creates preference hierarchy (2). Finally, by contemplating the death heterogeneity within our choice experiment, our analysis is then extended to inspecting columns 2, 3 and 4.

Introducing this third element means mean no obvious preference ranking can be extracted. Instead, the way in which a respondent's moral preferences are established will depend on the weight they attach to each column. With 'good' outcomes being denoted by the letters L, M and N for each element, we can denote each deer reduction method's relative merits:

Fencing =	L + M
Commission Culling =	M + N
Licenced hunter Culling =	N

We can now explore the methods-based valuation profiles for a given sample using this notation. Let us take this type of reasoning to the main sample. Their valuation profile was given by (3), rewritten below:

Culling by Licenced Hunters ~ Fencing < Culling by the Forestry Commission (3)

The first thing we can decipher from this is that N > L. This is again because Commission culling is seen as preferable to fencing and M (the importance of intention) is common to both methods. This would infer that participants attach greater weight to *how* deer are killed (and find starvation distasteful) than whether the action adheres to ethical permissibility in the eyes of DDE reasoning. Secondly, the preference for Commission culling relative to licensed hunting implies M > 0. Thus, the role intentions is important in the construction of a participant's preferences, and the woodland manager's more genuine mandate for culling enhances the moral justification for them to shoot deer.

Using this logic cannot provide us with a complete preference structure, yet its use is certainly insightful in a number of ways. On a general basis, it illustrates the importance of considering the context-specific details when one holds a portfolio of options involving death. This is because people might contain cognitive emotions which dissuade them from a certain policy purely due to the associated mechanism by which harm is inflicted. This also reinforces the scepticism which surrounds 'pure economic' theory, which believes agents to be driven solely by final outcomes and are indifferent to intentions-based or procedural differences. If economists advise policy-makers based upon this assumption, it would be highly unlikely that subsequently selected proposals would maximise the welfare benefits for society. This facet is particularly relevant for the fields of environmental and social sciences, where the choice of project is likely to be highly influenced by site or topic- specific elements. Here, one must hold great reservations regarding the ability to immediately assume that ethical reasoning can be transferred from one case to another.

More specific to the topic explored here, these findings give additional evidence of how the role of wildlife engagement may hold weight in determining human utility. Valuation profile (3) clearly illustrates the importance which is attached to the nature of deer death, with disagreement with starvation showing that those surveyed were influenced by the type of suffering a creature may endure. This alludes again to the role which 'nature connectivity' might perform and its potency for influencing optimal collective choice policies and maximising social wellbeing.

Deer Valuation and Nature Connectivity

Aside from influencing our moral preferences over deer death, the role of 'nature connectivity' is cautiously assumed through the valuation disparities between Large and Small deer,

with the latter enjoying more favourable attributes in both appearance and habits to instil a 'warden-style' satisfaction. This potentially enhances the level of engagement humans can establish with small deer species such as Roe and Muntjac, and increase the value they hold for them relative to larger Red or Fallow deer.

Let us firstly consider the absolute deer species valuations. It is perhaps unsurprising that these are greatest for 'environmentally conscious' groups such as vegetarians and animal welfare charity donors, who place as inflated worth upon deer relative to the main bank of participants. In contrast, men and those agreeing with badger culling express some of the lowest absolute values.

Combining absolute and relative valuations enables us to investigate the role of nature connectivity more deeply. For example, compare the deer valuations of animal welfare donors to those who feed birds. It seems safe to assume that members from each group on average hold a raised sense of nature connectivity, and Appendix E confirms that both sub-samples show a significantly elevated worth for small deer over larger ones. However, whilst the magnitude of values expressed by 'bird-feeders' coincides with the full sample, those of animal welfare charity donors rise by 22% and 42% for large and small deer respectively. Such increments are even more pronounced for vegetarians. One plausible interpretation of these findings would consider the relative level of 'environmental education' each group could be assumed to hold. Those who feed birds could be expected, on average, to possess a more sound understanding of wider environmental processes. Whilst they attach worth to deer and assess them as important natural entities, this greater knowledge base prevents them from placing an exaggerated value on deer protection. Instead, they realise the potential detriment that unnaturally high deer numbers would have for long-term biodiversity within woodland habitats. This might be contemplated less widely for vegetarians or donors to animal welfare charities, who tend to instead prioritise the welfare of an individual beast above that of a collective ecosystem.

Such reasoning could be extended to other sub-group valuations, and for example might resonate with the slightly deflated deer values from frequent (and thus more informed?) woodland users and our Suffolk respondents, many of whom live and work in East Anglia's forests.

Age is one final parameter we explore regarding our deer valuations. Mentioned previously, large and small deer valuation disparities seemingly diminish as the age of a respondent fell, such that our youngest band of participants (aged between 18 and 25) expressed no discernible difference between the two. To confirm this apparent relationship, we introduce an interaction term between age and each deer species. Whilst the full regression is contained within Appendix F, the impact of adding these two varaibles, named "largeage" and "smallage", is described in Table 9:

	Model 1	Model 4	
	Absolute Value	*Absolute Value*	*Average change as Age Group rises by 1*
Large Deer	£4.25	£7.54	-£0.83
Small Deer	£9.02	£6.41	+£0.65

Table 9: The impact of age in determining deer values

The above table suggests a complete eradiation of the nature connectivity effect once we control for age. Both interaction terms hold strong statistical significance and illustrate that as we

increase the age bracket of a given respondent, they will reduce their value for large deer, yet place a greater worth upon smaller ones.

This finding would infer that 'nature connectivity' is highly driven by age, with the oldest members of society gleaning most value from local engagement with nature. This assertion corresponds with the existing literature, with previous studies suggesting the utility-enhancing worth older people derive by engaging in activities such as keeping pets (Johnson, 2011), bird-watching (Brock, Sugden & Perino (2014); forthcoming) or gardening (Rappe, 2005). The logic behind this notion is that these members of society are endowed with fewer channels from which to derive a warden-style interconnectivity. For many older people, their children are now no longer dependent upon them, they do not work and thus have no employment-related responsibilities and for many their degree of immobility limits the range of actions they can undertake to otherwise engage and interact with wider society. An alternative theory could suppose that older respondents have the greatest amount of leisure time in which to engage with their local environment, and subsequently appreciate the wildlife which resides near to them more fully. This combination of factors provide a strong case to suggest the importance of local wildlife as a social tool for improving the wellbeing of otherwise isolated and vulnerable groups in society. This is surely an area where further investigation, testing the scope and robustness of this conjecture, could prove highly beneficial.

Meat sales and the role of economic efficiency

Our penultimate discussion area investigates how respondents approached the sale of venison meat from culled deer. The 'Meat' variable is always positive and statistically significant, suggesting that whilst the scope and nature of deer reduction may be contentious, people possess a desire to see the productive utilisation of any resulting deer carcasses. Qualitative statements support this idea, with many respondents verbally expressing their dislike for options which failed to sell meat. One sub-sample analysis show how meat valuation is particularly high among the oldest respondents, perhaps aligned to a greater tendency of this group to dislike food waste given their experiences of post war rationing. Another quirky result is the slight deflation in meat value for respondent identifications which tallied to an (inefficient) non-use of their voucher!

We felt it insightful to see if any attitudinal differences existed between when the Commission sold venison and when the profiteer was instead our licenced hunter. Touched upon earlier, it is feasible to construct an argument in either case. A persuasion towards licensed hunter profiteering could resonate with the notion that this forms a second, more ethically legitimate, reason for them to cull deer. We label this the 'alternative justification' theory. Alternatively, a negative perception could describe the heightened distaste one feels from a hunter profiting from their ill-intended activities. We call this the 'worse if he prospers' idea. To examine this, include an interaction term into our model. Full regressions again appear in Appendix D, with the most salient elements listed in Table 10 below:

	Model 1	Model 5	
	Absolute Value	*Absolute Value*	*Average change as meat is sold by the licenced hunter (relative to sale by the Commission)*
Value for 1% rise in Commission Culling *(at the expense of fencing)*	£0.12	£0.09	
Value for 1% rise in Licenced Hunter Culling *(at the expense of fencing)*	£0.01*	£0.12	-£0.21
Meat	£13.21	£16.50	

Table 10: The Impact of Who Sells the Meat

By including this variable, we witness licensed hunting adjust from being indifferently perceived against a policy of fencing to being strongly preferred. Commission culling retains the same stature, with each now of roughly equitable levels. However, the negative sign on our interaction term signals that when meat is sold by the licenced hunter, people support this action less relative to if a Commission employee had instead conducted the cull and sold the venison.

Two different stories can explain this result. One assumes people express a desire for Commission-based sales through the (tutorial reinforced) belief that such revenues aid the reduction in woodland management costs. Equally, it is plausible that people do not disapprove of licenced hunting *per se* and, given that hunters pay for permits, accept that some humans gain a form of pleasure by undertaking the killing of animals for leisure. Acceptance of licenced hunting may also rise if respondents register that permit sales reduce Commission costs, whilst employing those to cull 'in-house' is a large overhead for a woodland management operative. However, this tolerance towards licenced hunting is significantly eroded once hunters begin to profit from venison sales. Hence, the negative sign on our interaction effect infers that people dismiss the 'alternative justification' theory, instead adhering to the 'worse if he prospers' notion.

Income Effects and Public Forests as Inferior Goods

The final aspect we touch upon here is how values ascertained adjust across individuals of different income groups. This information, contained within Model 3, suggests that, on average, woodland values fall as people become wealthier.

Whilst at first this might appear surprising, considering pubic forestry as an inferior good seems highly plausible. Forestry forms a free and open amenity, which can be accessed at fairly localised levels. Therefore, we should expect the greatest beneficiaries from this amenity to be those on low incomes, who are relatively restricted in the range of alternative or substitutable activities they can instead enjoy. By contrast, wealthy people have a much broader spectrum of alternative uses at their disposal. They have the finances to partake in more expensive leisure pursuits, be this national or international travel, attendance at sporting and entertainment events or visiting more prestigious tourist attractions. This affluence not only affects their use of time, but also their scope to gain similar (even if not identical) nature connectivity utility from these other sources. This could be from national parks, international wildscapes, admission to zoos and safari parks or even from owning their own woodland estate!

If public woodlands do indeed form inferior goods, this could have major implications for the way their management is funded. Many public amenities historically rely upon contributions from wealthy benefactors to fund their upkeep, and this has been a financial lifeline for many art galleries,

charities and museums. Worryingly, if rich and influential members of society place a relatively low value upon public forestry, the ability to raise additional necessary revenues (or defend the scale of existing ones) could be severely jeopardised. Of course, this study provides only a first insight into the area, and further research would be needed to confirm these ideas. However, it is noteworthy to consider these policy implications for those involved in woodlands management, and poses questions which need to be addressed if long-term financial support is to be secured for the maintenance and/or improvement of our local woodlands, parks and environment.

SECTION 6: CONCLUSION

This paper sought to contribute to the ever-expanding evidence base within behavioural economics that the decision-making of individuals cannot be assumed purely through comparing relative outcomes. Reinforced by the theoretical predictions of moral philosophy, we use discrete choice experiments to test how aspects of procedure, intention and justification impact upon the preferences people hold over the ethically sensitive subject of deer culling.

Overall, the results of this study have confirmed many of the *a priori* beliefs held within the associated fields of environmental economics and moral philosophy. At the same time, they have also provided some alternative ideas and thoughts in these areas. Regarding the primary aim of this study, we see that respondents express a hierarchy of preference regarding the method by which deer populations should be controlled which do not fully adhere to that with moral philosophical theory would predict. This could be because our perceptions regarding human and animal deaths are not perfectly substitutable. However, this alternative preference structure could equally be inferring that our ethical perspectives on harm are far more intricate than first thought. Instead, we need to appreciate the related intentions to a given method and the moral justification for an agent to carry out their action. Furthermore, we may also need to consider the procedure by which a victim suffers harm. Regarding wildlife, these preferences may be highly influenced by our degree of 'nature connectivity', and the obligations we feel as wardens to protect and minimise the suffering of creatures in our local area.

Nature connectivity may also explain the differences which occur between the lower values held for larger and more robust deer species against those which are smaller and more 'locally engaging'. This alludes to a role of warden responsibility and interaction for people with their local wildlife. If believed, then one of the key drivers appears to be one's age, with older respondents possessing valuation structures most resembling that of a warden. Finally, we have explored how the roles of income and efficiency have performed within our study, and these two factors both have the potential to be insightful for establishing how and to what extent woodland habitats can be managed in an economically efficient manner.

This work is an example of where mutual benefits can be gained by combining economics and philosophy through an inter-disciplinary collaboration which looks to take the strengths of each field in order to answer complex and context-specific questions. However, the findings here provide only a first insight into the research area, providing preliminary conjectures regarding how human engagement with environmentally sensitive issues might relate to ethics and philosophy. It is for this reason that we suggest further research would be valuable. This is not only to enable the

corroboration or dismissal of the claims we make here, but seems to be of even greater necessity given the questionable moral transferability which arises with environmental topics. If our results are perceived to be legitimate, then the existence of emotional attachments to nature and the environment in shaping our ethical perspectives must surely then be appreciated and embraced by the associated academic fields. In doing so, collective decision-making should become more efficient, productive and welfare maximising, suggesting that inspections such as these can have much wider social and economic benefits.

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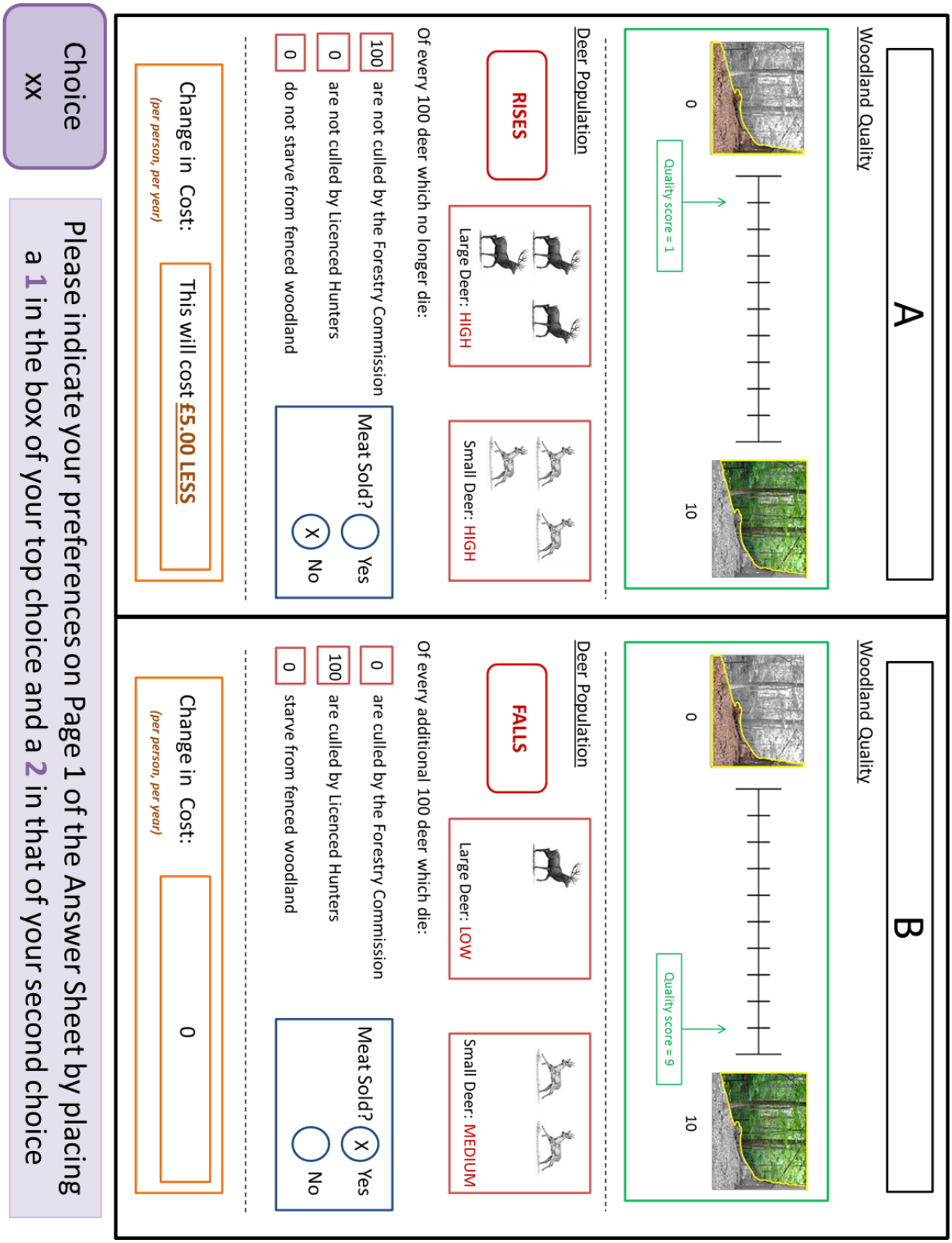
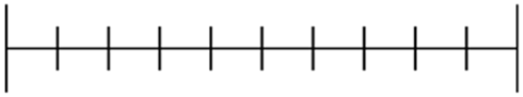
APPENDIX A: AN EXAMPLE CHOICE SET



C

Woodland Quality

0

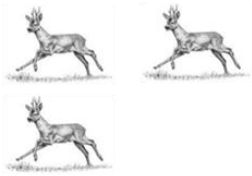


Quality score = 4

10

Deer Population

Large Deer: MEDIUM



Small Deer: HIGH

This is the current procedure. Therefore no extra deer will die.

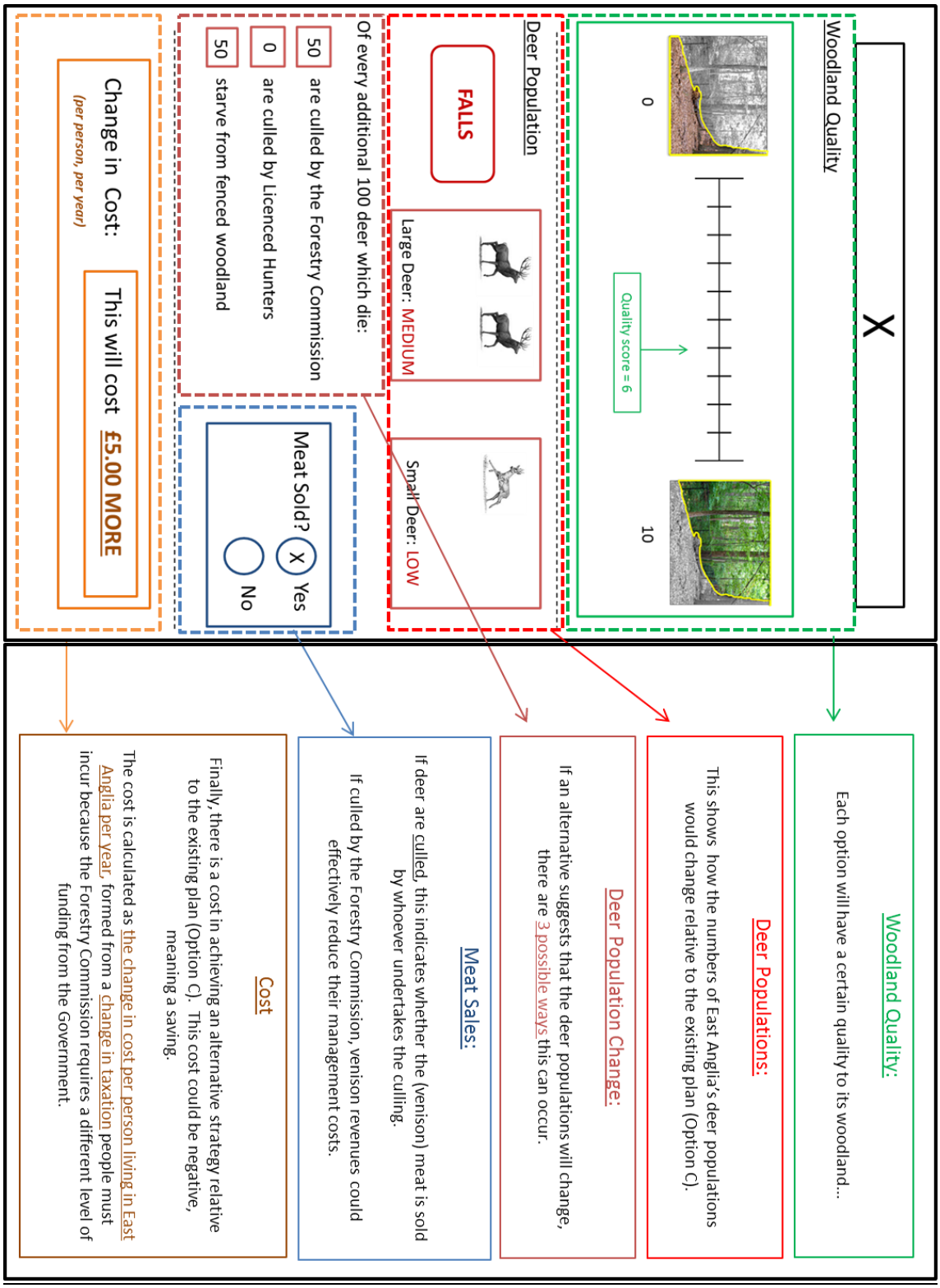
Meat Sold? (X) Yes

( ) No

Change in Cost: 0

(per person, per year)

APPENDIX B: ABBREVIATED TUTORIAL INSTRUCTIONS



APPENDIX C: THE RESPONDENT QUESTIONNAIRE

Survey Number: ☐

Respondent Survey

1. On average, how often do you visit East Anglia's Forests?

☐ At least once per month

☐ Once every 2 -3 months

☐ Once or twice per year

☐ Less than once per year

☐ Never (Please move to Question **3**)

2. When visiting these forests, what is normally the reason for your visit? (Tick all that apply)

☐ Walking or Dog Walking

☐ Cycling / Sport

☐ Nature- Watching

☐ Other (please specify)

☐

3. Please indicate your view regarding the following:

	I agree with this action		
Erecting Fences to prevent deer from accessing woodlands in East Anglia in order to protect forestry	YES	NO	Don't know
Culling deer in woodlands in East Anglia in order to protect forestry	YES	NO	Don't know
Culling badgers in the UK under the assumption that this will prevent the spread of TB in livestock.	YES	NO	Don't know

4. In the last 12 months, have you donated to or done voluntary work for either of the following:

(a) An Animal Welfare Charity ☐ Yes ☐ No

(b) Another Environmental Organisation ☐ Yes ☐ No

5. Do you regularly feed birds in your garden?

☐ Yes ☐ No

6. Please indicate the extent to which you agree with the following statements:

(1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree or Disagree; 4 = Agree; 5 = Strongly Agree)

a) Effective Forest Management is Important	○ 1	○ 2	○ 3	○ 4	○ 5
b) If deer populations must be reduced, culling is a better way than starvation.	○ 1	○ 2	○ 3	○ 4	○ 5
c) Educating children about nature and the environment is important	○ 1	○ 2	○ 3	○ 4	○ 5

---

7. Gender:
- ☐ Male
- ☐ Female

8. Age:
- ☐ 18-25yrs
- ☐ 26-35yrs
- ☐ 36- 45yrs
- ☐ 46- 55yrs
- ☐ 56 - 65yrs
- ☐ 65yrs +

9. What is your approximate annual *(monthly)* post-tax household income?

- ☐ Below £20,000 *(Below £1,667)*
- ☐ £20,000- £29,999 *(£1,668 - £2,499)*
- ☐ £30,000 - £39,999 *(£2,500 - £3,333)*
- ☐ £40,000 - £49,999 *(£3,334 - £4,166)*
- ☐ £50,000 - £59,999 *(£4,167 - £4,999)*
- ☐ £60,000 - £69,999 *(£5,000- £5,833)*
- ☐ £70,000 - £79,999 *(£5,834 - £6,666)*
- ☐ £80,000 - £89,999 *(£6,667 - £7,499)*
- ☐ Above £90,000 *(Above £7,500)*
- ☐ Prefer not to disclose

10. In the last 12 months, have you participated in either of the following activities?

(a) Game Hunting or Shooting	☐ Yes	☐ No
(b) Fishing	☐ Yes	☐ No

11. Are you Vegetarian or Vegan?

☐ Yes ☐ No

This is the end of the survey! Thanks again for your participation; both your responses and time have been invaluable and essential to the research.

APPENDIX D: AGGREGATED RESPONSE DISTRIBUTIONS

1. Visit Frequency	%
At least Once per Month	54
Every 2-3 months	12.5
2-3 times per year	23
Less than Once per year	7
Never	3.5

2. Type of Use	%
Walk	75
Nature-Watching	42
Cycle	26
Other	21

3(a). Attitude to Fencing	%
Yes	62
No	25.5
Don't Know	12.5

4(a). Give to Animal Welfare Charity	%
Yes	42.5
No	57.5

3(b). Attitude to Deer Culling	%
Yes	76.5
No	12
Don't Know	11.5

4(b). Give to Environmental Organisation	%
Yes	39
No	61

3(c). Attitude to Badger Culling	%
Yes	26
No	41
Don't Know	33

5. Feeds Birds?	%
Yes	63.5
No	36.5

6(a). Mean Score on Effective forest Management	4.53

6(b). Mean Score on Culling better than Starvation	4.34

6(c). Mean Score on Educating Children	4.74

7. Gender	%
Male	45
Female	55

8. Age	%
18-25	11.5
26-35	12.5
36-45	13
46-55	17.5
56-65	22
65+	23.5

9. Income	%
Less the £20,000	27
£20,000 – 29,999	18.5
£30,000 – 39,999	10.5
£40,000 – 49,999	11.5
£50,000 – 59,999	5
£60,000 – 69,999	4.5
£70,000 – 79,999	2.5
£80,000 – 89,999	3
Above £90,000	2.5
Prefer not to Disclose	15

10(a). Partake in Hunting	%
Yes	4
No	96

10(b). Partake in Fishing	%
Yes	7
No	93

11. Vegetarian or Vegan	%
Yes	13.5
No	86.5

Location	%
Norfolk	50
Suffolk	50

Survey Day	%
Weekday	50
Weekend	50

Voucher Used	%
Yes	74.5
No	25.5

APPENDIX E: VALUATIONS MATRIX

	Valuations in £0.00						
	QUALITY	LARGE	SMALL	MEAT	FC CULL	TH CULL	N
MAIN SAMPLE	**3.88**	**4.25**	**9.02**	**13.21**	**0.12**	**0.00**	**200**
1. VEGETARIANS	4.99	10.19	17.20	19.32	0.16	-0.06	27
2. WELFARE CHARITY	4.70	5.19	12.89	14.90	0.16	-0.01	85
3. BIRDFEEDERS	4.38	**4.26**	9.96	15.15	0.16	0.01	127
4. MEN	3.46	3.73	6.59	11.98	**0.10**	0.02	90
5. NON-VOUCHER USER	4.09	6.53	9.66	10.83	0.10	0.04	51
6. FREQ USER	3.70	**4.25**	8.69	16.74	0.14	0.00	108
7. PRO-BADGER CULLERS	2.76	1.57	4.90	12.15	**0.12**	0.06	52
8. CYCLISTS	3.51	3.49	7.27	14.87	**0.11**	-0.01	52
9. SUFFOLK	3.29	3.95	7.10	13.66	**0.12**	0.01	100
10. YOUNGEST	5.98	11.00	10.76	10.03	0.04	-0.10	23
11. AGE = 65+	**3.84**	**4.14**	6.61	17.42	0.14	-0.01	47
12. WEEKENDERS	4.12	4.86	10.50	12.69	0.09	-0.02	100
13. INCOME LOW (< £20K)	5.24	8.53	10.85	25.15	**0.13**	-0.07	54
14. INCOME MED (£20-40K)	3.72	**4.25**	8.51	9.88	**0.11**	0.04	58
15. INCOME HIGH (> £40K)	3.39	3.73	8.33	10.18	**0.10**	0.01	58

Insignificant	*Weakly Significant*	*No statistical difference from main sample*

APPENDIX F: INTERACTION REGRESSIONS

Age Interaction (Model 4)

```
. clogit choice1 quality large small fclevel thlevel meat  smallage largeage cos
> t, group(set)
note: multiple positive outcomes within groups encountered.

Iteration 0:   log likelihood = -9633.4961
Iteration 1:   log likelihood = -9557.0471
Iteration 2:   log likelihood = -9556.8102
Iteration 3:   log likelihood = -9556.8102

Conditional (fixed-effects) logistic regression   Number of obs   =      16000
                                                  LR chi2(9)      =    2305.65
                                                  Prob > chi2     =     0.0000
Log likelihood = -9556.8102                       Pseudo R2       =     0.1076
```

choice1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
quality	.3201952	.0140856	22.73	0.000	.2925879	.3478025
large	.6212441	.0769063	8.08	0.000	.4705105	.7719776
small	.5283679	.0642902	8.22	0.000	.4023615	.6543744
fclevel	.009716	.001061	9.16	0.000	.0076365	.0117955
thlevel	.0006992	.0010685	0.65	0.513	-.0013951	.0027935
meat	1.087223	.044512	24.43	0.000	.999981	1.174465
smallage	.0539088	.0132587	4.07	0.000	.0279222	.0798954
largeage	-.0681937	.0163221	-4.18	0.000	-.1001845	-.0362029
cost	-.082368	.0054417	-15.14	0.000	-.0930336	-.0717023

Meat Interaction (Model 5)

```
. clogit choice1 quality large small fclevel thlevel meat   thmeat cost, group(s
> et)
note: multiple positive outcomes within groups encountered.

Iteration 0:   log likelihood = -9597.0798
Iteration 1:   log likelihood = -9526.2657
Iteration 2:   log likelihood = -9526.0202
Iteration 3:   log likelihood = -9526.0202

Conditional (fixed-effects) logistic regression   Number of obs   =      16000
                                                  LR chi2(8)      =    2367.23
                                                  Prob > chi2     =     0.0000
Log likelihood = -9526.0202                       Pseudo R2       =     0.1105
```

choice1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
quality	.3433026	.0146141	23.49	0.000	.3146596	.3719457
large	.2800033	.0414334	6.76	0.000	.1987952	.3612113
small	.8326203	.038665	21.53	0.000	.7568383	.9084022
fclevel	.0081375	.0010856	7.50	0.000	.0060098	.0102653
thlevel	.0111266	.0015504	7.18	0.000	.0080878	.0141654
meat	1.499199	.0647407	23.16	0.000	1.372309	1.626088
thmeat	-.0186615	.0020914	-8.92	0.000	-.0227606	-.0145625
cost	-.0908779	.0055585	-16.35	0.000	-.1017723	-.0799835