Consumer attitudes to injurious pecking in free range egg production

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Introduction

Injurious pecking (IP) is a behaviour found in a majority of egg-laying flocks in the United Kingdom (UK) and beyond. Rodenburg et al (2013) and Nicol et al (2013) provide extensive reviews of both the extent of IP and its prevention and control in commercial systems. IP encompasses severe feather pecking and cannibalistic (often vent) pecking, frequently resulting in pain, skin damage, plumage loss and significant economic losses to the industry. It is particularly prevalent in non-cage systems, where a pecking bird has access to a far greater number of victims than it would in a cage system (Keeling and Jensen 1995). In addition, the problem is harder to manage in non-cage systems, since perpetrators cannot easily be identified (e.g. Gunnarsson et al 1999; Green et al 2000; Sherwin et al 2010). IP can start during the rearing period, though plumage damage is not usually recognised, as birds moult several times before lay. The problem increases when birds are brought into lay, possibly due to changes in hormone levels (Hughes 1973; Norgaard-Nielsen et al 1993). Careful management is essential during rearing to ensure a smooth transition from rear to lay (McKeegan & Savory 1999; Nicol et al 1999; Pötzsch et al 2001).

The estimated prevalence of IP depends on the method used to measure it in poultry populations. One method focuses on the proportion of flocks affected, regardless of severity. Using this measure, farmer reports have estimated the proportion of flocks experiencing IP at 62% in Sweden (Gunnarrson et al 1999), 37.5% in Switzerland (Huber-Eicher 1999) and 47% in the UK (Green et al 2000). Lambton et al (2010) when observing 111 UK farms found severe feather pecking on 85.6% of farms at 40 weeks. However, these estimates take no account of the proportion of birds within a flock that might be affected, or the degree of

severity of pecking. Both phenomena are reviewed by Nicol et al (2013). Rates of severe feather pecking have been recorded at 1.15 pecks/bird/h (Nicol et al 1999) or 1.22 bouts/bird/h (Lambton et al 2010). In all cases, these mean figures mask considerable inter-farm variation.

The economic consequences of IP can be substantial but calculating them is complex as many factors contribute to losses (Nicol et al 2013). Reduced plumage cover is linked with reduced feed conversion efficiency (Tauson & Svensson 1980; Peguri & Coon 1993). Severely feather pecked (bald) chickens need up to 40% more feed to maintain body temperature (Blokhuis et al 2007) and the birds are less efficient at converting food into egg mass. Outbreaks of feather pecking and cannibalism also reduce overall egg production because of the associated rise in mortality (Hughes & Duncan 1972; Green et al 2000; El-Lethey et al 2000; Huber-Eicher & Sebo 2001). Farmers tend to attribute a low rate of mortality to IP (Green et al 2000; Pötzsch et al 2001), much lower than the real proportion. IP is, in fact, a principal cause of mortality in non-cage systems (Rodenburg et al 2008; Fossum et al 2009; Sherwin et al 2010), which in many surveys is at significantly higher levels than in cage systems and may exceed 20% (Blokhuis 2005; Blokhuis et al 2007; Rodenburg et al 2013; Weeks et al 2012).

Worldwide, beak trimming conducted by either the infra-red (IR) or hot blade (HB) technique is the primary method used by the industry to limit the damage caused by IP (Dennis et al 2009). In adult birds, HB beak-trimming has been shown to reduce cannibalism-related mortality in floor pens (Damme 1999) and reduce plumage damage (Staack et al 2007). Beak trimmed birds also tend to eat ‘more efficiently’, performing less exploratory pecking and improving their food conversion ratio. However, it is difficult to distinguish whether the

commonly-observed behavioural changes observed to occur after trimming (reduced pecking behaviour and activity (Gentle et al 1990; Craig & Lee 1990)) indicate pain or changes in beak sensitivity (Hughes & Gentle 1995).

A number of countries have or are considering implementing a ban on beak trimming. The UK Government has set a review date of 2015 with a view to banning beak trimming in 2016 (Defra, 2010).

A ban on beak-trimming requires that the hens' propensity to peck other hens can be controlled or reduced by changes to housing, management, or other practices that maintain or improve bird welfare. The study reported here was part of a larger study which examined the effectiveness of evidence-based management strategies in reducing IP in practice. One hundred flocks on 63 farms were recruited for the study, of which 53 trialled suggested changes in management to control IP. Both treatment and control flocks were already employing a variety of the 46 possible management strategies, but farms enrolled as treatment farms added additional management strategies to their flock management at an early stage in the study. The uptake of new management strategies was encouraged by modest financial or practical assistance in obtaining some of the materials required (e.g. pecking blocks, starter packs of compressed wood pellets etc). The average cost of implementing the management strategies on the treatment farms was approximately 5 pence per bird (0.016p egg assuming a mean of 25 dozen eggs/bird/year). Some of the costs were one-off improvements that would remain in place for many subsequent flocks such as provision of artificial shelters or planting trees, whereas others such as maintaining friable litter require ongoing labour and substrate provision (for details see: www.featherwel.org). Lambton et al (2013) describe in more detail this project and its findings.

In the October quarter of 2011, 44.1 per cent of UK egg packers' throughput was from free range units, which make up the overwhelming majority of UK non-cage systems (Defra 2014). Almost all of this free range production is to Freedom Food Standards which specify stocking rates and limit colony size to 4,000 birds (maximum flock size of 16,000). The principal finding of the study was that the more of the 46 management strategies that were employed, plumage damage, incidence of feather pecking behaviour and likelihood of vent pecking were all significantly reduced alongside a reduction in levels of mortality at 40 weeks of age (Lambton et al 2013). Thus, the premise that IP can be reduced by altered practices, some of which have a cost, was substantiated.

A report by IGD (2011) found that nearly half of UK consumers surveyed stated that animal welfare was either very important, or extremely important, to them. There are a number of studies in the literature that report that consumers are concerned about hen welfare in particular, although not about IP specifically. For example, at the EU level, the Eurobarometer (2007) survey reported that 58% of citizens across 25 member states thought that hen welfare in their countries was either 'very' or 'fairly' bad. In Great Britain, Mayfield et al (2007) found that 64% of consumers thought the treatment of hens was very important (only 9% thought it not important) although 56% thought that welfare conditions for hens were poor.

In the sections that follow, we present the results of the above project's consumer survey where consumer attitudes to free range egg production are detailed together with the calculation of the price premium consumers said they would be prepared to pay to help reduce IP in free range systems. After discussion of the results, some conclusions are drawn and the implications for animal welfare policy are considered.

Methodology

A focus group of eight consumers was carried out to help inform the design of the consumer postal survey. The focus group was stratified to ensure participants came from a mix of socio-economic backgrounds. The following issues were explored with focus group participants: consumer beliefs concerning the welfare of hens in free range laying systems; current knowledge of IP; attitudes to IP and the welfare of hens after a full briefing about IP; and attitudes to the potentially higher costs of eggs resulting from the introduction of on-farm measures leading to reduced levels of IP. Beak trimming was not mentioned as it was regarded as a separate welfare issue.

Findings from the consumer focus group were used to help inform design of a questionnaire which was then trialled in a pilot exercise with 10 egg consumers. Following this exercise, the A4-size, two-page questionnaire was revised (see Appendix 1). It consisted of four sections designed to collect information, in order, on:

- the demographics of the respondent and their household;
- food, egg, and specifically, free range egg purchasing behaviour;
- attitudes to hen welfare (including IP); and
- willingness to pay (wtp) to help poultry farmers ensure that hens do not suffer from IP.

The amended questionnaire was sent to a sample of 1776 consumers stratified by geographical location and socio-economic characteristics such as age, sex, income and type of accommodation. This was undertaken to try to ensure the sample was representative of all GB consumers with particular emphasis on those socio-economic characteristics that were thought, a priori, to affect egg purchasing behaviour. The sample was purchased from the

126 Yell.com telephone database for GB and the questionnaires, together with a covering letter,
127 were sent out on Wednesday 20 July 2011 with a reply-paid envelope for their return. A
128 reminder letter with a further copy of the questionnaire was sent out on Wednesday 17
129 August 2011 and a second reminder letter was sent out on Wednesday 14 September 2011; a
130 response rate of nearly15% was obtained with 257 questionnaires returned. Response rates to
131 surveys can vary greatly depending on a host of factors. Kaplowitz et al (2004) report an
132 average response rate of 13% for mail surveys suggesting that 15% is not unreasonable.
133 Alternative survey administration methods, such as in person, by telephone and on the
134 internet were considered (see Marsden and Wright, 2010 for a comprehensive description).
135 The first was thought to be far too costly, the second was costlier than using mail and also it
136 was felt that respondents needed the wtp part of the questionnaire in front of them to be able
137 to answer the questions (although a mixed approach using post and telephone would have
138 been possible). The third method, using the internet, was thought likely to achieve a low
139 response rate for a survey of this kind.
140
141 To check the representativeness of the respondents, comparisons were made with the
142 National Population Census (ONS, 2013). This revealed that they were representative in
143 terms of age, education and employment status, but there was a significant difference in
144 gender balance, with 24% more women responding to the survey than would be expected.
145 This is likely to be because the main food purchaser in households would be the one who
146 tended to complete the questionnaire. Probably, for the same reason, there was a slight
147 under-representation amongst respondents of the very youngest consumers.
148
149 The contingent valuation (CV) technique was used to elicit consumers' wtp to help poultry
150 farmers ensure that hens do not suffer from IP. The CV approach (see Mitchell and Carson,

1989) was used because, in the context of this study, it was considered more appropriate and easier (i.e. less cognitively difficult) for respondents to understand and respond to in a mail survey compared to stated choice approaches (see Louviere et al 2000). Prior to the bid questions, some briefing information was offered. First, the phenomenon of IP was described and details given of management approaches that might be adopted to control it (see Appendix 1). It was also pointed out that these control measures would result in increased costs of production for the farmer. Second, respondents were reminded of the prevailing price context for free-range egg purchases in an attempt to 'ground' their wtp responses in reality (wtp studies often remind respondents of their limited budget or provide a 'cheap talk' script to ground their responses but given the small percentage of their budget that people spend on eggs a price context was thought to be more appropriate and more compatible with how consumers compare prices when food shopping).

Consumers were asked whether they would be willing to pay a specified amount of money as an extra payment on top of what they currently pay per half dozen for free range eggs to help poultry farmers ensure that hens do not suffer from injurious pecking. One of eight different initial bid levels (ranging from 2 pence to 16 pence) for six free range medium-sized eggs were randomly allocated to those sampled. If they were prepared to accept the initial bid (they were given the option of saying 'yes', 'no' or 'no opinion'), the next given bid level provided was 50% higher. If the first bid was rejected, respondents were then offered a bid at a level of half the initial bid level. This technique is known as the double-bounded dichotomous choice wtp elicitation method and has been recommended for use in CV studies (Hanemann et al, 1991). Immediately after the bid questions, respondents were then asked to describe briefly the reasoning behind their answers to the bid questions; this practice is often called 'debriefing'.

Several methods could have been used to estimate wtp using the data. The approach used in this case was an Interval Maximum Likelihood Logistic Regression (SAS, PROC LOGISTIC) which predicted consumer response to BID (the highest accepted bid value) based on a number of determining variables, including various socio-economic characteristics of the respondent, attitudinal responses to questions about egg production and the opening bid level. The total usable sample size was 250, after deleting non-responses to the wtp question. However, a relatively large number (190) of the observations had randomly occurring missing values, usually just one, or a small number, particularly in the attitudinal questions, resulting in the exclusion of these observations from the Logistic Regression. Thus it was decided that remedial action was necessary to recover and use some of the 'lost' observations.

For this purpose, a principled multiple imputation (MI) method was used to replace missing values (SAS, PROC MI) from the attitudinal questions. Several MI approaches are available (see Rubin 1987) but, in this case, the approach adopted was the Markov Chain Monte Carlo (MCMC) method, as this is regarded as the most appropriate method for datasets with arbitrary missing data patterns compared to any other method (Schafer 1997). MCMC draws a random sample of values to replace missing values from the available distribution for each variable. This process allows for the generation of valid statistical inferences that properly reflect the uncertainty due to missing values - for example, confidence intervals with the correct probability coverage. This also allows standard statistical procedures for complete data analysis to be used with the filled-in data set. As a result of this exercise, a useable sample of 193 respondents was obtained.

Various techniques could have been employed to estimate wtp but the method employed in this case was Maximum Likelihood Estimation, after Cameron (1988) and extended by Hanemann et al (1991) and employed by Bennett and Blaney (2003) to estimate consumers' wtp to improve hen welfare via legislation to ban battery cages.

By this approach, individual i has an implicit (unobserved) wtp, for a pack of 6 eggs produced to higher welfare standards, given by:

(1) $wtp_i = \underline{x}_i' \underline{b} + s u_i$,

where:

wtp_i is the individual's true, but incompletely observed, willingness to pay

$\underline{x}_i'$ is a vector of explanatory factors which can be observed,

u_i is a symmetric random error with zero mean and unit variance that arises from the unobserved factors about i's wtp, and

$\underline{b}$ is a vector and s a scalar to be estimated.

Each respondent was asked whether they were willing to pay a randomly assigned amount (B_i). The probability of observing a positive response to this wtp question is:

(2) $Pr(Yes) = Pr(u_i < -B_i / s + \underline{x}_i' \underline{b} / s)$.

Alternatively, this probability can be written as:

(3) $Pr(Yes) = F(c B_i + \underline{d}' \underline{x}_i)$,

where: $c = -1 / s$ and $\underline{d} = \underline{b} / s$. $F(\ )$ is the cumulative distribution function of u_i and its assumed distribution determines the type of binary choice model used. The use of a varying bid level enables the identification of the scale of the wtp relationship and so the bid (B_i) is included amongst the set of explanatory variables ($\underline{x}_i$) in the binary choice model. The coefficients obtained from the binary choice model are then used to identify the parameters in Equation (1). The estimated parameters in the binary choice model are c and $\underline{d}'$ and thus the estimates of $\underline{b}'$ and s (Bennett and Larson, 1996).

will be:

(4) $$\underline{b}' = -\underline{d}' / c$$

(5) $$s = -1 / c$$

Once the coefficients of the explanatory variables were obtained from the model, it was then possible to estimate wtp. In this case, maximum likelihood estimation procedures were used, specifying a logit model (assuming a standard logistic distribution function) and using standard procedures available in the software package of the SAS Institute Inc. of Cary, California.

A complete list of all variables used in the Logistic Regression analysis is provided in Appendix 2. The socio-economic variables were selected on the basis that, in past studies, they had proved to be good indicators of wtp for a variety of food attributes (e.g. Tranter et al 2009; Yiridoe et al 2005; Shaw & Shiu 2002).

Results

The consumer focus group findings can be summarised as: all participants bought free range eggs for perceived welfare benefits; participants had no idea that IP went on and were shocked to discover the fact, as they thought that free range production was the 'gold standard' for hen welfare; there was a general feeling of betrayal, with some indicating that they might stop buying free range eggs; and most participants said they would happily pay extra to compensate poultry farmers for the costs of removing or lessening the IP problem. In the main survey, only 3% of respondents reported that they did not buy eggs at all, most of whom kept their own chickens. The majority (67%) of consumers reported that they bought eggs for their household and, also, did so weekly. The mean number of eggs bought monthly was 23. Some 66% of the respondents reported that they always bought free range eggs, with a further 28% stating that they bought them sometimes; only 6% reported that they never bought free range eggs.

Respondents were asked why they bought free range eggs. They were given five possible reasons and asked to score each on a 6 point (0-5) Likert scale, with 5 being 'very important' and 0 being 'not important at all'. The most commonly given reason was: 'Hen welfare is better' which also had the highest mean importance score of 4.60 (S.D. 0.86). The next most commonly cited reason was: 'Free range hens are happy' with a mean importance score of 4.31 (S.D. 1.03). The next most commonly cited reason was: 'They taste better than other eggs' with a mean importance score of 3.67 (S.D. 1.51), followed by 'They are healthier than other eggs' (3.53; S.D. 1.52) and 'They are fresher than other eggs' (3.30; S.D. 1.68).

Consumers were asked a series of questions designed to elicit their attitudes towards egg laying hens and free range egg production. Their answers to the eight statements given, showing their levels of agreement or disagreement, are shown in Table 1 below. Some 43% of respondents either agreed, or strongly agreed, with the statement that they were well-informed about how laying hens were treated, with 78% expressing concern over the nature of the treatment they received; 86% of respondents believed that free range production offered 'higher levels of welfare than cage production', with 89% affirming that hens should be able to display normal behaviour. In terms of the impact of production system on the quality of eggs, 68% thought that 'eggs from birds with a high welfare are healthier and better tasting'. Furthermore, 41% of our respondents agreed with the statement that 'eggs from hens with high welfare are safer to eat', in spite of a lack of scientific evidence to support this view. Probably reflecting the highly positive views that respondents have of the benefits of free range egg production, 76% said they were 'happy to pay more for free range eggs'.

Table 1 around here

After the wtp questions, the respondents were asked whether, before reading the questionnaire, they knew that IP was a common problem in all flocks of laying hens, including free range. A minority (36%) said that they were aware, while 64% said they were not. They were then asked whether knowing about IP changed their attitude towards free range eggs: 40% said it did and 60% said that it did not.

The respondents were asked to rate, on a 100 point scale, how they perceived the welfare level of free range hens compared to caged laying hens. Three base levels of welfare for

caged hens were provided, at one of 40, 50 or 60 points, with respondents being asked to rate the welfare of free range hens relative to these three base levels. Half of the respondents were asked this question before IP was explained to them and the other half after it had been explained. When respondents were asked to rate the welfare of free range hens after the phenomenon of IP had been explained to them, they gave a slightly lower mean welfare score (78.22) than those who had not yet had IP explained (78.76). In both cases, the respondents rated the welfare of free range production as significantly higher than cage production, although the difference between the two groups was non-significant (Table 2). However, there were some differences in respondents' mean welfare scores according to whether the baseline score they had on their questionnaires was 40, 50 or 60. Higher 'mark-ups' for free range welfare were given for baselines of 40 and 50 compared to 60. From these responses, it can be taken that knowledge of pecking problems and the level of assumed welfare attributable to caged systems does not unduly impact consumer perceptions of the welfare premium that free range egg production provides over cage production.

Table 2 around here

To estimate wtp, Logistic Regression was carried out using backward stepwise regression, where variables were included in the regression model sequentially if their statistical significance was 0.1 or better and variables were retained in the model if their significance was 0.05 or better. Table 3 contains the two variables retained in the final model. From Table 3, it can be seen that the respondents' socio-economic characteristics were not found to be significant determinants of wtp to reduce IP.

Table 3 around here

To estimate wtp, the coefficients from Table 3 above were multiplied by the values of the relevant explanatory variables, for each respondent, as shown in Equation 1 above.

This gives a mean wtp estimate of 5.6 pence, i.e. the average respondent would be willing to pay a premium of 5.6 pence over the prevailing price of 6 medium-sized free range eggs to help poultry farmers ensure that hens do not suffer from IP. At the time of survey, the average current price of free range eggs was £1.65, so the estimated IP premium was 3.4% more.

It can be seen from Table 3 that only two of the variables tested were significant determinants of wtp: the bid level accepted and the attitudinal variable connected with the statement that respondents were happy to pay more for free range eggs. It is important to the credibility of such economic models that are used to estimate wtp that the bid level is a significant explanatory variable and that it has the expected sign (i.e. the higher the bid the less likely respondents are to say 'yes' to it). The positive sign on the attitudinal variable, indicates that the more strongly respondents agreed with the statement, the higher the bid level they were likely to accept in the wtp question.

It is common practice to identify and remove 'protest' bids from wtp estimation (these bids are often very high or very low, e.g. zero, depending on the context of the wtp questions; see Diamond et al, 1993). It is argued that these bids do not reflect the real value that respondents place on a good, but are posited in order to register an objection to having to pay by a particular payment vehicle, or for something originally available for free 'Debriefing' questions are used to identify such protest bids which may then be removed from the

analyses. However, various researchers have questioned the often arbitrary nature of excluding protest bids from analyses (e.g. Jorensen et al, 1999) and the potential introduction of significant bias by doing so (see Halstead et al, 1992). In this study, there was no clear indication of protest bids from analysing responses to the debriefing question, so no observations were excluded from the estimation of wtp for that reason.

Table 4 presents responses to the debriefing questions. It will be seen that the most common reason given by respondents for their choices was a desire to pay more if it improves hen welfare (25.6%), followed by a feeling that free range production is important for animal welfare (16.8%). Some 15% of respondents felt that free range eggs were too expensive already, or that they could not afford to pay any more for their eggs.

Table 4 around here

Discussion

IP is found in a majority of egg-laying flocks in GB and is particularly prevalent in free range and non-cage systems. IP can have substantial welfare issues for hens and financial implications for producers. The results of this survey show that consumers are largely unaware of the welfare problems associated with IP in free range laying hens and are somewhat concerned when informed about such issues. Nonetheless, consumers seem to largely maintain their belief that free range production is superior on welfare and other grounds (such as food safety, health and taste) compared to other production systems. Respondents to the survey expressed a wtp price premium of 3.4% (5.6 pence) on the current retail price of eggs to help address IP in free range systems. This amount may be thought relatively small, perhaps because a number of respondents considered free range eggs

to already be relatively expensive compared to cage eggs (and thus were not prepared to pay much more) and some were not convinced that paying more would help solve the problem (it could be argued that some in this latter category could be classed as protest bids). Indeed, a more rigorous identification of possible protest bids by the use of appropriate follow-up questions for this purpose could have resulted in some zero bids being removed from the sample with a subsequent increase in mean wtp. Moreover, it could also be argued that the framing of the wtp question in the context of the current egg prices at the time of survey and increased costs to farmers may have had a downward bias on respondents' wtp. Conversely though, one could maintain that this context merely served to ground the responses in reality. ~~Over three per cent also~~However, the wtp estimate appears credible when compared to the results of the Eurobarometer (2005) survey in the UK which found that most people would not pay more than 10% as an additional price premium to source eggs from an animal welfare friendly production system. ~~However, i~~It should also be noted that 5.6 pence is equivalent to around £1.40 per bird per year (assuming a mean yield of 25 dozen eggs per bird per year). This is a relatively substantial amount to producers given than an average gross margin per bird of around £7 might have been expected from free range egg enterprises at that time (Nix, 2013).

The finding that consumers have a positive wtp to improve animal welfare is consistent with other wtp consumer/citizen studies using various valuation methods. For example, Bennett et al (2012) (using choice experiment and CV methods) found that consumers in GB have a substantial wtp per annum to improve the welfare of various farmed species, whilst Bennett (1997) reported a consumer wtp of £0.32 per week to ban cage egg production in the UK (using the CV method) with the EC (2007) finding that 57% of EU consumers across 25 Member States were willing to pay a price premium for hens' eggs sourced from animal

401 welfare friendly production systems. In Northern Ireland, Burgess and Hutchinson (2005)
402 reported substantial mean wtp to improve the welfare of dairy cows, pigs, broilers and laying
403 hens through legislation (also using the CV method) whilst Norwood and Lusk (2008) found
404 that US consumers had a wtp for higher welfare in egg production (using an experimental
405 auction-based approach) as did Carlsson et al (2005) in relation to consumers in Sweden
406 (using a choice experiment method).
407
408 The CV method used for this study was considered appropriate by the authors. Alternative
409 stated preference valuation methods include choice experiments and experimental auctions
410 but these were not considered to be appropriate in this context. The choice experiment
411 method is used to elicit the values that people have for a range of attributes and for different
412 attribute levels associated with a good (see Louviere et al, 2000 for a comprehensive
413 description). In this study, we wanted to elicit only one value in terms of consumers' wtp to
414 help poultry farmers ensure that hens do not suffer from IP. Experimental auction approaches
415 have the advantage that they use real goods, and real money, in an (experimental) market
416 context as opposed to the hypothetical context used in CV (see Lusk and Shogren, 2007 for a
417 comprehensive guide to experimental auctions). However, the cost of experimental auctions
418 can be relatively quite high when a substantial number of consumers is involved. The price of
419 eggs in food stores was also considered an appropriate payment vehicle for the study.
420 Consumers are well used to a variety of shell eggs in food stores differentiated by size, breed,
421 production system, price etc. It is difficult to be sure that there is not some hypothetical, or
422 other bias, in our study which could have influenced the wtp estimates. We have tried to
423 minimize these by sensible design of the survey instrument and by appropriate choice of
424 analytical method. Moreover, as discussed above, the wtp results appear very credible and
425 broadly consistent with people's stated attitudes and opinions.

Conclusions and implications for animal welfare

The study reported here found that consumers are largely unaware of the problem of injurious pecking in free range laying hens. Despite the finding that consumers have a belief that free range means better welfare, there is a danger that this belief may be undermined if consumers learn of significant welfare problems on free range units, such as those caused by IP on the majority of free range egg production systems**.** Consumers were concerned when learning of IP on free range units, with 40% stating that it changed their attitude towards free range eggs. Producers need to address such welfare problems as a matter of urgency to ensure that consumers continue to value free range egg production and that it can continue to command its current price premium in the market. Indeed, the study findings suggest that there may be an additional price premium that producers could command, and that consumers would be willing to pay, for demonstrating the high welfare provenance of their eggs (e.g. birds with intact beaks and no, or limited, IP amongst other welfare attributes).

The findings of our study have relevance across livestock production systems (free range or otherwise) which consumers currently perceive as being high welfare. Consumers may feel equally concerned if they learn of other production practices or welfare issues of which they are unaware which could affect the demand for, and future sales of, free range eggs and other products in stores. Such practices and issues might include various animal mutilations such as beak trimming for chickens, castration and tail docking in pigs, lameness in dairy cows and in sheep, and leg health problems in broilers. Food retailers are keen to guard against such eventualities and have already put in place a number of initiatives to be able to demonstrate that they are addressing the issues. The livestock industries, and farm assurance schemes, need also to take action to address such welfare issues to ensure that they are not

vulnerable to large shifts in consumer demand as a result of changes in perceptions regarding the welfare of animals used to produce our food.

There is also a wider issue concerning welfare provenance of livestock products and the transparency of farm assurance. The FAWC (2006) recommended the development of a single, accredited, mandatory EU-wide welfare-labelling scheme, backed by welfare assessment based primarily on welfare outcomes, that would provide a transparent measure of the welfare status of animals involved in producing livestock products. To date, such a scheme has not been initiated, but it could greatly assist in assuring consumers about the welfare provenance of the food they eat, provide a vehicle on which to base price premia for differentiated livestock products, and so provide a stronger market incentive to producers to improve farm animal welfare.

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470 **Appendix 1. Specimen Questionnaire**

471 **Appendix 2. List of potential determining variables evaluated in the WTP analysis**

472

Variable name	Format	Description
Employ	Categorical variable (5 categories)	Employment status
Income	Ordinal variable (4 point scale)	Household income category, values given as central value in 4 categories
Eggfreq	Integer (interval scale)	Frequency of egg purchases, where 1=daily or weekly; 0=less than weekly
Rank_ch	Integer (ordinal scale 0-100)	Difference between respondent welfare rating and stated current average welfare rating
A1	Binary variable (M or F)	Gender
A2	Integer (interval scale)	Respondent age
A3	Integer (interval scale)	Age left full-time education
A8	Integer (interval scale)	Number of eggs bought each month
A10a	Ordinal variable (5 point scale)	Attitudinal variable. Ranking of agreement with statement: 'They are fresher than other eggs'
A10b	Ordinal variable (5 point scale)	Attitudinal variable. Ranking of agreement with statement: 'Free range hens are happy'
A10c	Ordinal variable (5 point scale)	Attitudinal variable. Ranking of agreement with statement: 'They taste better than other eggs'
A10d	Ordinal variable (5 point scale)	Attitudinal variable. Ranking of agreement with statement: 'They are healthier than other eggs'
A10e	Ordinal variable (5 point scale)	Attitudinal variable. Ranking of agreement with statement: 'Hen welfare is better'
B1	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'I feel well informed about how laying hens are treated'
B2	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'I am concerned about the way laying hens are treated in the process of producing eggs'
B3	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'Eggs from birds with high welfare are healthier and better tasting'
B4	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'It's wrong to eat eggs from hens that have not had a good life'

B5	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'Free range production provides higher levels of welfare than cage production'
B6	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'Eggs from high welfare are safer to eat'
B7	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'I am happy to pay more for free range eggs'
B8	Binary variable (1=agreement; 0= neutral or disagreement)	Attitudinal variable. Ranking of agreement with statement: 'It is important that hens can display normal behaviour'
C1	Integer (interval scale)	Bid level accepted
C3	Binary variable (yes / no)	Prior knowledge of feather pecking as a problem
C5a	Binary variable (yes / no)	Knowledge of feather pecking changes attitudes to free range eggs

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685 **Table 1. Respondents' levels of agreement/disagreement with a series of statements**

686 **concerned with egg production and hen welfare (% 193 of respondents).**

687

Statements on egg production and hen welfare	Strongly agree	Agree	Neither agree/ disagree	Disagree	Strongly disagree
I feel well-informed about how laying hens are treated in egg production	8	35	32	20	5
I am concerned about the way laying hens are treated in the process of producing eggs	35	43	20	1	1
Eggs from birds with high welfare are healthier and better tasting	22	46	27	3	2
It is wrong to eat eggs from hens that have not had a good life	33	31	26	8	2
Free range production provides higher levels of welfare than cage production	40	46	12	2	0
Eggs from hens with high welfare are safer to eat	15	26	47	11	1
I am happy to pay more for free range eggs	29	47	15	7	2
It is important that hens can display normal behaviour	46	43	10	1	0

688

689

690 **Table 2. Respondents' mean welfare scores for free range hens in comparison with**
691 **various arbitrary scores given for caged layers, stratified by whether they had yet been**
692 **informed about IP on the questionnaire.**
693

Respondents' welfare scores for free range egg laying hens			
Arbitrary cage welfare score	Question posed before IP explained (n)	Question posed after IP explained (n)	Overall (n)
40	74.32 (44)	72.7 (42)	73.53 (86)
50	78.56 (39)	79.34 (50)	79.00 (89)
60	85.32 (31)	82.63 (40)	83.80 (71)
Overall	78.76 (114)	78.22 (132)	-

694
695

696 **Table 3. Logistic Regression estimates and their statistical significance**

697

Variable name	Description	Maximum likelihood estimate	Pr>ChiSq
Intercept	-	-3.8761	0.0004
C1	Bid level accepted	0.0937	0.0002
B7	Attitudinal variable. Ranking of agreement on a 5-point scale where 1=agreement and 0=neutral or disagreement with statement: 'I am happy to pay more for free range eggs'	0.8458	0.0012

698

699 Notes:

700 -2 Log likelihood (with covariates) 239.24.

701 Chi-Square for covariates 54.7 with 27 degrees of freedom (p = <0.0003).

702 Association of predicted probabilities and observed responses = 75% concordant.

703

704

705 **Table 4. Answers to debriefing questions[1] as to why consumers indicated that they**

706 **might pay more to reduce levels of IP in free range flocks (% of 193 responses)**

Reasons	
Will pay more if it improves welfare/the hens have a better life	25.6
Insist on free range for welfare reasons/animal welfare is very important	16.8
Too expensive already/can't afford to pay any more	15.3
Miscellaneous reasons	13.7
No answer given at all	9.9
Price premium must benefit farmer only	7.3
Will the measures to reduce IP really work	6.1
All birds peck each other at times	5.3
	100.0

707 [1] **No respondent gave what could be construed as a protest bid.**

708