Animal welfare: Antispeciesism, veganism and a "life worth living"

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Abstract

While antispeciesism is an ethical notion, veganism is behavioral. In this paper, we examine the links between the two. Building on Blackorby and Donaldson (1992), we consider a two-species model in which humans consume animals. The level of antispeciesism is conceived as the weight on animals' welfare in the utilitarian social welfare function. We show that more antispeciesism increases meat consumption if and only if animals' utility is positive. That is, the critical condition is whether farm animals' lives are worth living. We then empirically explore this condition using a survey. We find that farm-animal experts and frequent meat eaters are more likely to believe that the lives of farm animals are worth living. We finally discuss some issues in the study of animal welfare in economics and social choice.

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1 Introduction

Speciesism involves treating the members of one species as morally more important than the members of other species (Gruen 2017). Research in economics and social choice is speciesist: It focuses on the welfare of humans, and usually ignores the welfare of (nonhuman) animals. In contrast, antispeciesism ascribes moral consideration to all sentient animals (Singer 1975). Although the utilitarian tradition proposes including animals' welfare into the social objective (Bentham 1789, Sidgwick 1893), economists have not seriously explored this possibility (Johansson-Stenman 2018).

An exception is the multi-species model in Blackorby and Donaldson (1992), where animals are brought into existence because they are consumed by humans. A utilitarian social planner decides how many animals are produced and consumed. The novelty in Blackorby and Donaldson's model is that the welfare of animals is also part of the social planner's objective. We here consider a compact version of their model to analyze the specific effect of antispeciesism on the socially-optimal consumption of animals, and in turn on the possibility of veganism (i.e., no animal consumption). We also examine the effect of antispeciesism on investments to improve farm-animal welfare.

Following Eichner and Pethig (2006) and Johansson-Stenman (2018), we introduce a simple formal characterization of antispeciesism in utilitarianism: The level of antispeciesism corresponds to the weight on animal welfare in the utilitarian social welfare function. We show that more antispeciesism always leads to improved farm-animal welfare. However, this improvement in rearing conditions makes the consumption of animals less morally-problematic and possibly even "socially desirable", which may lead to increased animal consumption. By socially desirable, we mean that farm-animals' utility is positive. That is, the critical condition is whether farm animals' lives are worth living.

We then develop an empirical approach to explore this critical condition using a survey. We present survey participants with scenarios describing various current farming conditions. We consider broilers, which are by far the most-consumed terrestrial farm animal in France. We find that most participants believe that the life of a broiler is not worth living under the most-common (i.e. intensive) rearing conditions. Moreover, we also find that farm-animal experts and frequent meat eaters are more likely to believe that the lives of farm animals are worth living. Following these results, we last

discuss some issues and difficulties in the study of animal welfare in economics and social choice.

2 Theoretical background

In this section, we provide a simple model relating the four concepts emphasized in the title: animal welfare, antispeciesism, veganism (and more generally animal consumption) and a life worth living.

We consider the utility of a representative human in the population. She has quasi-linear utility $u_h(n) - cn$, where $u_h(n)$ is the utility from the consumption of animals with $u_h'(.) > 0$ and $u_h''(.) < 0$, and where $n \geq 0$ is the number of animals consumed per representative human, that is "meat" per capita (or more generally the consumption of animal products per capita). All animals are identical. In the following, we interpret $c \geq c_0 > 0$ as the quality of rearing conditions,[1] which we will coin the level of animal welfare herafter. The parameter c_0 can be interpreted as the minimal value of investment in rearing conditions (food, shelter etc.) permitting animal survival.

Each animal enjoys utility $u_a(c)$, which depends on the level of animal welfare c, with $u_a'(.) > 0$ and $u_a''(.) < 0$. The social planner is utilitarian, and takes into account both the utilities of humans and animals. These utilities are measurable and comparable, and the weight $\alpha \in [0, 1]$ on animals' utility represents the level of antispeciesism, where $\alpha = 0$ (resp. $\alpha = 1$) can be interpreted as full speciesism (resp. antispeciesism). As the population of animals is variable, whether animals' utility is positive or negative therefore matters for welfare.[2]

To summarize, the objective of the social planner is to choose the number of animals n and the level of farm-animal welfare c to maximize social welfare, that is:

$$\max_{n \geq 0, c \geq c_0} [u_h(n) - cn] + \alpha n[u_a(c)] \tag{1}$$

This objective can be formally obtained from the model in Blackorby and Donaldson (1992) by compacting their equations (39) and (40), and assuming

[1] That is, it is costly to improve the rearing conditions of animals by for example increasing the size of cages or providing access to outdoor space.

[2] Blackorby and Donaldson (1992) use critical-level utilitarianism, which addresses concerns regarding the use of total utilitarianism. In our problem, there is no qualitative difference between critical-level and total utilitarianism. We thus adopt total utilitarianism for simplicity.

that the utility of humans is quasi-linear. The remaining difference with their model then concerns the representation of the utility functions and the respective weight of animal welfare in the social objective: while we assume standard utilitarianism (and not critical-level utilitarianism, as do Blackorby and Donaldson), we allow for the weight α to be different from 1.

The model (1) can then be rewritten as follows

$$\max_{n\geq 0} u_h(n) + n\{\alpha u_a(c^*) - c^*\}$$

in which we assume for simplicity that the optimal c^* is interior and characterized by:

$$\alpha u_a'(c^*) - 1 = 0 \tag{2}$$

This formulation shows that the social planner maximizes the social value of farm-animal welfare per animal, i.e., $\alpha u_a(c) - c$. In other words, the optimal animal welfare level c^* is unaffected by the number of animals consumed n.[3] It is obvious that c^* always rises with the level of antispeciesism α, as the social benefit of investing in farm-animal welfare increases in α.

The optimal interior solution for the number of animals consumed n^* is then characterized by the following first-order condition:

$$[u_h'(n^*) - c^*] + \alpha u_a(c^*) = 0 \tag{3}$$

The first term in brackets on the left-hand side of (3) is the net marginal benefit for humans of consuming an additional animal, while the second term represents the social value of raising an additional animal.

We now examine the impact of the level of antispeciesism α on optimal consumption n^*. It is immediate from the envelope theorem that $sign[\frac{\partial n^*}{\partial \alpha}] = sign[u_a(c^*)]$: more antispeciesism increases (resp. decreases) the number of animals consumed if the utility of farm animals is positive (resp. negative), i.e. $u_a(c^*) \geq 0$ (resp. ≤ 0). In other words, more antispeciesism leads to increased animal consumption if and only if bringing a new animal into existence has social value.

We note that a similar comparative-statics result would come about were the level of animal welfare c to be exogenous, implying that the utility of animals is fixed (and thus always positive or always negative). However, allowing

[3]This last result is obviously the consequence of our simplifying assumption that the marginal cost of animal welfare is constant. See the last section for a short discussion.

for the more-realistic case where the level of animal welfare is endogenous leads to an interesting non-monotonicity property, as we now show.

Since c^* (and thus $u_a(c^*)$) rises in α, the optimal number of animals consumed n^* may be increasing or decreasing in α. In fact, n^* is typically U-shaped in α. To see this, note that

$$\frac{\partial^2 n^*}{\partial \alpha^2} = \frac{u_h'''(n^*)}{-u_h''(n^*)}(\frac{\partial n^*}{\partial \alpha})^2 + \frac{u_a'(c^*)}{-u_h''(n^*)}\frac{\partial c^*}{\partial \alpha},$$

which implies that $\frac{\partial n^*}{\partial \alpha} = 0 \Longrightarrow \frac{\partial^2 n^*}{\partial \alpha^2} > 0$. One intuition for this result is as follows. Suppose that at some value of $\alpha = \underline{\alpha}$, it is optimal to invest in animal welfare such that the utility of animals is precisely zero. At this level, the optimal number of animals consumed is independent of α. At a lower (resp. greater) level of α, it is then optimal to select a value of c^* so that animal utility is negative (resp. positive), and socially-optimal meat consumption falls (resp. rises) in α.

The U-shaped form is illustrated in the following example and in Figure 1. Take $u_i(x) = 1 + \log(x)$, $i = h, a$, then the interior solution (when $c^* > c_0$) is defined by $c^* = \alpha$, implying $n^* = \frac{1}{-\alpha \log(\alpha)}$. Hence, n^* is decreasing in α until $\underline{\alpha} = 1/e \approx 0.367$ and then increasing.[4]

INSERT FIGURE 1

Moreover, note that veganism is optimal, i.e. we have a corner solution $n^* = 0$, when

$$[u_h'(0) - c^*] + \alpha[u_a(c^*)] \leq 0 \tag{4}$$

The possibility of veganism thus depends on the values of the ethical parameter α as well as on the utility functions $u_i(.)$, $i = h, a$. It is important to note that a rise in antispeciesism α makes veganism less likely if and only if $u_a(c^*) \geq 0$, so that we find a similar result to that above, implying that (more) antispeciesism may act against veganism when animal utility is positive.[5]

[4] In this specific example, note that under antispeciesism, i.e. $\alpha \to 1$, then $n^* \to \infty$. This can be interpreted as a form of Parfit's repugnant conclusion applied to animal consumption: once animal utility is positive, it is always socially beneficial to produce and consume an additional animal. See Singer (2011) for a related idea.

[5] Note that under full speciesism, i.e. $\alpha = 0$, the optimal number of animals consumed n_0 is defined by $u_h'(n_0) - c_0 = 0$. Interestingly, it is mathematically possible that the

Last, we ask: What is the impact of animal size on optimal animal consumption? If animal welfare counts, this may matter intuitively: it may be worse to consume smaller animals –e.g. chickens rather than pigs– as this would increase the number of animals killed per unit of meat. As a first exploration of this "chickens-pigs problem", we adapt our simple model. Suppose that the amount of meat produced by n pigs is equivalent to that of kn chickens with $k > 1$. For simplicity, we reason ceteris paribus, and vary only the size of the animal. That is, we assume that the cost per unit of meat is similar for pigs and chickens, and that the human utility from pork is equivalent to that from chicken. Moreover, we assume that the antispeciesism levels α are similar for both animals. The optimal number of chickens consumed kn is then given by:

$$\max_{n,c}[u_h(n) - cn] + \alpha kn[u_a(c)]$$

Hence the impact of animal size k is equivalent to that of a change in the level of antispeciesism. This implies that there should be more investment in improving farm-animal welfare when chickens are consumed instead of pigs: the cost per unit of meat is similar for both animals, while the social return of the investment in farm-animal welfare is higher for chickens as more animals profit from the improvement. As before, the impact of animal size on the quantity of meat consumed is not clear, as it depends on whether the welfare of animals is positive or negative. If this welfare is negative, as is likely for both chickens and pigs given modern industrial practices, there should be less meat consumed when animals are smaller, that is for chickens rather than pigs.[6]

number of animals consumed be greater under some levels of antispeciesism than under speciesism in the region where $u_a(c^*) \geq 0$. What is the impact of more antispeciesism on human welfare? Although more antispeciesism may drive n^* closer to the optimal speciesist's consumption n_0, this impact is always negative. At the optimum, the welfare of humans is defined by $W(\alpha) \equiv u_h(n^*) - c^*n^*$, and it is immediate from the envelope theorem that $W'(\alpha) = -\frac{\partial c^*}{\partial \alpha} n^* \leq 0$. That is, the welfare of humans falls with the level of antispeciesism due to the increase in the cost of meat, the quantity of animals consumed being adjusted optimally.

[6]Our approach here to the "chickens-pigs" problem is simplistic. In reality, there are of course many kinds of species to eat, with different characteristics and a multitude of mixing options to consider for the optimal diet. It would be thus interesting to consider a more realistic model where several species can be eaten simultaneously, and to examine the specific impact of the level of antispeciesism toward one species on the consumption of all species.

3 Are the lives of farm animals worth living?

We showed in the previous section that greater antispeciesism increases the consumption of animals if and only if farm-animal utility is positive, i.e. $u_a(c) \geq 0$. In our model, a value of 0 for the utility level corresponds to nonexistence. This raises the question of whether living for the animal is better than nonexistence, or: Are farm animals' lives worth living? It is obviously extremely difficult, and probably impossible, to answer this question in general. The concept of a life worth living is nevertheless central in the debates around Parfit's repugnant conclusion (Tännsjö 2002) and in the anti-natalist movement in philosophy (Benatar 2006). Brown (2012) suggests that the concept has a number of definitions. One is that a life is worth living if *"it contains more pleasure than pain"*, and another is if *"it is better than an empty life"*. Mellor (2016) discusses the interest of including the concept of a life worth living in the practice of animal sciences.[7] Gosseries and Meijers (2019) hypothesize that unlike human populations "*a significant amount of non-human animal beings have lives not worth living*".[8]

In this section, we propose a first and modest attempt to empirically analyze the concept of a life worth living. We developed a survey in France in

[7]Broom (2014) provides a list of negative and positive welfare indicators and Boissy et al. (2007) identify practical applications for the assessment of positive experiences such as pleasure. Nevertheless, in animal sciences there is usually no attempt to empirically measure if an animal life is worth living.

[8]This hypothesis is consistent with Matheny (2003): "*I suspect the suffering experienced by animals in factory farms is greater than that experienced by many of those sick dogs and cats we choose to euthanize, as factory farmed animals often experience an entire lifetime of suffering compared with a few weeks or months of pain. If, for instance, we knew our dog or cat would have no choice but to be confined in a cage so restrictive turning around or freely stretching limbs is difficult if not impossible, live in his own excrement, be castrated, debeaked, dehorned, or have his teeth, tail, and toes sliced off without anesthesia, I suspect most of us would believe euthanizing the animal would be the humane choice. It would be better, then, if farmed animals who endure these conditions did not exist.*" Ng (1995) supports this hypothesis for wild animals: "*Thus, a typical individual is destined to starvation, capture, or struggling unsuccessfully for mating. It is difficult to imagine a positive welfare for such a life. Thus, while a mathematical proof is impossible, reason requires us to accept that, in all probabilities, the welfare of an individual (affective) sentient that fails to survive to have successful mating is negative. It follows that, if we can reduce the number of such miserable individuals, other things being equal, we can increase the level of overall welfare*". Oscar (2016) shares the view in Ng, and systematically criticizes an idyllic view of Nature which is common in natural sciences that "*animals are able to live relatively easy and happy lives in the wild*".

the context of farm-animal welfare. We presented survey participants with a list of seven scenarios that differ in terms of the rearing conditions of broilers.[9] Hence, by varying the scenarios, that we can interpret as a change in the level of animal welfare c in the model, we may see how participants' beliefs about $u_a(c) \geq 0$ vary when c varies. Scenarios 1 to 4 correspond to the standard (i.e. intensive) rearing conditions of broilers in France, while scenarios 5 and 6 correspond to free-range farming. Higher scenario numbers are associated with less-dense and more "enriched" environments (with natural light, perches and pecking objects), lower transportation times to the slaughterhouse and longer lives. These scenarios are consistent with various current rearing conditions of broilers, and are actually used for the labelling of animal welfare by several large French retail firms. The last scenario 7 refers to the arguably uncommon case in which the chicken dies from natural causes at the age of six.

INSERT FIGURE 2
INSERT TABLE 1

We used a Likert scale to evaluate the extent to which participants agreed with the statement that the life of a broiler raised in each specific scenario was worth living. There are five answers: "strongly disagree", "tend to disagree", "neither agree nor disagree", "tend to agree" and "strongly agree". We submitted this questionnaire to four types of participants: students, experts in animal ethics, experts in farm animals (i.e., in poultry, bovine and porcine farming) and animal activists. The Appendix presents a more-detailed description of the survey and the questionnaire. Figure 2 shows for each scenario the proportion of participants in each category who agree (i.e., who respond either "tend to agree" or "strongly agree") with the statement that the life of a broiler is worth living (see Table 1 for the associated statistics).

We find that few participants agree with the statement for the most common intensive-farming practices (scenarios 1 to 4). For instance, none of the 20 animal-ethics experts and 62 animal activists agreed in scenarios 1 to 3, and only one of these participants agreed in scenario 4. Among students, under 5% think that life is worth living in scenarios 1 to 3, with an analogous

[9] Broilers represent more than 80% of the around a billion farm animals that are slaughtered in France for meat every year. Moreover, a large majority of broilers in France are raised under intensive farming conditions (ITAVI 2018).

figure of under 25% in scenario 4. If we assume that a life not worth living is associated with an overall negative balance of utility, this data supports the belief that breeding broilers under scenarios 1 to 3 reduces animal welfare.

We also find that the four groups of respondents display different majority pivot points. The majoritarian support for the statement emerges in scenario 4 for the farm-animal experts (from 15.7% in scenario 3 to 63.2% in scenario 4), scenario 5 for students (from 24.6% in scenario 4 to 52.5% in scenario 5), scenario 6 for animal-ethics experts (from 0% in scenario 5 to 50% in scenario 6) and scenario 7 for animal activists (from 16.1% in scenario 6 to 71.0% in scenario 7).

INSERT FIGURE 3

INSERT TABLE 2

More generally, there are sizable differences between the groups of respondents, especially for the intermediate scenarios (4 to 6). To investigate, we regress participants' perception of the worthiness of broilers' lives on their group (animal activists, farm-animal experts, animal-ethics experts, and students (the reference group)). As the answers across scenarios are very likely correlated at the individual level, we estimate a SURE regression model.[10] The results appear in Table 2. We first see that in almost all scenarios farm-animal experts are significantly more likely to agree with the statement than the other participants. This holds relative to students in scenarios 1 to 5 (p-value$<$0.001) and relative to ethics experts and animal activists for scenarios 1 to 6 (p-value$<$0.001). Animal activists and ethics experts are the least likely to agree with the statement. In all scenarios, the respondents in these two groups are significantly less likely to agree with the statement at the 10% significance level (and for all but one at the 5% significance level) relative to the group of students. This is also true relative to the group of farm-animal experts for scenarios 1 to 6. Moreover, respondents in these two groups agree with the statement in similar proportions. An exception is scenario 6, where animal-ethics experts are significantly more likely to say that the broilers' lives are worth living than animal activists (p-value$<$0.001). Finally, note that group variations explain a very large proportion of the variations in

[10] We assigned values 1 to 5 to the answers ranging from "strongly disagree" to "strongly agree". The *Seemingly Unrelated Regression Estimation* allows the individual error terms to be correlated between equations for each individual.

answers to scenarios 4 to 6: between 40.8% (scenario 4) and 53% (scenario 5).

Participants' beliefs thus vary sharply across both scenarios and the type of participants. In particular, the beliefs of farm-animal experts are significantly different from those of other participants: they are overall the most likely to agree that the broilers' lives are worth living. Two main factors may lie behind this finding. First, these experts know more about the reality of farming conditions on the ground than the rest of the population. Moreover, they know more about the physiology and wellbeing of farm animals. Therefore, this group is likely the best-informed about broilers' welfare. Second, these experts typically work directly or indirectly for the farming industry, and so may have a kind of conflict of interest. This may induce moral dissonance that the experts (perhaps unconsciously) attempt to reduce by adjusting their beliefs, for instance by underestimating animal suffering. This may lead them to more likely believe that the life of farm animals is worth living.[11]

INSERT TABLE 3

It is beyond the scope of the paper to fully explore this moral-dissonance hypothesis. Nevertheless, we can exploit additional information from our sample. We collected data about the frequency of meat consumption in the student population. In Figure 3, we split this population into two groups: students who eat white meat a few times a month or less and those who eat it a few times a week or more. We can see that a greater proportion of high-consumption participants believe that the broilers' lives are worth living (except in scenario 7). This intuition is confirmed by a SURE regression (Table 3) that shows statistically greater support for the statement among frequent white-meat eaters for scenarios 2 to 6. Note that respondents agree on the statement at the two tails of the scenario lists (scenarios 1 and 7), and the gap between the two groups is the largest for the intermediate scenarios ($\beta = 0.667$ for scenario 4, and $\beta = 0.74$ for scenario 5).[12] Consistent with the moral-dissonance hypothesis, one possible explanation here is that eating meat generates a feeling of guilt, providing incentives to hold more positive

[11] A third factor could be selection bias, as these experts may be more likely to self-select into activities related to farm animals due to pre-existing beliefs.

[12] These results are robust to controlling for additional individual factors (e.g., age, political views and gender). These results are available upon request.

views about animal welfare. This result is consistent with recent research in psychology and economics on the "meat paradox" (Loughnan et al. 2010, Bastian et al. 2012, Hestermann et al. 2018, Espinosa and Stoop 2019).[13]

4 Discussion

Animal welfare will probably be a major topic in the 21st Century. The way humans treat animals already raises deep and growing societal concerns. Philosophers and more recently Legal scholars have extensively discussed these concerns (Sunstein and Nussbaum 2004), but not economists. It would seem however that economics can contribute to this discussion. The harsh living conditions of farm animals produced intensively are mostly the consequences of economic constraints. The model of Blackorby and Donaldson (1992) provides a good starting point to think about the trade-offs between economic constraints and the moral considerations raised by the consumption of animals. In this model, animals not only matter as commodities, resource or biodiversity as in standard agricultural, environmental or ecological economics, but their welfare also plays a direct role.

In this paper, we have essentially reformulated the model of Blackorby and Donaldson (1992) to investigate the effect of the weight on animal welfare in the social objective on two choices: i) the level of farm-animal welfare and ii) the number of animals consumed. By doing so, we have examined formally how the two choices interact, while they have often been considered as separate in colloquial discussions. In turn, we have clarified the links between the ethical notion of antispeciesism and behavioral notions such as welfarism or veganism.[14] Specifically, we have shown that more antispeciesism always

[13]Note that the hypothesis that more-frequent meat eaters attribute higher animal welfare because of moral dissonance is questionable. It is not clear whether meat consumption underlies views on animal welfare or vice versa. However some trivial manipulations in the experimental setting (e.g., offering meat or plant-based food in the pre- or post-experiment stage, as in Loughnan et al. 2010 and Bastian et al. 2012) affect people's beliefs, providing causal evidence that individual perceptions are affected by their desire to rationalize meat consumption. By comparing hypothetical and incentivized questionnaires, Espinosa and Stoop (2019) conclude that moral dissonance plays a significant role in explaining beliefs about animal-based diets.

[14]Welfarism for farm animals is usually defined as the objective of the improvement of rearing conditions. Veganism usually corresponds to no use (and thus no consumption) of animals. Obviously, welfarism and veganism are also more broadly related to strategic or political movements (Leenaert 2017).

leads to improved farm-animal welfare, and is thus consistent with welfarism. However, it may consequently increase the consumption of animals, and thus make the possibility of veganism less likely.

This simple result illustrates a common criticism of the welfarist approach to animal protection. By focusing on the improvement of animal-rearing conditions, this approach may encourage more animal exploitation (Francione and Garner 2010). Further, it shows formally that the central question of whether the welfarist approach helps lead to the abolitionist objective crucially depends on whether farm animals' lives are worth living. This provides an intuitive conclusion to a common debate around animal-protection issues. If we consider that the exploitation of farm animals necessarily produces a negative welfare, then more antispeciesism always favors lower animal consumption and, in turn, veganism for high-enough levels of antispeciesism. But the opposite may be true if we consider that it is possible that the lives of farm animals are worth living.

This discussion emphasizes that the critical condition is whether farm animals' lives are worth living. Philosophical discussions of this question are not new. In a classic text in 1914, the writer Henry S. Salt criticizes the argument, dubbed the *"logic of the larder"*, that we do animals a favor by eating them because otherwise they would not exist, on moral grounds.[15] The philosophical debate is still ongoing; see for instance Hare (1999), Hanson (2002), Posner (2004), Mathany and Chan (2005), McMahan (2008), Singer (2011), Visak (2013) and McMullen (2016). This debate raises the empirical question of evaluating farm animals' utilities. Norwood and Lusk (2010, p. 225-229) propose to assign wellbeing scores to different production systems, with negative scores indicating that the animal would be *"better off dead"*. However, they recognize that existing score models in animal sciences such as SOWEL do not try to determine whether animals live a life worth living in a specific production system, but rather compare different systems. In the same spirit, Hare (1999) suggests applying the QALY concept to assess the quality of farm animals' lives.

This paper proposed a first empirical inquiry into this question based on a survey. We asked survey participants if they agree with the statement that the life of a broiler is worth living. We found that very few agree for the

[15]Emphasizing the debate at the time, Salt (1914) cites Leslie Stephen: "*Of all the arguments for Vegetarianism none is so weak as the argument from humanity. The pig has a stronger interest than anyone in the demand for bacon. If all the world were Jewish, there would be no pigs at all.*"

most-common (i.e. intensive) rearing conditions in France. We also found significant differences between participants. In particular, those who consume more meat are more likely to believe that the life of a broiler is worth living. One possible explanation is that participants adopt a more positive view about animal welfare in order to reduce the moral dissonance associated with their meat-eating habits.[16] This explanation is a challenge to the survey approach that we developed here, as it suggests that participants' assessments of animal welfare are tainted by self-serving biases. More generally, it emphasizes the limitation of any anthropic approach to animal-welfare assessment, which necessarily relies on humans' prior knowledge, subjective interpretations and possible psychological biases.[17] Our findings also emphasize the divergence of opinions between experts and the public (farm-animal experts vs. students), within the public (students vs. animal activists) as well as between experts themselves (i.e. farm-animal experts vs. animal-ethics experts). Specifically, farm-animal experts tend to have the most positive views about the welfare of farm animals.

Another contribution of the paper is to propose a characterization of the level of antispeciesism formally represented by the weight α on animals' utilities in the utilitarian social objective. It has the advantage of being mathematically simple, suitable for comparative-statics analysis and easily interpretable. The antispeciest case ($\alpha = 1$) seems consistent with the idea of "*equal consideration of interests of all beings, irrespective of species*" (Singer 2011), if one interprets "interests" as utility units.[18] Extensions to a multi-species setting as well as to other social criteria such as prioritarianism or critical-level utilitarianism (Blackorby and Donaldson 1992) are straightforward. But in applications this obviously raises the daunting task of choosing the specific value of α. Are we ready to assign different weights to different species that deserve moral consideration? On the one hand, doing so

[16] As Singer (1975) writes: "*Anyone who eats meat is an interested party. (...) For behind the mere momentary desire to eat meat on a particular occasion lie many years of habitual meat-eating which have conditioned our attitudes to animals.*"

[17] This is reminiscent of McMahan (2008): "*human intuitions about the moral status of animals are so contaminated by self-interest and irrational religious belief as to be almost wholly unreliable.*"

[18] Our characterization obviously raises the immense challenge of interspecies' utility comparisons (Johansson-Stenman 2018). There currently do not exist good methods for quantifying animal wellbeing and putting it on the same scale as quantified human wellbeing (Budolfson and Spears 2019).

conflicts with the impartiality (or anonymity) principle,[19] and with the idea that the weight per suffering unit should be the same for animals as it is for humans (Singer 2011). On the other hand, some argue that it is morally implausible to attribute the same moral weight to all sentient animals such as (e.g.) insects, rats, pigs, dogs, chimpanzees and humans (Posner 2004, Kagan 2016). Rogers and Kaplan (2004) for instance provide arguments against the equality view, and against "*drawing a line*" for defining the moral circle. Moreover, we note that attributing different weights might perhaps be justified given the scientific uncertainty about which animals are sentient, leading to the assumption that the weight represents the probability of sentience.

Our model is very simple and has severe limitations. We assume that improving farm-animal welfare increases the cost of meat but not its (perceived) quality, an unrealistic assumption (Norwood et al. 2007). We do not account for the diversity of consumer tastes, and we assume that animals are identical. We also assume that the consumer does not personally care about farm-animal welfare per se,[20] which seems inconsistent with a number of willingness-to-pay studies (Norwood and Lusk 2010). This raises the question of how to characterize consumers' pro-animal attitudes, and more fundamentally how to construct the social-welfare function with such individual preferences (Johansson-Stenman 2018, Fleurbaey and van der Linden 2018). Moreover, since the approach is normative, the level of farm-animal welfare and the quantity of meat consumption are determined by the social planner. This raises implementation issues, such as that of farm monitoring and imperfect compliance with animal-welfare legislation on the supply side or that of the (in-)efficiency and difficulty of implementing meat certification and taxation on the demand side (Lusk 2011).

We also stress again our assumption that the cost per animal of investing in animal welfare is constant. This simplifies the analysis, but may be criticized. On the one hand, the marginal cost may be decreasing because of the increasing returns to raising more animals (e.g., investing in costly technology such as showers or fans to ensure thermal comfort). On the other hand, it may be increasing due to the difficulty of raising many animals in proper

[19] More precisely, we assumed impartiality within species but not across species. One may argue that this assumption is illogical, and may require us to assign different weights to different individuals within the same species, including humans, which many view as a "slippery slope". See Singer (2009) for a discussion of this argument.

[20] Note however that model (1) can be conceived as a model of individual human-consumption choices under pure altruism towards animals.

conditions (e.g., high confinement in indoor systems). Ultimately, this is an empirical question. The meta-analysis in Robbins et al. (2016) shows that there is no systematic relationship between the size of the farm and animal welfare. Our constant marginal-cost assumption also has formal implications. For instance, optimal investment in animal welfare is independent of the utility that humans derive from meat (see Equation 2).[21]

Finally, and perhaps most importantly, in our model animals are only considered through the lens of their productive function for human consumption. This view is arguably problematic morally. Many deontologists such as Regan (1983) stress that it is morally wrong to eat animals, and that we should all be vegan. We can also perhaps interpret along these lines our survey finding that animal activists only favorably perceive scenario 7, the only scenario in which animals are not killed for humans. In our model, this can result if animals' utility u_a, as soon as animals are raised and killed for human consumption, is always very –perhaps infinitely– negative. As a result, a corner (i.e. vegan) solution is always optimal (see Equation 4).[22] In their seminal book, Kymlicka and Donaldson (2011) propose that farm animals cannot be humans' property, and thus cannot be raised for human consumption. Instead they would become citizens, and humans have a duty to take care of them if needed.[23] More generally, if the welfare of animals matters, and if humans can act to help animals, a multi-species utilitarian model may recommend that humans intervene in nature. This inevitably raises additional moral issues, such as those about whether humans should aid animals in dire need (Hadley 2006), reduce their birthrates (Clark and Ng 2006) and even limit predation in the wild (McMahan 2015, Horta 2016).

[21] Take the current reduction in meat consumption in developed countries, that we can view as an exogenous preference-shift in our model. Many have suggested that this shift is due to health and environmental concerns, and explains a trend toward "less but better" meat (de Boer et al. 2014). The point is that the normative implications for animal welfare of such a preference shift is unclear a priori under nonlinear marginal cost. This is left for future research.

[22] This formal point seems consistent with Singer (1980).

[23] Here the "stretch" in our model is that, for very high levels of animal welfare levels c implying high animal utilities, the model could possibly accomodate for an interpretation where animals are simply "consumed" as pets or neighbours but not as meat.

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Appendix: Survey

Implementation of the survey

The survey was carried out in France in Spring 2019. We contacted experts in farm-animal welfare and animal ethics via e-mail. We asked them if they would anonymously fill out a Google form document containing the survey questionnaire presented below. We contacted 28 experts in animal ethics, 20 of whom (71.4%) completed the questionnaire. We contacted 129 experts in farm animals (39 experts in poultry, 40 in bovine and 50 in porcine farming), 19 of whom (14.7%) completed the questionnaire. We also contacted animal activists through the Facebook site of an animal advocacy NGO in France which had 672 followers at the time of the survey. The followers could also anonymously fill out the Google form document containing the survey questionnaire. 70 followers opened the link to the questionnaire and 62 actually completed the questionnaire.

We also invited students at the University of Rennes to participate in an experiment (only a part of the experiment concerned our study). Ten days before the experiment, participants were asked to complete a mandatory online document that they had to complete up to two days before the experiment began. The online document asked participants to indicate how often (never, a few times a year, a few times a month, a few times a week, almost at each meal) they consume a list of items (red meat, white meat, fish, eggs, dairy products, vegetables, pulses, fruit, and starchy products). On the day of the experiment, we asked students in the lab to fill out the questionnaire that was presented to them on a sheet of paper. In total, 122 students participated in this experiment and completed the questionnaire.

Survey questionnaire

(Translated from French, parts in bold in the original text)

In the Table A1 below you will find seven scenarios describing different living conditions of a broiler in a poultry farm. Scenarios 1 to 5 correspond to the standard living conditions according to different farming conditions in France, which are compatible with European regulatory requirements. The scenarios – listed from 1 to 7 – are described in the table below.

For each scenario, we will ask you to give your personal opinion on the following statement: **"The life of a broiler reared in those conditions**

is worth living". You can either answer that you: 1 Strongly disagree; 2 Tend to disagree; 3 Neither agree nor disagree; 4 Tend to agree; 5 Strongly agree. Thus, if you answer 1 for instance, this means that **you do not think that the life of a broiler reared in these conditions is worth living**. However, if you answer 5, this means that **you think that the life of a broiler reared in these conditions is worth living**.

We stress that we would like to know **your** perception of whether a broiler's life worth living. We ask you to evaluate **the value of life for the broiler,** and not from the point of view of a consumer or from a point of view of the producer of broilers for instance. Thus, we want to know if **according to you it would be preferable that a broiler was born and reared in the living conditions mentioned in the different scenarios, rather than not born at all.** In order to answer to each of these questions, you can ask yourself for instance whether the sum of positive experiences (pleasure, etc.) is greater than the sum of negative experiences (pain, etc.) the broiler experiences under the living conditions described in each scenario.

There are no right or wrong answers. We are simply interested in your frank and subjective opinion on the value of life of a broiler under different living conditions. This questionnaire is part of a study of CNRS and INRA researchers on animal welfare, and the individual data collected will be kept confidential.

Table A1: Living conditions in each scenario – Please fill in the last line of the table

	Scenarios						
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**	**Scenario 7**
Indoor rearing	20 chickens/ m²	14 chickens/ m²	14 chickens / m²	8 chickens / m²			
Natural light	No	Yes	Yes	Yes			
Perches	No	Yes	Yes	Yes			
Pecking objects	No	Yes	Yes	Yes			
Outdoor access	No	No	No	Yes			
Free-range rearing					Yes	Yes	Yes
Number of chickens inside the farm	> 1000	> 1000	> 1000	> 1000	> 1000	Around 10	Around 10
Stunning before slaughter	No	Yes	Yes	Yes	Yes	Yes	
Age at slaughter	40 days	40 days	60 days	80 days	80 days	200 days	6 years (natural death)
Transport time to slaughterhouse	8h	6h	3h	3h	3h	On the farm	On the farm
"The life of a chicken reared in those conditions is worth living". *1 Strongly disagree ; 2 Tend to disagree ; 3 Neither agree nor disagree ; 4 Tend to agree ; 5 Strongly agree*							
Your opinion on a scale from 1 to 5							

Table 1: Proportion of participants who agree with the statement that the broiler's life is worth living.

Scenario	S1	S2	S3	S4	S5	S6	S7	N
Animal Activists	0%	0%	0%	1.6%	1.6%	16.1%	71%	62
Animal-Ethics Experts	0%	0%	0%	0%	0%	50%	75%	20
Farm-Animal Experts	5.3%	10.5%	15.8%	63.2%	73.7%	78.9%	73.7%	19
Students	0.8%	2.5%	4.9%	24.6%	52.5%	84.4%	92.6%	122

Table 2: SURE regression of the agreement on the statement that the broiler's life is worth living.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Students	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Farm-Animal Experts	.456***	.549***	.482***	1.046***	.758***	.07	-.414
	(.114)	(.161)	(.183)	(.242)	(.239)	(.278)	(.263)
Animal-Ethics Experts	-.123	-.451***	-.623***	-1.483***	-1.745***	-1.396***	-.58**
	(.112)	(.158)	(.179)	(.237)	(.233)	(.272)	(.258)
Animal Activists	-.123*	-.435***	-.607***	-1.436***	-2.053***	-2.407 ***	-.923***
	(.072)	(.102)	(.116)	(.153)	(.151)	(.176)	(.167)
H_0: Farm = Ethic	<.001	<.001	<.001	<.001	<.001	<.001	.628
H_0: Farm = Activists	<.001	<.001	<.001	<.001	<.001	<.001	.069
H_0: Ethic = Activists	1	.924	.933	.853	.216	<.001	.211
Observations	223	223	223	223	223	223	223
R^2	0.0978	0.1634	0.1822	0.4087	0.5299	0.4779	0.1253

The model includes a constant term.
Standard errors in parentheses.
Significance level: *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Table 3: SURE regression of the agreement on the statement that the broiler's life is worth living for students only.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
White-meat consumption...							
...Infrequent	Reference	Reference	Reference	Reference	Reference	Reference	Reference
...Frequent	.042	.324**	.405**	.667***	.74***	.411**	-.122
	(.096)	(.146)	(.169)	(.22)	(.204)	(.178)	(.133)
Observations	122	122	122	122	122	122	122
R^2	0.0016	0.0391	0.0450	0.0703	0.0972	0.0421	0.0068

The model includes a constant term.
Standard errors in parentheses.
Significance level: *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Figure 1: Animal consumption and antispeciesism

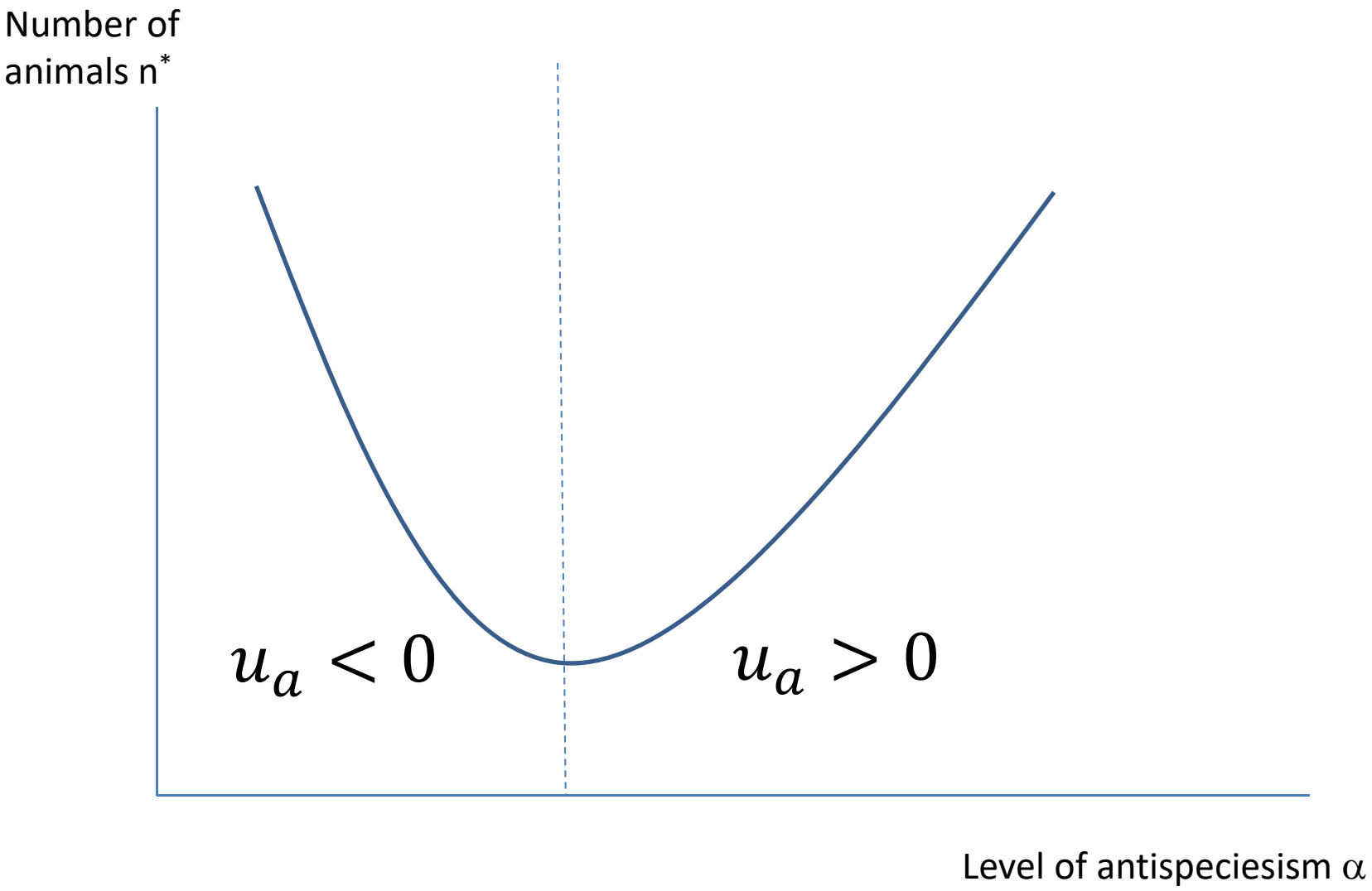

Figure 2: Proportion of respondents who agree with the statement that the broiler's life is worth living per scenario and type of respondent.

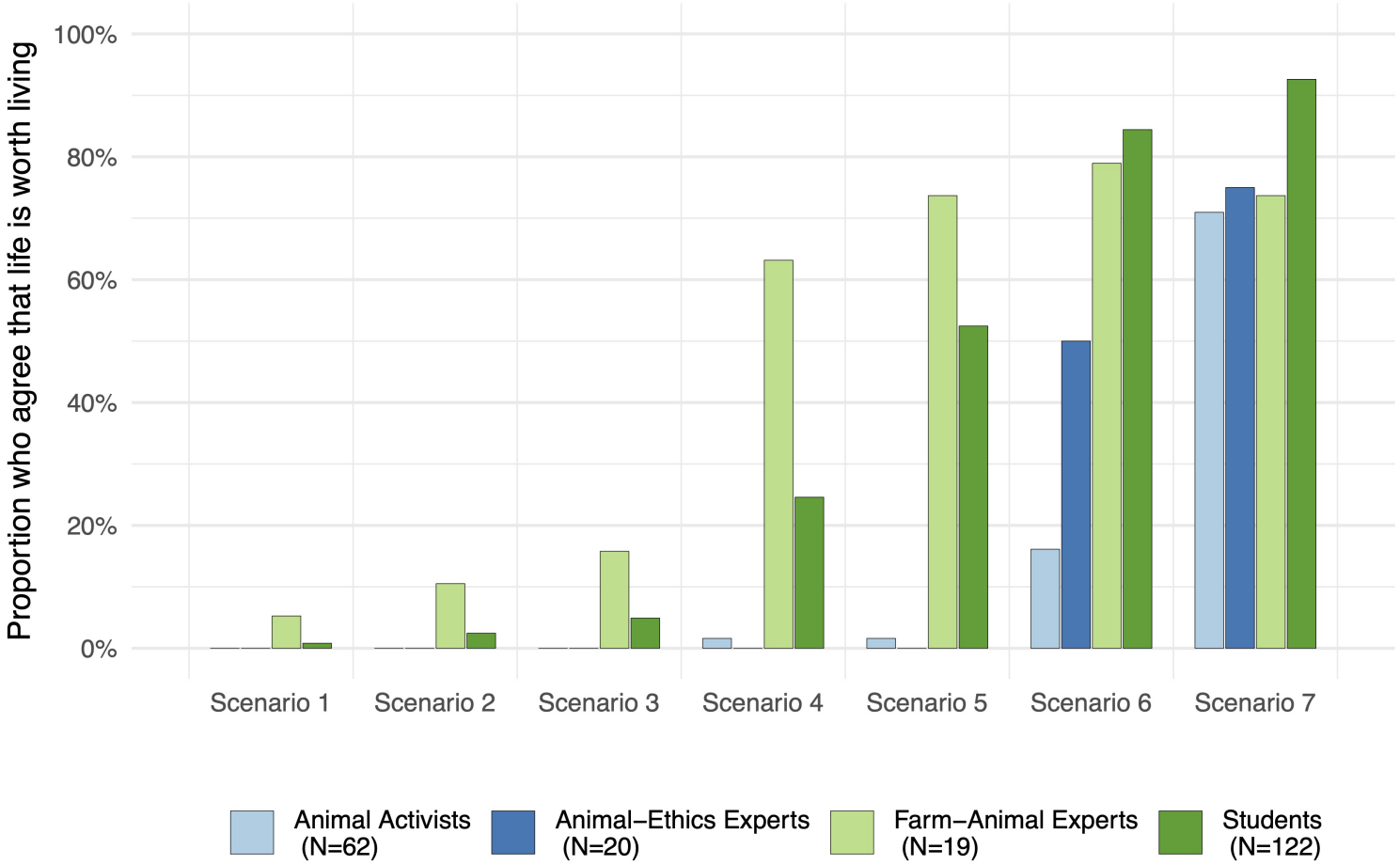

Figure 3: Proportion of students who agree with the statement that the broiler's life is worth living per scenario and level of white-meat consumption.