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**Sheep farmers' attitudes to farm inspections and the role of sanctions and rewards
as motivation to reduce the prevalence of lameness**

Running title Rewards and sanctions to reduce sheep lameness

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Abstract

The Welfare of Farmed Animals (England) Regulations 2007 make it an offence to allow unnecessary suffering to animals, highlighting that farmers have a duty of care for their animals. Despite this, the current global mean prevalence of lameness in sheep in England is 5%; i.e. ~750,000 lame adult sheep at any time. To investigate farmers' attitudes to sanctions and rewards as drivers to reduce the prevalence of lameness in sheep, farmers' attitudes to external inspections, acceptable prevalence of lameness and attitudes on outcomes from inspections were investigated using a self-administered questionnaire. A total of 43/102 convenience-selected English sheep farmers responded to the questionnaire. Their median flock size was 500 ewes with a geometric mean prevalence of lameness of 2.8%. Few farmers selected correct descriptions of the legislation for treatment and transport of lame sheep. Participants considered 5–7.5% prevalence of lameness acceptable and were least tolerant of farmers who rarely treated lameness and most tolerant of farmers experiencing an incident out of their control, e.g. disease outbreak. Participants consider sanctions and rewards would help to control lameness on sheep farms in England. Sanctions (prosecution, reduction in payment from the single (basic) payment scheme or suspension from a farm assurance scheme) were considered “fair” when lameness was $\geq 10\%$ and rewards “fair” when lameness was $\leq 2\%$. If these farmers' attitudes are applied to 1,300 randomly selected flocks with a mean prevalence of lameness of 3.5%, 24.6% flocks had $\geq 10\%$ lameness and would be sanctioned and 32.5% flocks had $\leq 2\%$ lameness and would be rewarded.

Keywords: lameness, rewards, sanctions, attitudes, legislation, animal welfare

1. Introduction

The control of lameness is covered by legislation and codes of practice on the welfare of livestock. The Welfare of Farmed Animals (England) Regulations 2007 came into force on 1st October 2007 under the Animal Welfare Act of 2006. The Act sets down minimum standards for the protection of all farmed livestock, making it an offence to cause or allow unnecessary suffering to any animal. This, therefore introduced a duty of care for all animals, setting out minimum standards for accommodation, feeding and watering, maintenance of equipment used with livestock, and regularity of inspection. This is to ensure that animals are in a state of good well-being. The Welfare of Farmed Animals (England) Regulation 4 (2)(d) requires that a person responsible for a farmed animal “must have regard to its physiological and ethological needs in accordance with good practice and scientific knowledge.” Sheep farmers must also comply with the Council Regulation (EC) No 1/2005 on the protection of animals during transport and related operations. In addition, the Welfare of Animals (Transport) (England) Order 2006 bans the transport of unfit animals, including those that are injured or present physiological weaknesses or pathological processes, and those unable to move independently without pain. The legislation is written to cover all farmed animals or all animals, respectively, so the wording is generic and the style of language is complex.

Other than legislation, codes on welfare are available that are species specific, these provide guidance on how to care for animals and how to comply with the Act and any regulations issued under the Act. Breaching a code, in itself, is not an offence but could be used by a court to establish or negate liability. Approximately 1% of sheep farms in Great Britain (GB) are inspected annually by the Animal and Plant Health Agency (APHA) to investigate compliance with welfare legislation and code (KilBride *et al* 2012; Clark *et al* 2016).

In addition to the above, there are statutory management requirements (SMRs) which farmers must comply with under cross compliance with the EU to qualify for full payment under the direct payments schemes. These offer a layer of income support to farmers as well as targeting specific types of beneficiaries funded in the EU; there are a number of specified SMRs to which sheep farmers must adhere. Of particular importance is SMR 13 (previously SMR 18) (Defra, 2015) which requires farmers to thoroughly inspect their livestock as often as necessary to avoid suffering, and to ensure that they are looked after by staff who have the correct skills and knowledge. Approximately 1% of claimant farms in GB are inspected annually to investigate compliance with SMRs (Clark *et al* 2016).

Farm assurance schemes were developed to ensure that producers comply with certain standards of food safety and animal welfare in the UK as a result of well-publicised food scares during the 1980s and 1990s (Knowles *et al* 2007), which led to increased pressure on the agricultural industry to improve its practices, and the Food Safety Act of 1990. Different quality assurance schemes (QAS) weight standards differently (Wood *et al* 1998; Morris & Young 2000), for example, the Freedom Food scheme set up by RSPCA in 1994 emphasises animal welfare (RSPCA 2013a). Other schemes such as Red Tractor are overseen by Assured Food Standards (AFS) and carry out independent inspections to confirm businesses are meeting standards on food safety, animal welfare and the environment. In contrast to 1% of farms inspected, all farms that are members of these voluntary, private schemes are inspected at 12 – 24 month intervals (Clark *et al* 2016).

Despite legislation, regulation, codes of practice and inspections for all aspects of animal welfare, lameness in sheep is endemic in GB where most sheep farms in England have some lame sheep. To comply with legislation, where every animal's welfare is of concern and Farm Animal Welfare Committee (FAWC 2011) ideal, all lame sheep would be treated and in

recovery. Lameness in sheep is a significant welfare concern for farmers and vets (Goddard *et al* 2006; FAWC 2011). Lamé sheep are in pain and, if left untreated, develop hyperalgesia (Ley *et al* 1989; FitzPatrick *et al* 2006), lose body condition and are less productive (Wassink *et al* 2010). Many sheep farmers do not treat individual sheep the day they become lame (Kaler & Green 2008a) and interpretation of the legislation is unclear, however, ‘intention to treat’, e.g. if a farmer demonstrates a routine of treating sheep within three days of becoming lame, this fits with the evidence for best practice (Wassink *et al* 2010).

Sheep farmers are able to estimate the prevalence of lameness in their flock reliably (King & Green 2011); with >90% farmers considering sheep lame with locomotion score 2 or above (Kaler *et al* 2009). In 2004, 10.4% of English flocks were lame at any one time (Kaler & Green 2008b). In 2011, the FAWC published a recommendation that ‘the prevalence of lameness in flocks farmed in Great Britain should be reduced to 5% or less by 2016 as an interim target, and to 2% or less, (which is already possible with best practice (Wassink *et al* 2010)) by 2021’ (FAWC 2011). There is a wealth of evidence that avoiding routine foot trimming (Wassink *et al* 2003; Kaler & Green 2009; Winter *et al* 2015) and early and accurate diagnosis of the cause of lameness, followed by the correct treatment leads to rapid recovery (Kaler & Green 2008a; Kaler *et al* 2010; Dickins *et al* 2016) that reduces the prevalence of lameness (Wassink *et al* 2010), prevents loss of body condition, and so reduces unnecessary suffering; summarised in (Green *et al* 2012).

In 2013, 1,300/4,000 English sheep farmers responded to a questionnaire, selected through stratified random sampling of flocks with > 200 ewes. From this, the global mean prevalence of lameness had fallen from 10.4% to 5% (Winter *et al* 2015). The geometric mean flock prevalence of lameness was 3.5% and, again, a lower prevalence of lameness within respondents was associated with rapid and correct treatment of lame sheep and avoiding foot

93 trimming (Winter *et al* 2015). These practices are defined as ‘current best practice’ (O’Kane
94 *et al* 2016) to minimise lameness in sheep.

95 A reduction in national average lameness to 5% is an improvement from 10.4% of 2004 and,
96 whilst on target for FAWC’s 2016 target, it is still higher than the proposed target of 2% by
97 2021. It is possible that a further reduction in the prevalence of lameness might be possible
98 through legislation. Enforceable legislation from a central authority is known to be a
99 powerful mechanism to encourage compliance and cooperation (Gurerk *et al* 2006; Traulsen
100 *et al* 2012) even if that sanction is not always applied.

101 There are insufficient resources to apply legislation across all farms in England and farmers
102 view the current systems of inspection as ‘unfair’ if they are caught in breach of legislation.
103 Because inspecting farms is resource intensive, Government would prefer farmers to self-
104 regulate (Defra 2014). It is possible that self-regulation could be done by farm assurance
105 schemes with sanctions for high percentages of lame sheep or rewards for low percentages of
106 lame sheep or both. There is also a large literature showing that people cooperate when they
107 can be sanctioned by peers (Traulsen *et al* 2012), however, rewarding good practice also
108 results in compliance (Balliet *et al* 2011).

109 In this paper, we investigate the role of all external inspections for compliance with
110 legislation, codes of practice and private schemes as well as farmers’ attitudes about rewards
111 and sanctions as motivators to control lameness in their flock and in the national sheep
112 industry in order to evaluate whether, and how, external inspections might be used to further
113 reduce the prevalence of lameness in sheep. Questions of interest are when do farmers think
114 that sanctions or rewards should be used? Do farmers view these options as fair and viable?
115 Two key concepts with respect to fairness and viability are (1) acceptable risk (Fischhoff *et al*
116 1978; Freeman & Bass 1992; Dowling & Staelin 1994) and (2) legitimisation. One aspect of

acceptable risk refers to the level of risk people are willing to tolerate or indulge (Dowling & Staelin 1994). In the context of lameness, this would equate to the prevalence of lameness in a flock that farmers consider the acceptable upper limit. Legitimization here refers to legitimizing the behaviour due to external factors (Lotem *et al* 1999). For example, if sheep are lame due to no fault of the farmer, then this should mitigate against sanctions (Ferguson *et al* 2012). It should only be fair and viable to sanction a farmer whose prevalence of lameness exceeds the acceptable upper limit when there are no legitimate means to mitigate against the sanction. We used these basic ideas to develop the scenarios explained below.

2. Materials and Methods

Ethical approval for the study was granted by the University of Warwick human ethical review committee, BRSEC. Throughout the paper, participant is used to refer to a farmer who responded to this questionnaire, whilst farmer is the general grouping of sheep farmers in England.

2.1 Questionnaire design and administration

Consensus methods were used to derive coteries of risk; these have been used commonly elsewhere e.g. linked to health and climate change (Johnson 2003; Blaser & Cornuz 2015). Experts in lameness in sheep, the sheep industry, legislation and code and health psychology from the Universities of Warwick and Nottingham designed a 12-page questionnaire to capture data from participants on their membership of farm assurance and organic certification schemes (Table 1), their management and treatment of lameness, the period prevalence of lameness between July 2013 and June 2014, personal and flock descriptors and external inspections of their farms between January 2011 and December 2014 (Table 2).

One section of the questionnaire was designed to investigate knowledge of legislation in England regarding lameness in sheep. In this section, participants were asked to select one statement which best described their understanding of the current law relating to the care of lame sheep on English farms and the transport of lame sheep in England. Participants were then asked to rate their confidence in their selected statement, presented in Table 3. Another section requested participants' attitudes to external inspections of their flock and were asked to respond to four statements using a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Statements included "there is currently too much external inspection of animals in my flock" and "external inspections to check animal welfare in my flock waste my time" (Table 4).

To investigate attitudes of theoretical inspections specifically for lameness, four cut-off percentages of lameness were defined: 2% (FAWC recommended target prevalence achievable with current evidence (FAWC 2011), 5% (current global mean prevalence (Winter *et al* 2015), 10% (global mean prevalence of lameness in 2004) and 25% (above the 75th percentile of prevalence of lameness (Winter *et al* 2015). Participants were asked which prevalence of lameness they perceived to be the upper acceptable limit (Theme 1) and at what prevalence of lameness it was fair to sanction farmers (Theme 2) in the four scenarios (A – D) following an inspection by an outside body: A) a farmer who rarely treats lame sheep; B) a farmer who has managed lame sheep the same way for over 20 years; C) a farmer who uses best practice (O'Kane *et al* 2016) to manage lameness and D) where the prevalence of lameness has increased rapidly in the past few months despite seeking and following veterinarian's advice. In theme 1, participants were asked to select a fair prevalence of lameness for each scenario. In theme 2, participants were asked to select by prevalence of lameness, and scenarios A – D, what they considered the fairest outcome from the inspection. The possible outcomes were prosecution, reduction in single payment (the EU subsidy

payment to sheep farms), suspension of farm assurance status, no action, able to sell stock to specialist suppliers, gain a bonus on single payment and extra payment per kilo of lamb sold. Results from Theme 1 indicates farmers' acceptable risk and Theme 2, the legitimised prevalence of lameness above which it would be fair to intervene: if farmers are sensitive to mitigating circumstances then they should select a higher acceptable prevalence of lameness before it is fair to sanction when there is a legitimization for the lameness prevalence than where there is not.

In theme 3, three situations were presented to investigate the attitudes of participants on sanctions and rewards following an inspection. The situations were 1) a law is introduced that sets a legal cut-off for the maximum prevalence of lameness, farmers with prevalence above this maximum level would be breaking the law, every flock is inspected every year to check for compliance; 2) a penalty is introduced so that if lameness is above a maximum level when inspected by the Rural Payments Agency, rural payment income would be reduced and 3) if farmers were able to maintain lameness in their flock below a certain prevalence, they were able to sell under a new 'Assured Sound Sheep' trademark. This gives an extra payment per kilo of lamb sold. For each situation, farmers selected the maximum upper prevalence of lameness and whether the proposed situation would be an effective way to reduce the prevalence of lameness on sheep farms in England and whether it would impact their business negatively or positively. Theme 3 assessed farmers' attitudes on the effectiveness of rewards and sanctions in particular contexts to differentiate fair from effective.

Most questions were closed or semi-closed and some questions had an "other" option allowing for free text. The questionnaire was read and commented on by all members of research groups at both Universities. Finally, the questionnaire was pilot tested on 5 sheep farmers in England (equivalent to 5% of the target sample) to estimate a realistic time frame for the completion of the questionnaire and to check farmers' understanding of the

questionnaire using a feedback form; two farmers responded. They completed the questionnaire correctly and indicated that the questionnaire was logical and they understood the questions; no changes were therefore made.

2.2 Recruitment of participants

In 2011, 449/972 sheep farmers selected using stratified random sampling based on county and flock size from 18,000 members of the AHDB Better Returns programme participated in a University of Warwick study (King 2013; Brian, personal communication 2016). The mean global period prevalence of lameness was 5.6%. A total of 102/449 farmers (global mean period prevalence of lameness of 4%) had agreed to participate in further research and this convenience-selected group were invited to take part in the current study. Questionnaire packs containing a cover letter, the questionnaire and a prepaid return envelope were sent to farmers in December 2014. Reminder letters were sent in January 2015, and a second questionnaire pack was sent to those who had not returned the questionnaire by February 2015. Thank-you letters were sent on return of questionnaires. Each questionnaire returned was allocated a unique number and sent to an external agency (Wyman Dillon Ltd) for double data entry. The data received back were stored in Microsoft Excel, cleaned manually and checked for consistency with the raw data. Where answers were illogical / inconsistent they were excluded from statistical analyses.

2.3 Statistical analysis

Summary statistics of central tendency and dispersion were made for each variable in Stata/SE 13.1 (StataCorp.2013). The geometric mean (GM) lameness and 95% confidence intervals (CI) and the median and range of flock sizes were estimated. Graphs were made to summarise data on the acceptable prevalence of lameness by plotting scenarios by 2%, 5%, 10% and 25% lameness and whether participants ranked this as acceptable or unacceptable.

Responses from participants on cut-off levels for sanctions and rewards were compared with the distribution of lameness reported in a 2013 survey of 1,300 randomly selected sheep farmers in England (Winter *et al* 2015) to estimate the percentage of farmers in each category that would be sanctioned and rewarded.

3. Results

A total of 43/102 (42%) farmers returned the questionnaire; however, not all farmers answered all questions. There were 40 male and 1 female respondents. Two participants were 26-35 years old, 11 were 36-45, 13 were 46-55, 10 were 56-65 and 5 were > 65 years old. The flock size ranged from 28 to 1,400 ewes (median 500). Seventy-two percent of participants were members of the Red Tractor scheme (Table 1); 98% claimed rural payments subsidy; 5 were members of a retailer scheme but no one was a member of a selling group. Between January 2011 and December 2014, 33 participants' farms were inspected, most for farm assurance. The number of external inspections per farm ranged from 1 to 9 (Table 2).

3.1 Prevalence of lameness and management of ewes with footrot, July 2013 - June 2014

The GM prevalence of lameness from July 2013 to June 2014 was 2.8% (95% CI 2.3% – 3.5%); this was lower than the GM of 3.5% (CI 3.3% – 3.7%) of a random sample of 1,300 farmers in 2013 (Winter *et al* 2015). Overall 39%, 90%, 98% of participants had a prevalence of lameness $\leq 2\%$, $\leq 5\%$ and $\leq 10\%$ respectively; 1 respondent had a prevalence of 12%. Approximately 61% treated lame ewes within three days, 56% always, 37% sometimes and 7% rarely used antibiotic injections to treat ewes lame with footrot and 29% never or rarely trimmed the feet of lame ewes. In addition, 63% culled ewes because they had been lame, 35% culled after the second lameness event and 31% culled ewes after they had been lame

more than twice. There were 28%, 60%, 28% and 40% of farmers routinely foot trimming, routinely foot bathing, vaccinating and separating lame sheep respectively. Overall, participants were more compliant, but not completely, with best practice for both treatment and control of lameness than the 2013 respondents (Winter *et al* 2015).

3.2 Understanding of the legislation in England relating to lameness in sheep

Forty-two percent of participants did not think there were any laws relating to the treatment of lame sheep on a farm, whereas 35% answered correctly that it is ‘illegal to have untreated lame sheep on a farm without evidence of intention to treat’; 18% of those who selected the correct statement were very confident, 73% were fairly confident and 9% were not confident with their answer (Table 3).

When asked about the law regarding transport of lame sheep in England, 56% of farmers selected the correct statement that ‘it is illegal to transport sheep that are unable to move independently without pain or walk unassisted to any destination’; 50% were very confident of their answer, 39% were fairly confident and 11% were not confident. However, 34% of participants thought that it was ‘illegal to transport sheep that are unable to move independently without pain or walk unassisted unless going straight to slaughter’ (Table 3).

3.2.1 Attitudes on external inspections for lameness

The frequency of inspections reported by participants was similar to that from a recent survey of 771 farmers in GB (NFU 2015). Of the 38 participants that responded, 16% would not welcome inspection of their flock to check compliance with animal welfare legislation and 37% felt that external inspections to check animal welfare ‘wastes time’. In addition, of 39 participants that responded, 41% thought that external inspections were not important in

maintaining animal welfare standards. When asked whether they thought there was too much external inspection 64% were impartial, 23% disagreed and 13% agreed (Table 4).

3.2.2 Themes 1 and 2. Attitudes on fair outcomes of external inspections for lameness

In Theme 1, (Figure 1), participants identified 7 - 7.5% as the upper acceptable prevalence of lameness for 3 of the 4 scenarios (B-D), but 5% for the scenario 'the farmer rarely treats lame sheep' (A). Participants' responses to a fair outcome from inspection in Theme 2 (Figure 2) show a number of interesting features. First, suspension of farm assurance membership, a voluntary based sanction is preferred (Gurerk *et al* 2006) over prosecution. Secondly, the prevalence of lameness, where suspending farm assurance membership is seen to be a fair sanction, varies as a function of scenario. When the farmer rarely treats (A) or uses the same method to manage lameness (B), prosecution is viewed as a fair option at 8-10% lameness, however, when the farmer uses best practice (C) or there is a sudden increase despite seeking advice (D), this increases substantially to approximately 22% and 17%, respectively. Rewards were rarely selected over sanctions. Most participants selected no reward for flocks even with $\leq 2\%$ lameness: only 6 participants in total selected rewards; a bonus in rural payment ($n = 2$), able to sell to specialist suppliers ($n = 2$) or extra payments per kg lamb sold ($n = 2$).

3.2.3 Theme 3. Attitudes on rewards and sanctions for lameness

Participants identified $\leq 10\%$ as the threshold for a fair legal cut-off prevalence of lameness (Figure 3A) and $>10\%$ when farmers should be penalised (B). They considered that this would lead to a reduction in prevalence of lameness nationally and it would benefit on their own farm. Most participants considered a legal cut-off $<10\%$ would negatively affect their farm business (A). Participants were increasingly less likely to consider that farmers should be rewarded as the prevalence of lameness increased from 2% to 25% (C). Participants

reported that rewards up to 5% prevalence of lameness would impact positively on their farm business, but that rewards up to a maximum of 2% prevalence of lameness would impact negatively on their business (C).

If the same cut-offs for sanctions and rewards identified by the farmers in the current study were applied to the distribution of lameness in the 2013 study of 1,300 randomly selected lowland sheep farmers in England (Winter *et al* 2015), approximately 32.5% of flocks had $\leq 2\%$ lameness and would be rewarded and approximately 24.6% of flocks had $\geq 10\%$ lameness and so would be sanctioned.

4. Discussion

To the authors' knowledge, this is the first study to investigate sheep farmers' attitudes to sanctions and rewards as incentives to control the prevalence of lameness in their own flock and nationally. The participants were convenience-selected because it provided a willing group of respondents, a historic baseline prevalence of lameness and ensured that these farmers were not in another on-going study of lameness (Winter *et al* 2015). The number of participants was relatively small. Participants had a geometric mean prevalence of lameness in their flock of 2.8%; this is lower than the 3.7% estimate from a random sample of English farmers (Winter *et al* 2015). As would therefore be expected, a greater proportion of participants were using 'best practice' than those in Winter *et al* (2015) when analysing their management strategies, and so we are reasonably confident that whilst we did not define 'best practice' explicitly nor set it as a criterion, the respondents were aware of the principles of best practice to manage lameness in sheep. As the mean prevalence of lameness was lower than for a random sample, it is possible that the cut-offs for acceptable prevalence of lameness in themes 1 and 2, and rewards and sanctions in themes 2 and 3 might be slightly biased downwards. However, the very consistent pattern of responses that varied by context

suggests that participants believed that the national industry and they themselves would be influenced / affected by the theoretical situations proposed.

Participants differentiated an absolute upper limit to the prevalence of lameness that was acceptable (Theme 1), an upper limit that depended on scenario (where the farmer's inability to control lameness was identified by participants as a case for leniency) when sanctions could be applied (Theme 2) and participants rationally identified how different sanctions and rewards might affect the English sheep industry and themselves (Theme 3). These patterns, discussed below, shows regularities consistent with farmers using the available information to make decisions about sanctions and rewards.

In theme 1, participants differentiated farmer behaviour and acceptable risk or prevalence of lameness that is tolerated (Figure 1). The farmer who rarely treated lame sheep was given a lower acceptable level of lameness (5%) than the farmer actively trying to manage lameness (7-7.5%). Interestingly, participants did not distinguish greatly between the farmer using best practice and the farmer using traditional approaches to manage lameness and expected both types of farmers to control lameness equally well. The respondents might not have differentiated the two types of managements; it could be that they assume the two are the same or think that different managements would be effective on different farms.

From theme 2, we see that deviation from the normative acceptable level of 7.5% is needed before it is considered fair for sanctions to be introduced. However, the extent of that deviation depends on the context facing the farmer (Figure 2). If the farmer faces a rapid increase in lameness despite following advice from a veterinarian, then there is greater tolerance. The underlying decision making mechanism that may account for these patterns cannot be identified from these descriptive results. However, they are suggesting a mixture of rapid affective process (anxiety, gut feelings), slower judgements (cost-benefit analysis) as

well as morality and ethics. These are all known to influence judgements about risk, its acceptance and reaction to others' violations of best practice (Slovic 1987; Sjöberg 2000; Slovic & Peters 2006; Kahneman 2011). For example, consider the finding that participants have a higher acceptable risk (are more lenient) for those who are performing best practice; they were more likely to be performing best practice and so this may reflect a 'gut feeling' based on feelings of similarity and we know that people are more generous to those who are similar to themselves (Kahneman 2011). Thus, participants identify with best practice farmers and protect the future self. The sanctioning decisions are then anchored relative to the acceptable level of risk of lameness of 7.5% that participants identify for good farmers (Tversky & Kahneman 1974) and they are, intuitively, more lenient towards farmers managing lameness like themselves. In addition, participants were more lenient towards the farmer who could legitimate their negative outcome (Lotem *et al* 1999; Ferguson *et al* 2012), showing that once the acceptable threshold for the good farmer was crossed, then sanctions were proportional to the degree to which the farmer had some control over any outbreak. Pragmatically and anecdotally, these results reflect the concern farmers have that inspectors and legislation cannot differentiate a sudden high uncontrollable prevalence of lameness from on-going high prevalence of lameness for a fair outcome of inspections (LE Green, personal communications since 2004).

The critical prevalence, selected by participants, for acceptable prevalence of lameness and cut-offs for sanctions and rewards were generally protective of their own situation (Theme 3), with the exception that whilst rewards for lameness prevalence $\leq 2\%$ was selected as fair and effective nationally, approximately 40% of participants said this would impact their own business negatively and considered a fair reward when lameness prevalence was $\leq 5\%$ would benefit their business. This suggests that these farmers know that the prevalence of lameness in their flock exceeds 2%, at least on occasion.

Consistent with the literature, in theme 2, participants preferred to sanction negative outcomes rather than reward positive outcomes (Fehr & Gächter 2002), although prosecution as a sanction was rarely selected as a fair outcome. This may reflect the feeling that losses loom larger than gains and people believe that sanctions result in greater behaviour change (Kahneman & Tversky 1979). However, the evidence for the relative effectiveness of rewards (incentives) and sanctions is not fully understood nor clear and to some extent, is dependent on the nature of the behaviour that is trying to be changed, and the person who is trying to change (Balliet *et al* 2011, Gneezy *et al* 2011, Ferguson & Starmer 2013, Boyce *et al* 2016).

Whilst legislation relates to every individual animal, the context of farming is that farmers work with populations of animals. This is challenging and makes interpretation of the law complex. According to the law, animals that are lame with no evidence of treatment can result in prosecution for failing to treat. However, a farm with some untreated lame animals, with evidence of an intention to treat, can be deemed acceptable. The cut-offs of prevalence of lameness >2% selected by most participants in the current study indicate that those farmers considered some untreated lame sheep acceptable. We did not investigate whether these would be in a planned programme of treatment.

Currently, the proportion of sheep farmers sanctioned for high prevalence of untreated lameness is not known. There were 63 RSPCA convictions under the Animal Welfare Act 2006 for all farmed animals in 2013 (RSPCA 2013b). It is not possible to differentiate which of these were related to sheep, but it is clearly a very low number. With the cut-offs in the current study applied to respondents to Winter *et al* (2015), 24% of flocks would be financially sanctioned in our theoretical framework. This would increase sanctions above current activity hugely, but it would still be for prevalence of lameness of >10%, higher than might be expected if current legislation were fully enforced. If rewards were acceptable and

effective, as indicated by participants, then this might be a better approach and encourage farmers to reduce flock prevalence of lameness to <2%, the FAWC goal (FAWC 2011).

Four participants suggested that veterinary advice should be sought when the prevalence of lameness was high, whilst two participants highlighted the annual visit from their veterinarian as an external inspection. It is a legal requirement that veterinarians can only prescribe medicines to animals directly under their care. Some practice standards therefore include inspection of animals on farm at least once a year. One hypothesis to consider, given the desire by government for more private regulation, is that if all sheep flocks were inspected by their veterinarian each year, this could be a route by which new information on best practice for lameness, and other updates on managing health could be discussed with farmers, it would improve dialogue between farmers and veterinarians (Kaler & Green 2013; Bellet *et al* 2015). One survey suggested that approximately 22% of sheep farmers have all-year-round contact with their veterinarians (ADAS 2008). If this could be increased, then these visits could be a one-to-one facilitated discussion and opportunity for new information to be given to farmers whatever the prevalence of lameness to lead to more rapid improvement in the management of lameness in sheep, assuming veterinary knowledge (Kaler & Green 2013). This could be audited by quality assurance schemes and together these activities might further decrease prevalence of lameness.

Participants' knowledge of current welfare legislation was poor with many farmers unable to identify the correct interpretation of legislation, and those who correctly identified the legislation indicated that they were not confident of their choice. It might be that the legislation, which is necessarily general to ensure it can be used appropriately, is confusing for farmers (and others in the livestock industry). This issue has been discussed recently in a

consultation by Defra (Defra 2011; Defra 2013) with the proposal to reform farm animal welfare codes so that they are moved from statutory codes to guidance drafted collaboratively with government, but led by the relevant sector of the livestock industry. The aim would be to 'ensure that guidance on how keepers comply with farm animal welfare legislation is up to date, reflecting the latest scientific and veterinary knowledge whilst being presented in the most relevant way for farmers (Defra 2014). The current situation (2016) is that this has not been approved (Vet Record 2016). Whilst the participants had poor ability to identify the legislation on lameness, the average prevalence of lameness in their flocks was relatively low. This might indicate that knowledge of the law is unnecessary to manage lameness and that clearer explanation is not necessary. It could, however, be that if farmers were more aware of the legislation, that the stockperson should understand diseases in their flock, then all farmers would adopt best practice for management of lameness and every lame sheep would either be treated or scheduled for treatment within 3 days, then the prevalence of lameness would be <2% as in Wassink *et al* (2010).

5. Animal welfare implications and conclusions

As a study that investigated farmers' attitudes to including welfare measures within external inspection frameworks, these results might be used to evaluate whether, and how, external inspections could be used to reduce the prevalence of lameness in sheep and inform on the role of sanctions and rewards in welfare of sheep generally. It was observed that sanctioning (mainly to suspend farmers from their farm assurance membership) would be initiated above 10% lameness, which could potentially encourage the 24% farmers with >10% lameness (Winter *et al* 2015) to reduce levels of lameness by introducing best practice. The flock prevalence of lameness is highly skewed and targeting flocks with the highest prevalence of

424 lameness would reduce the global mean prevalence of lameness in the national flock,
425 currently at 5% to <4%. Rewarding low prevalence of lameness could encourage more than
426 the current 33% of farmers to maintain a prevalence of lameness of <2%. In addition, the
427 national prevalence of lameness might fall if all farmers followed the legislation that farmers
428 are responsible to care for their livestock and use best practice.

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431 the farmers for completing the questionnaire. We would also like to thank Dr Annmarie
432 Ruston for her input to the literature review.

433 Table 1 Number and percentage of 43 English sheep farmers by membership of voluntary
 434 assurance schemes by the geometric mean (95% CI) average flock lameness between July
 435 2013 and June 2014.

	N	%	GM (95% CI)
Member of farm assurance or organic certification scheme			
Yes	35	81.4	2.73 (2.10 – 3.54)
No	8	18.6	3.37 (2.23 – 5.10)
Scheme			
Red Tractor	31	72.1	2.68 (2.05 – 3.50)
Freedom Food	1	2.3	1.5*
Organic Certification	3	7.0	4.58 (0.49 – 43.20)
Other ¹	3	7.0	2.52 (0.93 – 6.81)
Did not answer	9	20.9	2.95 (1.84 – 4.73)
Member of a supermarket supply group			
Yes	5	11.6	2.19 (1.04 – 4.61)
No	38	88.4	2.95 (2.32 – 3.75)
If yes, specify ²			
Member of any other selling group			
Yes	0	0	-
No	42	97.7	2.82 (2.25 – 3.53)
Did not answer	1	2.3	4*
Claimant under basic payment scheme (BPS)			
Yes	42	97.67	2.84 (2.27 – 3.56)
No	1	2.33	3*

436 ¹FABBL

437 ²Four farmers are a member of Sainsbury's supermarket supply group and one farmer at
 438 Waitrose

439 *95% CI not calculated for small group sizes

440

Table 2 Number and percentage of 43 English sheep farmers by number of inspections per year between January 2011 and December 2014, inspector and geometric mean (95% CI) flock prevalence of lameness between July 2013 and June 2014.

Sheep enterprise inspected between January 2011 and December 2014	N	%	GM (95% CI)
Yes	33	76.74	2.83 (2.20 – 3.65)
No	8	18.60	2.47 (1.49 – 4.10)
Do not know	1	2.33	2*
Did not answer	1	2.33	12*
Number of inspections January 2011 – December 2012			
No inspections	14	32.6	-
Inspected once	21	48.8	-
Inspected twice	5	11.6	-
Inspected more than twice	3	7.0	-
Number of inspections January 2012 – December 2013			
No inspections	15	34.9	-
Inspected once	16	37.2	-
Inspected twice	9	20.9	-
Inspected more than twice	3	7.0	-
Number of inspections January 2013 – December 2014			
No inspections	15	34.9	2.95 (2.30 – 3.79)
Inspected once	17	39.5	2.84 (1.86 – 4.33)
Inspected twice	9	20.9	3.22 (1.68 – 6.14)
Inspected more than twice	2	4.7	1.26*
Inspections Jan 2011 – Dec 2012 by			
Animal Health/ APHA veterinarian	2	4.7	-
Local authority	2	4.7	-
Trading standards	6	14.0	-
Farm assurance	26	60.5	-
Other ³	4	9.3	-
Did not answer	14	32.6	-
Inspections Jan 2012 – Dec 2013 by			
Animal Health/ APHA veterinarian	3	7.0	-
Local authority	1	2.3	-
Trading standards	11	25.6	-
Farm assurance	24	55.8	-
Other ⁴	5	11.6	-
Did not answer	15	34.9	-
Inspections Jan 2013 – Dec 2014 by			
Animal Health/ APHA veterinarian	2	4.7	1.41*
Local authority	4	9.3	3.87 (1.15 – 13.04)
Trading standards	7	16.3	3.02 (1.27 – 7.21)
Farm assurance	27	62.8	2.69 (1.95 – 3.72)

Other ⁵	2	4.7	1.79*
Did not answer	15	34.9	2.95 (2.30 – 3.79)

445 ³One farmer was inspected by cross compliance for SFP, one farmer was inspected by ‘our
 446 veterinarian’, one farmer inspected by Organic and one other farmer by RPA during January
 447 2011 and December 2012.

448 ⁴One farmer was inspected by cross compliance for SFP, two farmers inspected by
 449 private/our veterinarian, one farmer inspected by DEFRA, one farmer by Organic and the
 450 other farmer inspected by RPA during January 2012 and December 2013.

451 ⁵One farmer inspected by ‘our veterinarian’ and the other farmer inspected by Organic during
 452 January 2013 and December 2014.

453 ‘-’ data not collected for these years

454 *95% CI not calculated with small group sizes

Table 3 Number and percentage of participants' understanding of current law regarding care and transport of lame sheep on English farms and confidence in selected statement

Statements relating to the care of lame sheep on English farms (N = 31)	Confidence in selected response		
	Very confident	Fairly confident	Not confident
It is illegal to have lame sheep on a farm	0	0	1
It is illegal to have untreated lame sheep on a farm	1	2	0
It is illegal to have untreated lame sheep on a farm without evidence of intention to treat	2	8 (19%)	1
There are no laws that relate to treatment of lame sheep on a farm	3	9 (21%)	1
Do not know or other ⁶	0	2	1
Statements regarding transport of lame sheep on English farms (N = 32)			
It is illegal to transport sheep that are unable to move independently without pain or walk unassisted to any destination	9 (21%)	7 (16%)	2
It is illegal to transport sheep that are unable to move independently without pain or walk unassisted unless going straight to slaughter	5 (12%)	3	3
There are no laws relating to transport of lame sheep on the farm	0	1	0
Do not know or other ^{7,8}	1	1	0

⁶One farmer specified that it is illegal to cause unnecessary pain and suffering

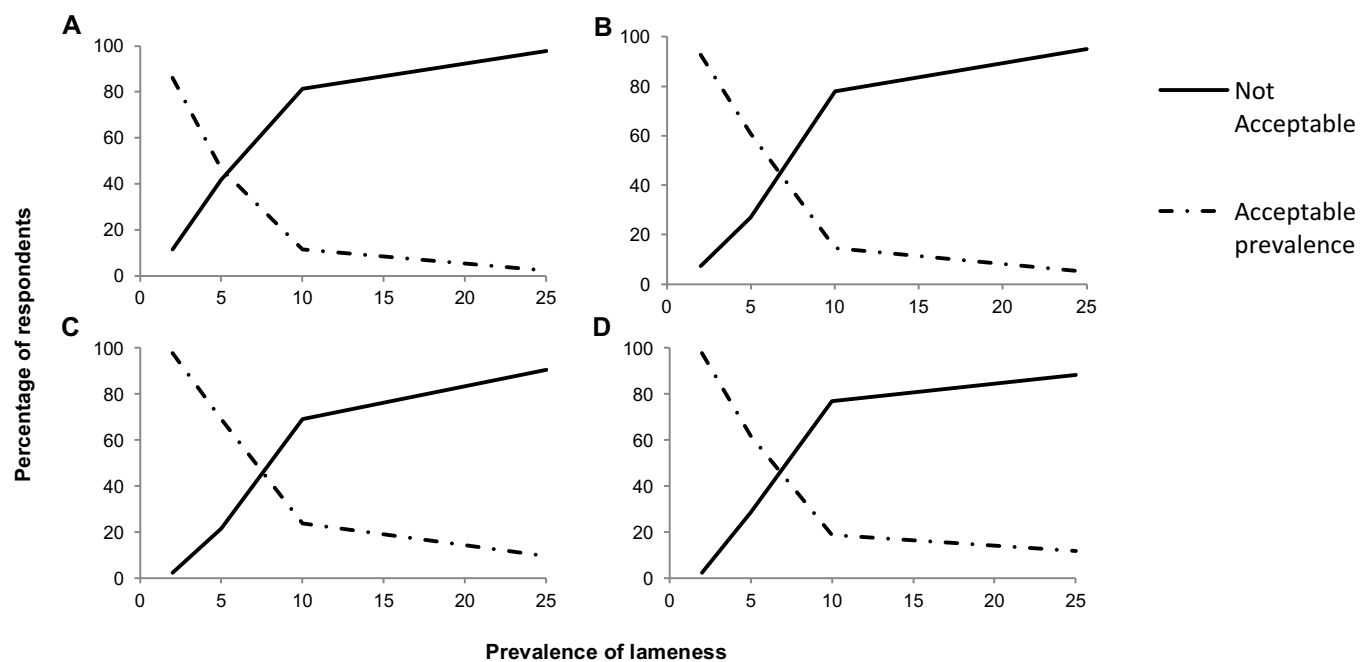
⁷One farmer specified that it is illegal to maltreat animals. This farmer was very confident in their answer

⁸One farmer specified as point two (that it is illegal to transport sheep that are unable to move independently without pain or to walk unassisted unless going straight to slaughter) but requires appropriate certificate for slaughter. This farmer was fairly confident in their answer

464 Table 4. Number and percentage of participants by attitude to animal welfare inspections for
 465 lameness in their flock by the [geometric mean prevalence and 95% CI] for lameness in ewes
 466 between July 2013 – June 2014

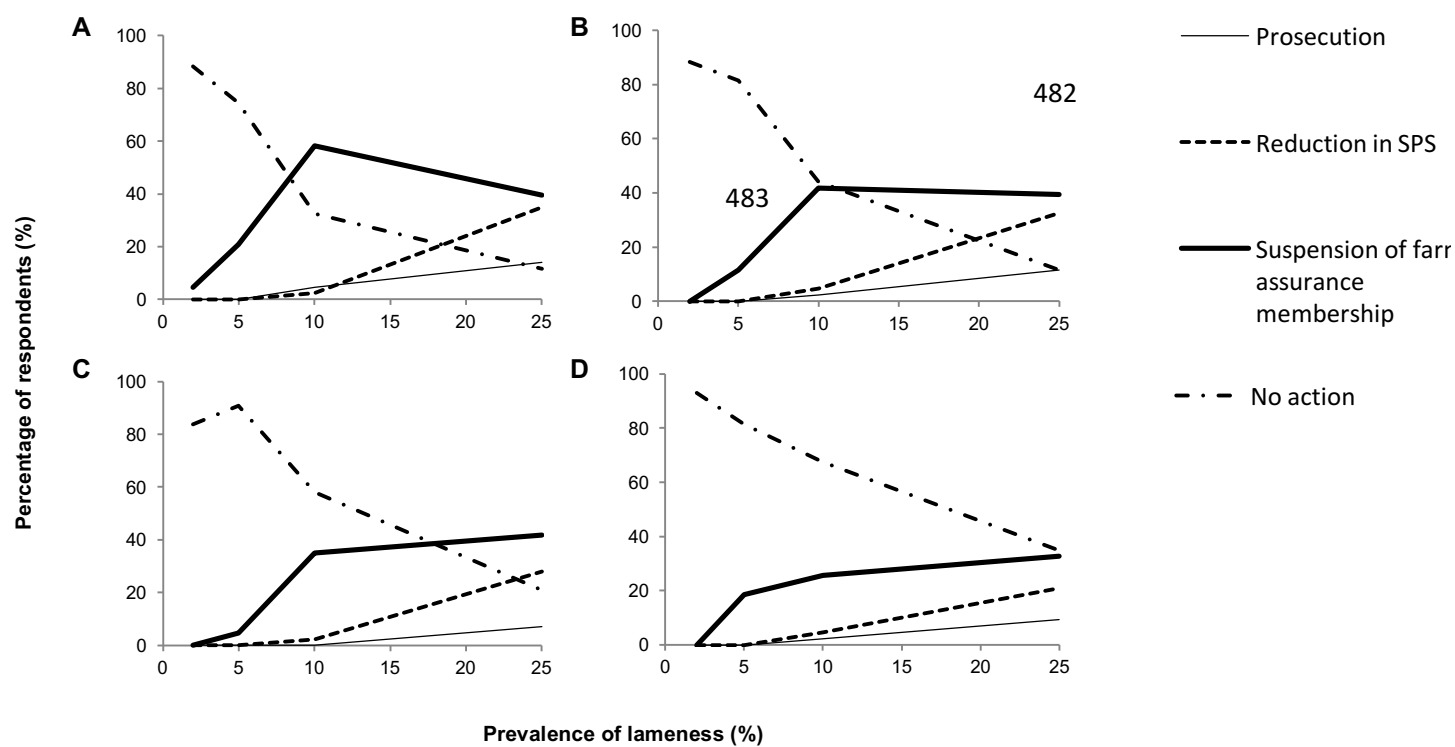
Statement	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I welcome inspection to check compliance with animal welfare legislation (N = 38)	2 [1.41, 0.02 – 115.6]	4 [4.5, 3.6 – 5.5]	15 (39.5%) [2.7, 2.0 – 3.7]	15 (39.5%) [3.0, 1.8 – 4.9]	2 [2.1, 0.03 – 173.4]
External inspections to check animal welfare wastes my time (N = 38)	1 [2, -]	12 (31.6%) [2.9, 1.5 – 5.6]	11 (28.9%) [2.6, 1.7 – 4.0]	14 (36.8%) [3.0, 2.3 – 3.9]	0
External inspections are important in maintaining animal welfare standards (N = 39)	1 [4, -]	15 (38.5%) [3.1, 2.3 – 4.2]	10 (25.6%) [2.2, 1.6 – 3.2]	12 (30.8%) [2.9, 1.5 – 5.5]	1 [3, -]
There is too much external inspection of animals in my flock (N = 39)	0	9 (23.1%) [1.9, 0.9 – 4.1]	25 (64.1%) [3.0, 2.4 – 3.9]	4 [4.2, 2.8 – 6.1]	1 [3, -]

Figure 1 Theme 1. 42 participants' attitudes of an acceptable prevalence of lameness for each scenario. A. Farmer rarely treats lameness; B. Farmer has been using the same method to manage lameness over 20 years; C. Farmer claims to use best practice and D. Prevalence rapidly increases despite seeking and following veterinarian's advice. Where lines intersect defines the average upper acceptable prevalence.



477 Figure 2 Theme 2. Participants' attitudes of a fair outcome for each scenario by A - D. A. A
 478 farmer rarely treats lameness; B. Using the same method to manage lameness > 20 years;
 479 A farmer that claims to use best practice D. Prevalence rapidly increases despite seeking and
 480 following veterinarian's advice.

481

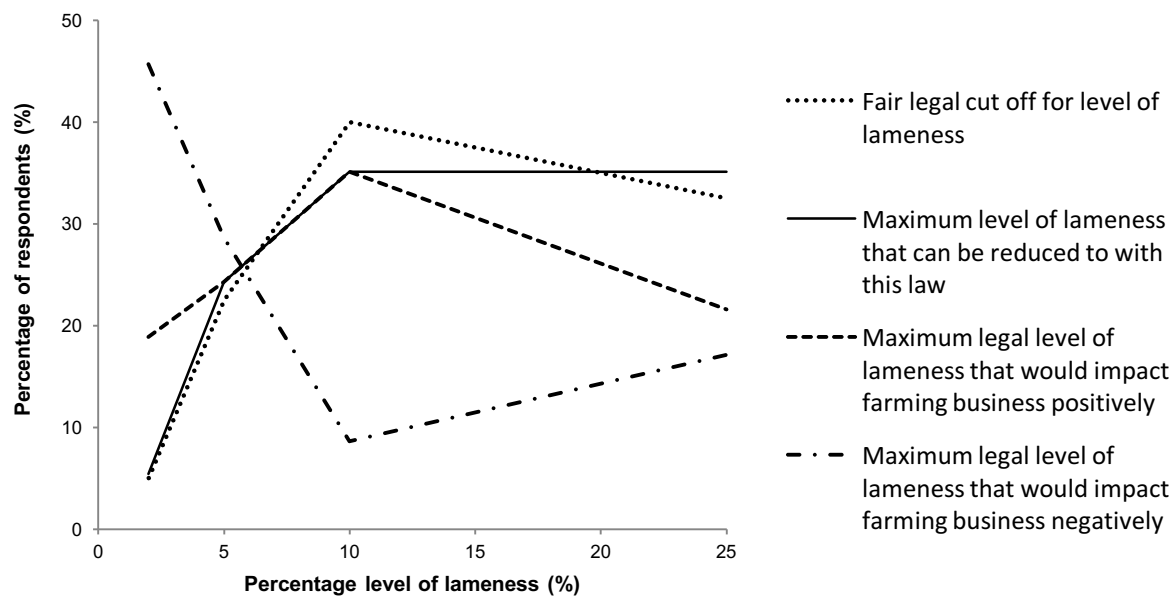


Rewards not shown in Figure due to small numbers

484 Figure 3 Theme 3. Attitudes of 42 English sheep farmers by percentage of participants on
 485 how sheep farmers are rewarded or sanctioned for lameness in their flock

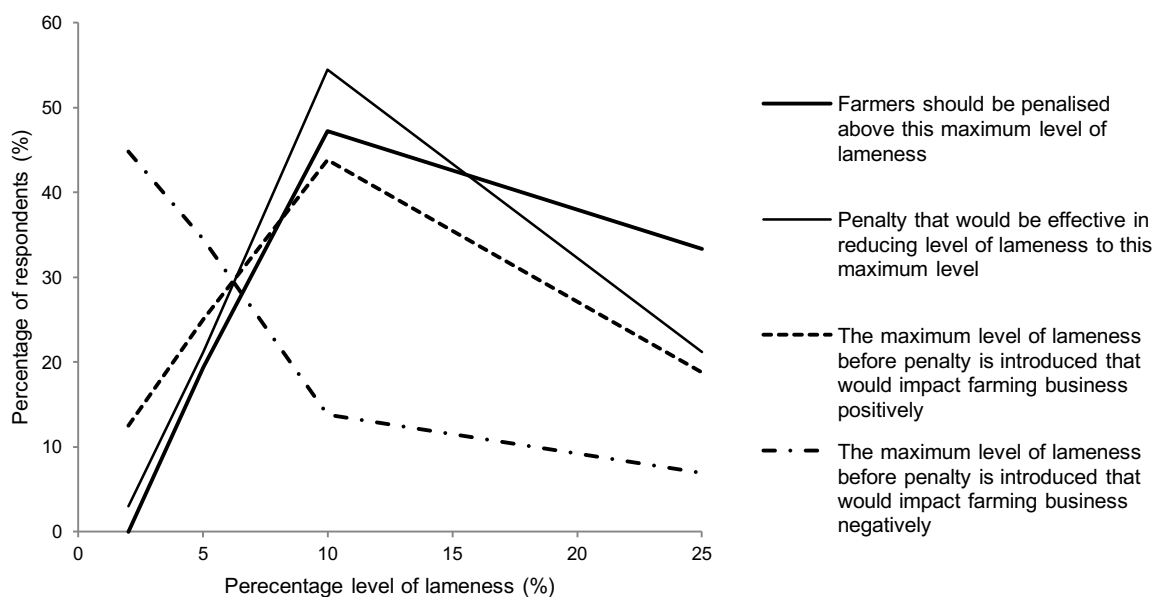
486

487 A. The fair legal cut-off for the maximum level of lameness in sheep flocks



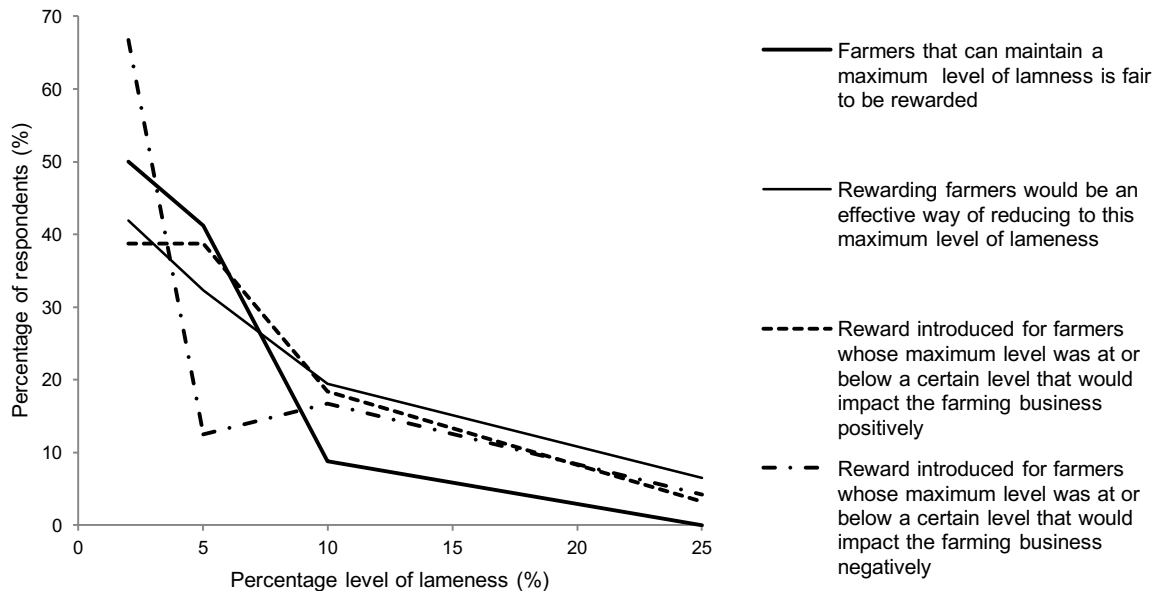
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489 B. The prevalence of lameness above which a penalty should be introduced



490

491 C. The prevalence of lameness below which a reward should be introduced



492

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References

- ADAS** 2008 Flock Health Planning in the West Midlands. In: A Report for Defra FFG
- Animal Welfare Act 2006** c 45 www.legislation.gov.uk retrieved 8th November 2006
- Balliet D, Mulder LB and Van Lange PA** 2011 Reward, punishment, and cooperation: a meta-analysis. *Psychol Bull* 137(4): 594-615
- Bellet C, Woodnutt J, Green L E and Kaler J** 2015 Preventative services offered by veterinarians on sheep farms in England and Wales: Opinions and drivers for proactive flock health planning. *Preventive Veterinary Medicine* 122(4): 381-388
- Blaser J and Cornuz J** 2015 Experts' consensus on use of electronic cigarettes: a Delphi survey from Switzerland. *BMJ Open* 5(4)
- Boyce C, Wood J and Ferguson E** 2016 Individual differences in loss aversion: conscientiousness predicts how life satisfaction responds to losses versus gains in income. *Personality and social psychology bulletin* 42: 471-484
- Clark CCA, Crump RE, KilBride AL and Green LE** 2016 Farm membership of voluntary welfare schemes results in better compliance with animal welfare legislation in Great Britain. *Animal Welfare* 25(4): 461-469
- Council regulation (EC) No 1/2005 on the protection of animals during transport and related operations** www.eur-lex.europa.eu retrieved 22nd December 2004
- Defra** 2011 Non-formal consultation on proposals to reform the animal welfare inspection regime. *Department for Environment Food & Rural Affairs: Policy Team, The National Archives, Kew, Richmond, Surrey, TW9 4DU*
- Defra** 2013 Consultation on the reform of farm animal welfare codes. *Department for Environment Food & Rural Affairs: Policy Team, The National Archives, Kew, Richmond, Surrey, TW9 4DU*
- Defra** 2014 Independent Farming Regulation Task Force Implementation Group: Final Assessment of Progress. *Department for Environment Food & Rural Affairs: Policy Team, The National Archives, Kew, Richmond, Surrey, TW9 4DU*
- Defra** 2015a The guide to cross compliance in England. *Department for Environment Food & Rural Affairs: Policy Team, The National Archives, Kew, Richmond, Surrey, TW9 4DU*
- Dickins A, Clark CCA, Kaler J, Ferguson E, O'Kane H, Green LE** 2016 Factors associated with the presence and prevalence of contagious ovine digital dermatitis: A 2013 study of 1136 random English sheep flocks. *Preventative Veterinary Medicine* 130: 86-93
- Dowling GR and Staelin R** 1994 A Model of Perceived Risk and Intended Risk-Handling Activity. *Journal of Consumer Research* 21(1): 119-134
- FAWC** 2011 Opinion on Lameness in Sheep. Farm Animal Welfare Council: London, UK
- Fehr E and Gächter S** 2002 Altruistic punishment in humans. *Nature* 415(6868): 137-140
- Ferguson E, Taylor M, Keatley D, Flynn N and Lawrence C** 2012 Blood donors' helping behavior is driven by warm glow: more evidence for the blood donor benevolence hypothesis. *Transfusion* 52(10): 2189-2200
- Ferguson E and Starmer C** 2013 Incentives, expertise and medical decisions: Testing the robustness of natural frequency framing. *Health Psychology* 9: 967-977
- Fischhoff B, Slovic P and Lichtenstein S** 1978 How safe is safe enough? : a psychometric study of attitudes towards technological risks and benefits. *Policy Science* 9: 127-152
- Fitzpatrick J, Scott M and Nolan AM** 2006 Assessment of pain and welfare in sheep. *Small Ruminant Research* 62(1): 55-61
- Freeman TR and Bass MJ** 1992 Determinants of maternal tolerance of vaccine-related risks. *Fam Pract* 9(1): 36-41
- Gneezy U, Meier S and Rey P** 2011 When and why incentives don't work to modify behavior. *Journal of economic perspectives* 25:191-210

- 543 **Goddard P, Waterhouse T, Dwyer C and Stott A** 2006 The perception of the welfare of
 544 sheep in extensive systems. *Small Ruminant Research* 62(3): 215-225
- 545 **Green LE, Kaler J, Wassink GJ, King EM, Grogono TR** 2012 Impact of rapid treatment
 546 of sheep lame with footrot on welfare and economics and farmer attitudes to lameness in
 547 sheep. *Animal Welfare* 21: 65-71
- 548 **Gurerk O, Irlenbusch B and Rockenbach B** 2006 The competitive advantage of
 549 sanctioning institutions. *Science* 312(5770): 108-111
- 550 **Johnson BB** 2003 Communicating air quality information: Experimental evaluation of
 551 alternative formats. *Risk Analysis* 23: 91-103
- 552 **Kahneman D and Tversky A** 1979 Prospect theory: an analysis of decision under risk.
 553 *Econometrica* 47:263-291
- 554 **Kahneman D** 2011 Thinking , fast and slow. *New York:Farrar, Straus and Giroux*
- 555 **Kaler J and Green LE** 2008a Recognition of lameness and decisions to catch for inspection
 556 among sheep farmers and specialists in GB. *BMC Veterinary Research* 4(41)
- 557 **Kaler J and Green LE** 2008b Naming and recognition of six foot lesions of sheep using
 558 written and pictorial information: A study of 809 English sheep farmers. *Preventive*
 559 *Veterinary Medicine* 83(1): 52-64
- 560 **Kaler J, Wassink GJ and Green LE** 2009 The inter- and intra-observer reliability of a
 561 locomotion scoring scale for sheep. *Veterinary Journal* 180(2): 189-194
- 562 **Kaler J and Green LE** 2013 Sheep farmer opinions on the current and future role of
 563 veterinarians in flock health management on sheep farms: A qualitative study. *Preventive*
 564 *Veterinary Medicine*, 112(3–4): 370-377
- 565 **KilBride AL, Mason SA, Honeyman PC, Pritchard DG, Hepple S and Green LE** 2012
 566 Associations between membership of farm assurance and organic certification schemes and
 567 compliance with animal welfare legislation. *Vet Rec* 170(6): 152
- 568 **King EM and Green LE** 2011 Assessment of farmer recognition and reporting of lameness
 569 in adults in 35 lowland sheep flocks in England. *Animal Welfare* 201:321-328
- 570 **King EM** 2013 Lameness in English lowland sheep flocks: farmer's perspectives and
 571 behaviour. PhD thesis, University of Warwick
- 572 **Knowles T, Moody R and McEachern MG** 2007 European food scares and their impact on
 573 EU food policy. *British Food Journal* 109(1): 43-67
- 574 **Ley SJ, Livingston A and Waterman AE** 1989 The effect of chronic clinical pain on
 575 thermal and mechanical thresholds in sheep. *Pain* 3: 353-357
- 576 **Lotem A, Fishman MA and Stone L** 1999 Evolution of cooperation between individuals.
 577 *Nature* 400(6741): 226-227
- 578 **Morris C and Young C** 2000 'Seed to shelf', 'teat to table', 'barley to beer' and 'womb to
 579 tomb': discourses of food quality and quality assurance schemes in the UK. *Journal of Rural*
 580 *Studies* 16(1): 103-115
- 581 **NFU** 2015 NFU review of livestock farm inspections in England. Department for Business,
 582 Innovation and Skills: London, UK
- 583 **O'Kane H, Ferguson E, Kaler J and Green LE** 2016 Associations between sheep farmer
 584 attitudes, beliefs, emotions and personality, and their barriers to uptake of best practice: The
 585 example of footrot. *Preventative Veterinary Medicine*
- 586 **RSPCA** 2013a RSPCA welfare standards for sheep. The Royal Society for the Prevention of
 587 Cruelty to Animals: West Sussex, UK
- 588 **RSPCA** 2013b RSPCA Prosecutions Department Annual report: Justice for Animals. West
 589 Sussex, UK
- 590 **Sjoberg L** 2000 Factors in risk perception. *Risk Anal* 20(1): 1-11
- 591 **Slovic P** 1987 Perception of risk. *Science* 236(4799): 280-285

- 592 **Slovic P and Peters E** 2006 Risk Perception and Affect. *Current Directions in Psychological*
 593 *Science* 15(6): 322-325
- 594 **Statutory Management Requirements (SMRs) 2015** The guide to cross compliance in
 595 England 2015. *Department for Environment Food & Rural Affairs*: Policy Team, The
 596 National Archives, Kew, Richmond, Surrey, TW9 4DU
- 597 **The Welfare of Animals (Transport) (England) Order 2006** No. 3260
 598 www.legislation.gov.uk retrieved 5th January 2007
- 599 **The Welfare of Farmed Animals (England) Regulations 2007** No. 2078
 600 www.legislation.gov.uk retrieved 1st October 2007
- 601 **Traulsen A, Rohl T and Milinski M** 2012 An economic experiment reveals that humans
 602 prefer pool punishment to maintain the commons. *Proc Biol Sci* 279(1743): 3716-3721
- 603 **Tversky A and Kahneman D** 1974 Judgement under uncertainty: Heuristics and biases.
 604 *Science* 185:11124-11131
- 605 **Veterinary Record** 2016 Industry ‘disappointed’ as Defra backtracks on welfare codes.
 606 *Journal of the British Veterinary Association* 178(16): 383
- 607 **Wassink GJ, Grogono TR, Moore LJ and Green LE** 2003 Risk factors associated with the
 608 prevalence of footrot in sheep from 1999 to 2000. *Veterinary Record* 152(12): 351-358
- 609 **Wassink GJ, King EM, Grogono-Thomas R, Brown JC, Moore LJ and Green LE** 2010
 610 A within farm clinical trial to compare two treatments (parenteral antibacterials and hoof
 611 trimming) for sheep lame with footrot. *Preventive Veterinary Medicine* 96(1–2): 93-103
- 612 **Winter JR, Kaler J, Ferguson E, KilBride AL and Green LE** 2015 Changes in
 613 prevalence of, and risk factors for, lameness in random samples of English sheep flocks:
 614 2004–2013. *Preventive Veterinary Medicine* 122(1–2): 121-128
- 615 **Wood JD, Holder JS and Main DCJ** 1998 Quality Assurance schemes. *Meat Science* 49
 616 *Supplement 1*: S191-S203