Painful dilemmas

Lund, Thomas Bøker; Mørkbak, Morten Raun; Lassen, Jesper; Sandøe, Peter

Published in:
Public Understanding of Science

DOI:
10.1177/0963662512451402

Publication date:
2014

Document Version
Peer reviewed version

Citation for published version (APA):
Lund, T. B., Mørkbak, M. R., Lassen, J., & Sandøe, P. (2014). Painful dilemmas: a study of the way the public's assessment of animal research balances costs to animals against human benefits. Public Understanding of Science, 23(4), 428-444. DOI: 10.1177/0963662512451402

Danish Centre for Bioethics and Risk Assessment
This is a post-print version of an article published in
Public Understanding of Science by Sage Journals
For more articles on animal ethics, see www.animalethics.net

Painful dilemmas: A study of the way the public's assessment of animal research balances costs to animals against human benefits[1]

T.B. Lund[1], M.R. Mørkbak[2], J. Lassen[1] & P. Sandøe[1]*

[1] University of Copenhagen, Denmark
[2] University of South Denmark, Denmark
* Corresponding author: tblu@ifro.ku.dk

Abstract

The conflict between animal costs and human benefits has dominated public as well as academic debates about animal research. However, surveys of public perceptions of animal research rarely focus on this part of attitude formation. This paper traces the prevalence of different attitudes to animal research in the public when people are asked to take benefit and cost considerations into account concurrently. Results from the examination of two representative samples of the Danish public identify three reproducible attitude stances. Approximately 30–35% of people questioned approved of animal research quite strongly, and 15–20% opposed animal research. The remaining 50% were reserved in their views. Further studies will ideally use the measure developed here; and if they do so, relatively fine-grained comparisons and understandings of differences between populations and changes in attitudes over time, will become possible.

Keywords: Ambivalence, animal research, attitudes, cost-benefit, public, quantitative study, value conflict

Introduction

Since the 1960s a wave of concern about human treatment of animals has steadily made its way across the western world. Earlier controversies about human use of animals centred chiefly on the idea of "cruelty"—that is, the notion that animals were being mistreated for no good reason due to a lack of care and concern. The new wave of concern highlighted "animal welfare," and in doing so introduced the idea that we should provide animals with good conditions in which to live even if that meant limiting their rational use. Thus attention was drawn to the suffering of animals, notably in intensive animal production (Sandøe and Christiansen 2009).

[1] The reference of the printed version is:
Lund, TB; Mørkbak, MR; Lassen, J & Sandøe, P. (2013): Painful dilemmas: A study of the way the public's assessment of animal research balances costs to animals against human benefits. *Public Understanding of Science*. First published on August 3, 2012, doi:10.1177/0963662512451402.
The definitive version is available at
http://pus.sagepub.com/content/early/2012/08/02/0963662512451402

Concern about animal welfare has since led to legal reforms, notably in Europe, where minimum standards for the treatment of livestock and other animals—not least, those used in scientific experimentation—have been defined in response to public concerns. Although recognition of the animals perspective has become commonplace and is to some extent reflected in policies and legislation, this consideration competes with other human interests in practice. For instance, it is notorious that public interest in improvements to animal welfare in modern agriculture is translated only to a very limited degree into consumer decisions to purchase special, more costly, food products produced so as to meet higher standards of animal welfare (e.g. Verbeke et al. 2010).

In general the evaluation of animal use can be said to be governed by the consideration of two factors: benefits to humans and costs to animals. As in the example of consumer purchases above, these considerations often coincide and conflict in several domains of animal use (Garner 2005). However, the conflict is perhaps most clearly evident when we examine the use of animals in medical research. Obviously, everyone wants to fight deadly and debilitating human diseases; but what if this comes at a price, namely using laboratory animals? And what if the research could only be carried out successfully by exposing the laboratory animals to pain?

Such questions illustrate the clear ethical challenges that surround animal research. Therefore it is likely that the tension between animal costs and human benefits is the decisive factor in people's decision to approve of such research. However, surprisingly we cannot know for sure, at a generalized level, how the public thinks about the dilemma in this arena. Thus, the two evaluative principles are seldom reflected jointly in quantitative measures, as briefly reviewed below. It is unsatisfactory that the public's view of, and reaction to, this fundamental dilemma has not been mapped, since opinion polls play a central role in the claim, made by opponents and proponents of animal experimentation, that their specific views about animal research have moral and democratic legitimacy (Hobson-West 2008).

Opinion measures attempting to gauge attitudes by reporting percentages "for," "against" or/and "undecided" (reviewed in Hagelin et al. 2003) have not integrated the dilemma between animal costs and human benefits. In framing and phrasing questions, some of these measures focus primarily on the animal pain dimension—e.g. "How strongly do you approve or disapprove of the use of animals like mammals and birds in research and testing when the animals experience *little or no pain or distress, moderate, or severe pain or distress*? (HSUS 2001, emphasis added)." Most, however, focus solely on the benefit dimension. For instance: "It is right to use animals for medical testing if it *might save human lives* (ISSP 2000, emphasis added)." To date, EuroBarometer surveys and US National Science Foundation surveys have used the following statement many times: "Scientists should be allowed to experiment on animals like dogs and monkeys if this can help resolve human health problems (e.g. Eurobarometer 2010)." The wording of this question has recently been criticized on the grounds that it is not built upon a solid theoretical framework (Crettaz von Roten 2009; Lund et al. 2012). It is certainly correct to say that the phrasing omits to prompt on the animal cost dimension—and therefore on the dilemma between this and human benefits.

Other types of tool that have been used include *factorial studies* (Aldhous et al. 1999; Henry and Pulcino 2009). These do indeed integrate the cost and benefit perspectives in the measures of attitudes they deliver. However, they use substantial resources, since in their approach to attitudinal assessment multiple responses are required per respondent. For example, 27 questions were used in the study by Aldhous and

colleagues (1999). In many practical settings such a large number of items are unlikely to be feasible, since costs for representative surveys of national populations increase to some extent in tandem with the amount of items researchers plan to use. Using 27 items may, then, exceed the budget, or alternatively have the side-effect that additional measures of interest cannot be included in the survey. Thus, it will only be in generously funded research that this sort of questionnaire can be employed, and this limits its applications.[1] A further problem for this type of measure is that it cannot be used to qualitatively categorize typical underlying stances encountered in members of the public. Other tools employ a *composite approach* so as to construct interval-scaled measures of attitudes to animal research (Furnham and Pinder 1990; Saucier and Cain 2006; Swami et al. 2008; Takooshian 1988). The quantitative nature of these measures means that they are unsuited for the assessment of public opinion, since there is no obvious and appropriate way to identify the thresholds that constitute, and distinguish, qualitatively different attitudes.

In short, an examination of public attitudes to animal research is called for that pays specific attention to any differential attitudes that may emerge when citizens take the dilemma between animal costs and benefits into consideration. Here, we attempt to do just that by following up on a recent qualitative study conducted in Denmark (Lund et al. 2012). In that study, ordinary Danish citizens debated animal research in focus groups and, indeed, a clear value conflict between animal costs and human benefits emerged among participants. However, the focus group data revealed that reactions to this dilemma were very different and gave rise to three attitude stances. One group (*Disapprovers)* rejected animal research by referring to animal well-being and animal rights. Another (*Approvers*) supported animal research in general by granting first priority to considerations of human benefit and playing down the importance of animal well-being. A third group (*Reserved*) found it extremely hard to balance the considerations of animal pain and human benefits and remained ambivalent (Lund et al. 2012).

Since the study that revealed these attitude stances employed qualitative methods, and since only a small group of Danes were asked about their attitudes, the generalizability of the results remains limited. Furthermore, the qualitative nature of the study does not indicate the relative prevalence of Approvers, Reserved and Disapprovers in the general public. To find out how the three reactions to the tension between animal costs and human benefits are distributed among the public we need to outline the prevalence of the stances. The prevalence of the attitude stances will also be of interest to stakeholders, since it may well reveal to them the potential impact public debates have on policy making. Therefore, a quantitative investigation that follows up on the central findings from the qualitative study will be carried out.

Research aims and hypotheses

We start off by examining quantitatively whether the three attitude stances that were revealed in the study by Lund et al. (2012) are generalizeable and apply to the Danish public. At the same time we test whether the stances are reproducible in two independent samples. Thus, if they are reproducible, that will add credibility to the reliability of the stances.

Following successive identification of the three attitude stances, we go on to assess whether they are valid representations of attitudes in Denmark by setting up and testing a number of hypotheses within three

overarching themes detailed below. This assessment can be made by exploiting the fact that the stances are embedded in an explanatory framework (derived from the above mentioned qualitative study) in which the argumentative routes used to form an attitude are outlined together with further pertinent components that transpire during attitude formation (Lund et al. 2012). The framework, then, reveals the mechanisms that are assumed to govern attitude formation among the underlying stances. This in turn makes the theoretical or explanatory validity of the stances testable. The three themes where specific hypotheses are tested were as follows:

A: Hypotheses regarding human interest versus concern for animals, and ambivalence. The value conflict surrounding attitudes to animal research can be handled by emphasizing either human interests or animal considerations as core values (Lund et al. 2012).

Hypothesis a1: Disapprovers will champion the view that animal costs either trump human benefits or at least weigh very heavily.

Hypothesis a2: Approvers will maintain that humans in general matter more than animals and that concern for human interests therefore weighs more heavily than concern for animals.

Hypothesis a3: Reserved cannot at the general level choose between these options and consequently respond with an intermediate attitude, where both human interests and concerns for animals are stressed.

Due to this indeterminacy among the Reserved a fourth hypothesis is:

Hypothesis a4: Reserved exhibit higher ambivalence about using animals in experimentation, as compared with Approvers and Disapprovers.

B: Hypotheses regarding approval/disapproval tendencies. Alongside the underlying three stances people are prone to switch between support and rejection when specific examples of animal research are debated. However, the character of these switches is quite different depending on the underlying attitude stance:

Hypothesis b1: Disapprovers will tend not to accept animal research if pain is caused to the animal during the experiment regardless of the potential benefits.

Hypothesis b2: Approvers will tend to accept the use of animals in research if the benefits are high, and they will do so regardless of the levels of pain the animals will experience.

Hypothesis b3: Reserved will very frequently move between support and rejection.

C: Hypotheses regarding cost-benefit decision approaches. There is a widespread tendency to approve/disapprove following a weighing-up of the benefits of the animal experimentation and the animal costs.

Hypothesis c1: The tendency to apply cost-benefit decisions is most apparent among people with Reserved attitudes.

Methods

Data

Two independent samples were used, both drawn from an internet database held by a commercial survey company in Denmark consisting of approximately 120 000 Danish panel members. In both samples participants were invited to answer an internet-based questionnaire. Participants were drawn so as to create a representative sample of the Danish public in the age bracket 20–70 years.

For Sample 1, invitations were issued to 5311 panel members in February and March 2010. 1247 participants completed the questionnaire, giving a response rate of 23.5%. For Sample 2, 6280 panel members were issued an invitation in November 2010. 1111 participants completed the questionnaire, giving a response rate of 17.7%. A comparison with census data from Statistics Denmark showed that both samples deviated significantly from the Danish public (aged 20–70) with regard to age, region, and education. For this reason we employed an age/region/education adjusted variable in univariate analyses. All bivariate and multivariate analyses, on the other hand, were conducted with non-weighted data.

There are two reasons why two samples were used in this study. The first reason is that we wanted to assess the reliability of the three attitude stances, more specifically, whether their attitudinal patterns and the relative extent of their presence among the Danish public are reproducible across two samples. The second reason is that due to financial restrictions, it was not possible to fund a lengthy questionnaire encompassing all variables of relevance in only one sample.

Measures and procedures

The measures described below are designed on the basis of an additional methodological finding from the qualitative study, described earlier, where it was suggested that the substantial variation in acceptance/opposition to animal research that has been observed in opinion measures (see Hagelin et al. 2003) most probably stems from the fact that the question phrases that have been used confound different levels of attitudes. Thus, in practical discourse, ordinary citizens argue on an underlying value-based level (e.g.; “In general, I cannot accept animal research,” “If the research is important, I am willing to accept the use of laboratory animals” etc.) and on a context-specific level (where specific purposes, animal species or animal costs are evaluated). When prompting for attitudes to context-specific animal research designs, there is significant attitudinal variation (Hagelin et al. 2003, Aldhous el al. 1999), which may explain the discrepant results observed by Hagelin et al. A further problem with this practice is that the context-specific variation has not been conducted systematically and that the representation of people’s underlying attitudes has lacked depth.

A solution to this pending problem is to separate measures of underlying attitudes from context-specific attitude measures (Lund et al. 2012). This suggestion is employed in this study, such that only underlying attitude items are employed when detecting the three attitude stances, whilst context specific attitude items are used to test the specific hypothesis about the stances pertaining to disapproval/approval tendencies and cost-benefit evaluations (hypotheses tested under B and C).

Testing for the existence of the three attitude stances. In order to investigate whether Disapproving, Reserved and Approving attitude stances can be identified and also reproduced in the Danish public we made use of both Sample 1 and Sample 2. Five similar question items were presented to the respondents in both samples. Together these items represented the main arguments and argumentative routes that people use when formulating their underlying attitudes to the use of animals in research (Lund et al. 2012). The first item prompted for overall disapproval: "The Government should ban all experiments on animals for any form of research." The second item also prompted for disapproval—however, in this case in a less categorical sense, and together with a reference to animal welfare: "I do not support the use of animals in any experimentation because of the importance I place on animal welfare." The third item dealt with the proviso encountered primarily among Approving and Reserved individuals, namely that animal research is acceptable only when no research alternatives exist: "I agree with animal experimentation for medical research where there is no alternative." Item four and item five enquired into attitudes people have to harm being caused to animals during experimentation. One item let people trade off pain against purpose: "I agree with animal experimentation, even if the animals will suffer seriously, as long as the purpose is important enough." The last item dealt with general disapproval of the harm imposed upon animals in the laboratory: "I do not agree with animal experimentation where the animals suffer seriously." These last two items were inserted in the modelling of attitude stances, enabling us to distinguish between Approvers and Reserved who diverged exactly in their views about pain versus benefits.[2]

To determine whether these five items can identify and reproduce the hypothesized attitudinal stances, we employed latent class analysis (LCA). LCA is a method that clusters observations into discrete classes in order to simultaneously account for unobserved heterogeneity and identify cases that resemble each other. By comparison with many competing clustering techniques LCA has the specific advantage that the indicator items put into the analysis can be categorical, and that evaluative instruments are available that allow one to assess the appropriateness of a specific modelling of the data—e.g. to test whether a specific number of classes fit the data well (McCutcheon 1987). We assessed the statistically optimal quantity of classes in Sample 1 and Sample 2 by inspecting the BIC values. The BIC value is a recommendable model evaluation criterion when sample sizes are large (McCutcheon 2002). The lowest value observed among any number of competing models is the optimal model, and hence it is preferred in that respect. Since the BIC statistic does not reveal the actual amount of variation accounted for by improved models, we also displayed, inspected and compared reductions in the likelihood ratio chi square (G^2) in the competing models. After making this statistical assessment of models, we determined whether the latent structure of the optimal models corresponded to the three hypothesized attitude stances.

All items had response options ranging from 1 = "Strongly disagree" to 5 = "Strongly agree," with a "Don't know" option also available. They were dichotomously re-coded into either agreement (4 and 5) or non-agreement (1, 2, 3 and "Don't know" option) with the statement before being entered into the latent class analysis.

Measure used for testing hypotheses regarding human interest versus concern for animals (Hypothesis a1 to a3). In order to assess the degree to which animal costs are trumped by human interests or vice versa in the attitude stances we employed, in Sample 2, a one-question measure developed to reveal attitudes to the notion that animals have a right to life (Rehbinder et al. 2009, p.148). This measure instructs people to choose the single statement, of three presented, with which they agree most (or indicate "Don't know"): 1.

"It makes no sense to talk about the recognition of an animal's right to life", "2. "We should recognize that animals have a right to life, but not in the same way as humans," 3 "We should recognize that animals have a right to life in a similar way to humans," and 4. "Don't know."

In this analysis we re-coded the "Don't know" response into the intermediate view=2, since initial analysis revealed that the "Don't know" response option exhibited similar tendencies, among the three stances, as the intermediate view.

Measure used for testing hypothesis about ambivalence (Hypothesis a4). We used a meta-attitudinal ambivalence measure that prompts directly for the participant's feeling or experience of ambivalence (Jonas et al. 2000). This was chosen in place of formula-based ambivalence measures, as it has been shown recently that the latter suffers from serious statistical flaws (Ullrich et al. 2008). Four items were given to the respondents in Sample 2 in order to assess subjective ambivalence (all deriving from Mulligan (2006): "I have both positive and negative feelings about this issue at the same time," "I do not find myself feeling torn between favouring and opposing this issue, my feelings go in one direction only," "My views on these issues are extremely consistent," and "When I think about whether I favour or oppose this issue, I feel like I could go either way"). Participants rated the statements on a scale ranging from 1 = "Disagree very strongly" to 7 = "Agree very strongly." Originally the scale contained nine items (Mulligan 2006). Satisfactory scale reliability was obtained (Cronbach's alpha = 0.78). Following reverse coding of the second and third items, the four items were summed together, thus producing a variable (ranging from 4–28) in which higher values indicated a greater degree of ambivalence. Respondents who ticked "Don't know" in one or more items were assigned a missing value.

Associations between the attitude stances and animal rights/human interest and ambivalence were assessed in gamma tests and an analysis of variance, respectively.

Measure used for testing hypotheses about approval/disapproval tendencies (Hypothesis b1 to b3). To reveal approval/disapproval tendencies a conjoint rating exercise was applied in Sample 1 (Green and Srinivasan 1978). In this kind of rating exercise respondents are presented with a number of scenarios, each of which is described as having a number of attributes, and are then asked to rate each scenario on a scale (in this case, a scale ranging from 1–5: see below). A within-subject full factorial design was carried out, in which the three factors known to affect attitudes (Aldhous et al. 1999; Hagelin et al. 2003; Henry and Pulcino 2009) were varied. The first factor, purpose of the animal experimentation, was an operationalization of the "benefit" factor. It contained five distinct research aims: safety test of a cosmetic product, development of medicine against obesity, migraine medicine, cardio-vascular medicine, and cancer medicine. The second factor, level of pain, was an operationalization of the animal cost factor. It contained three levels: none, medium, and high degree of pain. The third factor—type of animal species used for experimentation—contained three species: mice, pigs, and dogs. The important methodological point when choosing values within factors is to stretch out the dimension from what is assumed to be a high degree of acceptability to what is assumed to be a low degree of acceptability. In this study, we assume that cancer medicine, no pain, and the use of mice are the most acceptable values, while cosmetics testing, a high pain level, and the use of dogs are the least acceptable values. In principle, other purposes and animal species could have been used to serve as indicators of high/intermediate/low acceptability levels within the dimensions.

This factorial design yields (5 x 3 x 3) 45 unique combinations. Respondents were randomly assigned to one of three blocks, with each block containing 15 of the 45 possible combinations. They were asked to consider an introductory text: "Do you think the following type of animal experimentation should be allowed?" There were five possible response categories: 1="Should definitely be allowed," 2="Should be allowed," 3="Should definitely not be allowed," 4="Should not be allowed" and 5= "I am in doubt." Responses to these question items were re-coded into approval (1 and 2) or non-approval (3, 4, and 5), and this coding scheme was maintained in all analyses employing these data.

In order to analyze, and begin a discussion of, the degree to which the specific attitude stances determine opposition or approval as hypothesized, we first computed average approval rates for all five purposes, all three pain levels, and all three animal species. This provides approval rates when all other factors are held constant and is important for understanding the character and degree of support among the three attitude stances.

For all attitude stances we displayed minimum, maximum, and average approval rates; and we assessed, in numerical terms, the factor that is most important in decisions to approve or not by computing the relative importance (RI) of purpose, animal pain, and animal species. Relative importance was computed by taking the approval range for each factor separately and dividing it by the sum of the approval ranges for all factors. The RI values then represents percentages and has the property that, added together, they equal 100. The calculations, it should be noted, were made at accumulated levels, since the inserted maximum and minimum values were based on the average approval rates. Taking pain as an example the relative importance was computed as:

$$RI = \frac{\max(pain) - \min(pain)}{\max(pain) - \min(pain) + \max(purpose) - \min(purpose) + \max(animal) - \min(animal)} \times 100$$

Measure used to test hypothesis about cost-benefit decision approaches (Hyupothesis c1) (Hypothesis c1). In order to confirm the existence of cost-benefit decisions across the three attitude stances we drew on data from the conjoint rating exercise described in the previous section. Cost-benefit decisions were investigated and displayed with the help of two studies. These studies investigated whether there were significant differences in approval rates when the purpose of the experiment and the pain level, respectively, were varied while holding the remaining factors at a constant level. This was done by conducting χ^2 tests of differences in proportions: first, across all 5 purposes with one specific factorial design (in an experiment using pigs that will experience moderate pain); and secondly, similar tests of differences in proportions were conducted across all 3 pain levels in an experiment targeting cardio-vascular disease and involving mice. If significant differences are detected, it supports the cost-benefit hypothesis.

Results

Are there three reproducible attitudinal stances?

Table 1 lists latent class modelling results for Sample 1 and Sample 2; this modelling identifies potential stances in the samples. The results in both samples are very similar, since a model with three classes is preferable to a simpler 2-class or more complex 4-class model, according to the BIC statistics. In addition, inspection of the changes in G^2 values reveals that a model hypothesizing that the participants have homogeneous attitudes (1 class model) fits the data very badly. On the other hand, a model hypothesizing two classes fits the data much better, since the G^2 is reduced by over 70% in both samples.

The three-class model reduces the G^2 even more by over 95% in both samples. The four-class model reduces the G^2 further, by 1.2% and 3.9%, respectively. This suggests that the introduction of a fourth class reveals only slight extra variation in the data.

Table 1. Latent class modelling results for Sample 1 and Sample 2

Sample 1				**Sample 2**			
Model	BIC	G^2	% reduction in G^2	Model	BIC	G^2	% reduction in in G^2
1 class	698.11	883.4	0	1 class	784.76	967.1	0
2 classes	111.34	253.9	71.3	2 classes	76.08	216.3	77.6
3 classes	-73.61	26.1	97	3 classes	-50.87	47.31	95.1
4 classes	-41.49	15.5	98.2	4 classes	-47.04	9.06	99

The three-class model, then, represents a very sensible modelling of the heterogeneity among participants in both samples. Table 2 shows differences, in response patterns to the attitude items, among the three derived classes for both Sample 1 and Sample 2. The stances differ very clearly in this respect: a class responds in a *disapproving* fashion across all items; a second class responds in an *approving* fashion across all items; and a third class responds with *reservation*, since participants in this class disagree that animal experimentation should be banned as such but withdraw their support if serious suffering is imposed on the animals during experimentation This last class contrasts with the *approving* class, who, predominately, do not withdraw support when made aware of animal suffering.

Table 2. Latent class results: conditional probabilities of agreeing in statement per class, and the relative sizes of the attitude stances (Sample 1 and Sample 2)

	Sample 1 (N=1247)			**Sample 2 (N=1111)**		
Attitude stances / Statement[1]	*Approv-ers*	*Reserved*	*Disapprovers*	*Approv-ers*	*Reserved*	*Disapprovers*
Government should ban all experiments on animals	0.01	0.02	0.92	0.01	0.02	0.77
Do not support animal experimentation due to animal welfare	0.03	0.29	0.87	0.08	0.12	0.95
Agree with animal experimentation for medical research if no alternatives	0.93	0.85	0.42	0.97	0.77	0.36
Agree with animal experimentation, even when animals suffer seriously, if purpose is important	0.78	0.06	0.06	1.0	0.0	0.05
Disagree with animal experimentation if animals suffer seriously	0.18	0.83	0.85	0.35	0.71	0.92
Size of classes (in % of sample)	**34,9**	**49,1**	**16,0**	**31,8**	**50,9**	**17,2**

[1] Refer to methods section for verbatim wording of the attitude statements

The patterning of the three classes that emerges is similar across Sample 1 and Sample 2, although it should be noted that the similarity has some exceptions: e.g. the disapprovers exhibit differences in tendency to agree that "Animal research should be banned" in Sample 1 (92% agree) and Sample 2 (77% agree); and other differences between the concrete response patterns in Sample 1 and 2 are identifiable. However, the differential impact remains small, and it does not spoil the general distinction in three underlying classes. Most importantly, it does not obscure the fact that these three classes, derived from the data, correspond rather well with the three attitude stances hypothesized in the earlier study (Lund et al. 2012).

Hence, we conclude that a distinction between Approvers, Reserved, and Disapprovers is a statistically sufficient, and reliable, description of the stances in Denmark in this attitudinal field.

Human interests versus concern for animals and ambivalence among the three attitude stances

Cross-tabulation test statistics clearly reveal that views on animal rights correlate strongly with attitudes to animal research (γ *0.69; Somers d 0.47*). The direction of the association is as anticipated according to Hypotheses a1, a2, and a3. Thus, 70% of those responding that it makes no sense to talk about an animal's right to life are Approvers, while only 28% are Reserved and 2% are Disapprovers (consistent with Hypothesis a1). Disapprovers are primary holders of the opposing view, since they account for 51% of those who responded that animals have a right to life that is similar to that enjoyed by humans, while 39% who responded in this way are Reserved and 10% are Approvers (Hypothesis a2). Finally, Reserved are the main subscribers to the intermediate view that we should recognize that animals have a right to life, but not in the same way as humans / Don't know, since 57% who responded in this way are Reserved, 31% are Approvers and 12% are Disapprovers.

Turning to ambivalence, results from an analysis of variance show significant differences between the attitude stances in respect of ambivalence score $(F\ 2, 1037) = 41.7$, $p < 0.0001$, $eta^2 = 0.34$. A Bonferroni post hoc test shows that Reserved are significantly more ambivalent (mean 16.4; S.D 4.6) about the use of animals in research than Approvers (mean 14.9; S.D. 4.4) and Disapprovers (mean 12.8; S.D. 5.9), and that Disapprovers are significantly less ambivalent than Approvers. These results correspond well with the ambivalence tendencies among attitude stances set out in hypothesis a4.

Approval and disapproval tendencies

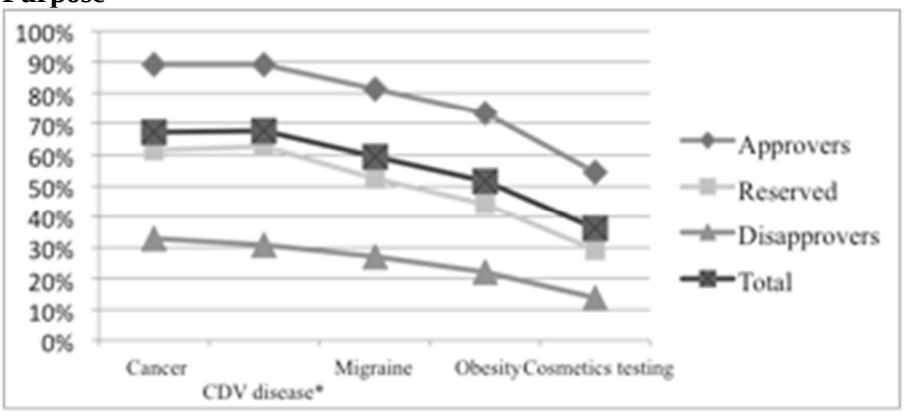
In Figure 1 the mean approval rates of all purposes, pain levels, and animal species are displayed. Approvers are the most supportive subgroup. Around 90% in this group support animal experimentation into cancer and cardio-vascular diseases averaged across all pain levels and animal species involved. This indicates that the subgroup is quite willing to sacrifice animal well-being, and to override species issues, if the purpose is important enough. This is consistent with Hypothesis b2.

At the other end of the spectrum, Disapprovers are the clearly most unsupportive of animal experiments. Unlike Approvers, they pay little attention to the purpose of the experiment, since acceptance only varies between 14–33%. They attach most importance to pain: approval drops from 44% to 20% as soon as any form of pain is introduced in the experiment. This pattern confirms the assumption from Hypothesis b1.

Finally, Reserved exhibit very variable tendencies to support/reject. This variation seems to be based, to a large extent, on considerations having to do with both the purposes and the pain levels of specific experiments. Thus, acceptance is quite high at the no-pain level (approximately 80%) but decreases to just above 20% at the level of strong pain. Support also varies considerably with the purpose of the experiment, although it never rises above 65%.

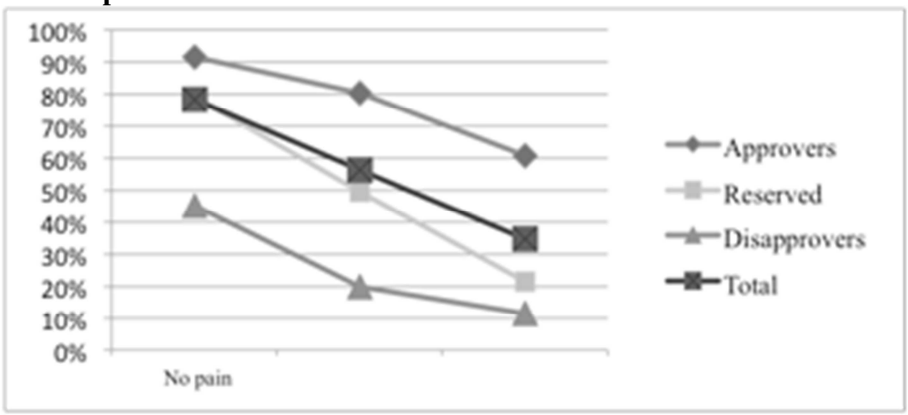
Figure 1. Mean approval rate per purpose, pain level, and animal species -among three attitude stances and in total (N=1247)

Purpose



* CDV disease = Cardio-vascular disease

Animal pain



Species

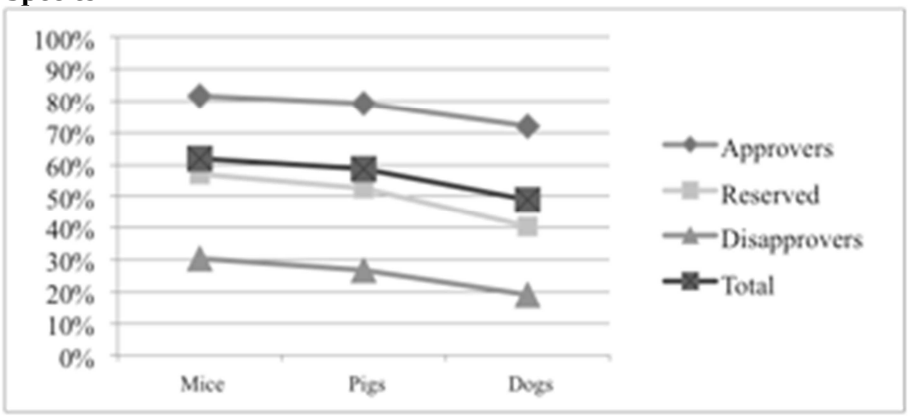


Table 3 further reveals frequent shifts between support and rejection in the Reserved group. Thus, the approval of members of this group varies between 5.1–97.2%, depending on the specific characteristics of the animal research. This amounts to a 92.1 percentage range—a range which is considerably greater than those found among Approvers (74.8%) and Disapprovers (65.2%). This great variation is consistent with Hypothesis b3.

Table 3 also demonstrates the relative importance of the three factors. The importance scores do not reveal differences in specific approval rates among the attitude stances (which are quite high: cf. Figure 1). They reveal only the relative importance ascribed to the three factors when deciding to support a specific experimental design. An interesting overall finding here is that information on the pain caused to the animal has the greatest impact on the Danish publics' decisions as to whether or not to support an experiment (49.5%); information on the benefit dimension has considerably less impact (with relative importance of purpose at 35.4%). Information on the animal species to be used in research is clearly even less important.

Table 3. Relative importance of purpose, pain and animal species in decision to support animal research and descriptive statistics pertaining to approval (N=1247)

		Approvers	*Reserved*	*Disapprovers*	*Total*
Relative importance	Purpose	46.5%	31.1%	29.5%	35.4%
	Pain	40.1%	53.5%	52.6%	49.5%
	Animal species	12.5%	15.4%	18%	15.2%
Descriptive statistics	Minimum approval	25.2%	5.1%	1.5%	1.5%
	Maximum approval	100%	97.2%	66.7	100%
	Average approval rate	77.6%	50%	25.4%	56.5%
	Range	74.8%	92.1%	65.2%	98.5%

Digging more deeply into the specifics of the attitude stances, it can be seen that, for Approvers, the purpose of the animal research is the most important factor in making decisions to support experiments (explaining 46% of their decision to support/reject). The Reserved and Disapprovers exhibit similar tendencies: they attribute similar importance to the three factors, where the pain inflicted on the animal has the absolute highest importance (above 50%) followed by purpose (approximately 30%).

(Hypothesis C) Cost-benefit decisions

To investigate potential cost-benefit decision approaches we set up accumulated approval rates for two situations: 1) where the purpose of the research is varied and the animal and pain level is fixed (pigs experience moderate pain); and 2) where the pain levels are varied and the purpose and animal level is fixed (cardio-vascular research using mice). Table 4 reports results on these two situations. The findings

displayed in it suggest quite forcefully that cost-benefit decisions are being employed. Furthermore, this is the case in all of the attitude stances. Thus the change in support of cardio-vascular research using mice from 18% (strong pain) to 57% (no pain) demonstrates that even Disapprovers are willing, to some extent, to support animal research if it delivers important benefits. However, this support comes with the proviso that the research must either not hurt the animal or do so only moderately. Thus, looking at purpose, where moderate pain in pigs is involved, approval rates among Disapprovers remain steadily low (12–28%) across all purposes. Disapprovers, then, are in general inclined to weigh costs against benefits only when no, or at most a low, animal cost is involved.

Table 4. Cost-benefit decisions among the attitude stances - displayed by accumulated approval rates in percentages.

		Approvers[c]	*Reserved*[d]	*Disapprovers*[e]
Purpose[a]	Cancer	*96%*	*69%*	*23%*
Approval of research when pigs experience moderate pain	Cardio vascular	94% [n.s.]	72% [n.s.]	22% [n.s.]
	Migraine	91% [n.s.]	58% *	28% [n.s.]
	Obesity	80% **	46% **	24% [n.s.]
	Cosmetic testing	55% **	31% **	12% [n.s.]
Pain level [b]	No pain	*100%*	*95%*	*57%*
Approval of cardio-vascular research using mice	Moderate pain	96% *	76% **	33% **
	Strong pain	82% **	40 **	18% **

[a] All tests of differences in approval were conducted between cancer (reference) and the remaining purposes; [b] All tests of differences in approval were conducted between "no pain" (reference) and the remaining pain levels; [c] Number of observations in cells is either N=135,152 or 174; [d] Number of observations in cells is either N=191, 196 or 216; [e] Number of observations in cells is either N=51, 65 or 67

[n.s.] not significant (chi^2 test); *Significant at the 0,05 level; ** Significant at the 0,01 level

Although Approvers mainly remain supportive of all forms of animal research, they are also inclined to make cost-benefit decisions. As we would expect from Hypothesis b2, this decision procedure is used primarily to calculate benefits. Thus, it is only in cases where benefits of particular research purposes are perceived to be very low that they are outweighed by considerations having to do with animal well-being, since cosmetic testing is a significantly less supported experimental purpose than cancer. Research into obesity is also significantly less strongly supported than research into cancer. However, here the support drops by only 16% (to 80%), so a clear majority remains in favour of the experimentation. *Pace* Lund et al. (2012), the weighing of costs against benefits also emerges as a significant factor in Approvers' attitudes: here, support for cardio-vascular research causing no pain to mice is significantly stronger than support in cases where moderate and/or strong pain are inflicted. However, the great large majority of this group remains supportive of animal research, even at the highest level of pain (82%).

Finally, as hypothesized (Hypothesis c1), the Reserved group exhibits statistically significant cost-benefit decision inclination of a very strong and nuanced kind. Here, approval rates more than double as a result of changes in the purpose factor (31–72%) and the pain factor (40–95%).

Discussion

The aim of this study was to investigate attitudes to animal research in Denmark, paying particular attention to the way in which members of the public react to the dilemma between the animal costs and human benefits of experimentation.

Three attitude stances in the Danish public were identified. The reproducibility of these stances appeared to be excellent, since they were identified independently in two representative samples of the Danish public. In addition, we investigated whether they exhibited certain tendencies, and had traits that were relevant to attitude formation, as suggested by a recent qualitative study. All of the hypotheses were confirmed (more or less) in that regard.

In more detail, we found that around 30–35% of Danes (Approvers) support animal research rather strongly and require very strong arguments, indicating low levels of benefit and high levels of pain, if they are to abandon this support. Around 15–20% (Disapprovers) rejects the use of laboratory animals and will only accept it where no animal pain is involved in the experiments. The remaining group, comprising around 50% of Danes (Reserved), have at a general level not chosen a core value to subscribe to (that is, neither animal considerations or human interests). As a result of this, members of this group are rather ambivalent in their attitude to animal research and decide to approve or reject of animal research on a case by case basis by weighing the animal costs and human interests.

It was also confirmed that cost- benefit approaches are clearly employed by Danes. This was suggested by the average changes in overall approval (Figure 1). More specifically, it was confirmed by our observation of statistically significant changes in approval in directions that would be expected given cost-benefit reasoning. Furthermore, cost-benefit decision-making is employed throughout the attitude stances, although in rather varying kinds and to different degrees. This is the first time that a procedure to assess relative importance (ascribed to pain, purpose, and animal species) has been employed in an analysis of attitudes to animal research. A novel finding from this procedure was that the animal species is clearly of secondary importance when people decide whether to reject or support animal research designs. Animal pain and research purpose have the greatest impact on all attitudinal segments of the public. This corroborates with a qualitative finding where people deliberate more thoroughly on the subject (Lund et al. 2012).

In the introduction, three different types of quantitative measurement approaches to attitudes were outlined (opinion measures, factorial approaches, and composite approaches). It is our belief that the method by which attitudes were measured in this study generates a relatively more *credible*, *systematic* and *useful* public opinion measure than more commonly used procedures. Arguably, it is more credible since the three attitude stances were identified using an exploratory sequential design (see e.g. Creswell and Plano Clark 2011). This methodological procedure stipulates that quantitative measures should be

developed from qualitative pre-analysis and findings. The philosophy of this sequence rests on the assumption that quantitative measures become more credible when they are backed up empirically and theoretically by "thick" and "in-depth" insights from qualitative studies. Since the research foci and hypotheses testing carried out in this study were informed by a preliminary qualitative study (Lund et al. 2012) we optimized the chances that the derived measure of attitude stances developed here is in tune with the way most people deliberate.

The measure can also be viewed as an attempt to make a systematic tool to assess public opinion, which circumvents a problem that opinion studies in this field suffer from. More specifically, only items that represent attitudinal processes occurring at the underlying level (as opposed to a context-specific level) were used to identify the attitude stances, which should make it an ideal measure in the attempt to overcome the challenge that acceptance/opposition to animal research has varied considerably in practice (Hagelin et al. 2003).

As an offshoot to the two aforementioned points, the measure is arguably also more useful, since the division into three stances gives substance to the evaluation of changes in attitude over time and to differences in attitude between populations. For instance, the tool developed here can improve our understanding of cross-national attitudinal differences—by comparison, that is, with the insights offered by currently available question items, and in particular the Eurobarometer item mentioned earlier (Eurobarometer 2010). The Eurobarometer measure fails to embed the trade-off between animal costs and human benefit. This means it cannot identify any attitudinal differences between countries in respect of this trade-off. Nor can it track similar changes, over time, within populations—from, say, Approving to Reserved attitudes—which reflect changes in the relative importance attached to animal costs and human benefits in the minds of members of the public.

The novel contribution of this study is, then, an improved and relatively feasible tool (only five questions needed) to measure underlying attitudes to animal research, which should facilitate more meaningful comparisons over time and populations. In future, studies of attitudes to animal research could consider employing the five questions, and the subsequent LCA procedure, raised and carried out in this study in an attempt to reproduce these attitude stances in other population settings.

It was a limitation of this study that two samples were employed. Although this sampling approach afforded excellent opportunities to assess the reliability of the attitude stances, there were some components of the attitude formation process which, ideally, should have been investigated in a multivariate setting: specifically, whether ambivalence and cost-benefit tendencies operate in tandem. A further limitation of this study was the low response rate in both Sample 1 and Sample 2. The critical question in that regard is whether the low response rate and non-representativeness only distort differences in means and proportions when univariate results are set out, or whether there are systematic selection biases with regard to the type of Dane who responds to the questionnaire in the first place. The former is a trivial problem which can be overcome by employing a weighted variable in univariate displays, and indeed we did precisely this. The second issue, of selection bias, is more serious. It could mean that some attitude stances remain unobserved, and this would produce false representations of public opinion in Denmark. A final limitation of this study was that there was an upper age limit in the sample (20–70 years). This age limit was necessary. A large and biased group of the 70+ age group is constituted by people

who do not use the internet routinely yet, so a representative sample of this age group cannot feasibly be obtained at this point in time. This sample limitation may have altered proportions and means slightly.

The study identified three different attitude stances among the Danish public. We encourage researchers in other countries undertaking quantitative studies of public attitudes to animal research to attempt to identify the attitude stances in other populations.

Notes

[1] Another approach is used in the study by Henry and Pulcino (2009) where each respondent only receives one of 27 possible designs. However, such an approach is not recommendable, if there is heterogeneity in the population, which is likely to be the case in this attitude field (as this study shows).

[2] The three first items are similar to items that are used in an ongoing survey of attitudes to animal research in the UK public (Ipsos MORI 2010), so that comparisons between the UK and Denmark is possible on these three items.

References

Aldhous P, Coglan A. and Copley J (1999) Animal experiments: let the people speak. *New scientist* 22(162): 26-31.

Creswell JW, Plano Clark VL (2011) *Choosing a Mixed Methods Design* in Designing and

Conducting Mixed Methods Research. Sage Publications, USA 2011. p. 53-106.

Crettaz Von Roten F (2009) European attitudes towards animal research: overview and consequences for science. *Science, Technology, and Society* 14(2): 349–364.

EuroBarometer (2010) *Science and Technology. Special EuroBarometer. Wave 73.1*. European Commission. <http://ec.europa.eu/public_opinion/archives/ebs/ebs_340_en.pdf> Accessed on October 28, 2011.

Furnham A, Pinder A (1990) Young people's attitudes to experimentation on animals. *The Psychologists* 10(Oct.): 444-448.

Garner, R. 2005. *Animal Ethics*. Cambridge: Polity Press.

Green P, Srinivasan V (1978) Conjoint analysis in consumer research: Issues and outlook, *Journal of Consumer Research* 5: 103–123.

Hagelin J, Carlsson HE, and Hau J (2003) An overview of surveys on how people view animal experimentation: some factors that may influence the outcome. *Public Understanding of Science* 12: 67–81.

Henry B, Pulcino R (2009) Individual Difference and Study-Specific Characteristics Influencing Attitudes about the Use of Animals in Medical Research. *Society and Animals* 17:305-324.

Hobson-West P (2010) The Role of 'Public Opinion' in the UK Animal Research Debate. *Journal of Medical Ethics* 36(1): 46-49.

HSUS (2001) *Americans Disapprove of Research Involving Animal Suffering*. Human Society of the United States Omnibus Survey Results.

Ipsos MORI (2010) Views on animal experimentation. UK: Department of Business, Innovation & Skills. March 2010. < http://www.ipsos-mori.com/DownloadPublication/1343_sri-views-on-animal-experimentation-2010.pdf> Accessed on December 16th, 2011.

ISSP (2000) *"Environment II"* - ZA No. 3440. International Social Survey Programme. < http://www.gesis.org/?id=885>Accessed< Accessed on December 10th 2011.

Jonas K, Broemer P, and Diehl M (2000) Attitudinal Ambivalence. European Review of Social Psychology 11(1): 35-74.

Lund TB, Lassen J, and Sandøe P (2012). Public attitude formation regarding animal research. *Anthrozoos* (Forthcoming)

McCutcheon AL (1987) *Latent Class Analysis*. Quantitative Applications in the Social Sciences Series No. 64.. Thousand Oaks, California. Sage Publications

McCutcheon AL (2002) *Basic concepts and procedures in single and multiple-group latent class analysis* in Applied Latent Class Analysis (eds) Hagenaars JA and McCutcheon AL. Cambridge University Press, UK, p. 56-88.

Mulligan K (2006) The Meaning and Measurement of Ambivalence and Value Conflict in Public Opinion Research. *Paper presented at the annual meeting of the American Political Science Association, Marriott, Loews Philadelphia, and the Pennsylvania Convention Center,* Philadelphia, PA, Aug 31, 2006.

Rehbinder E, Engelhard M, Hagen K, Jørgensen RB, Pardo-Avellaneda R, Schnieke A, and Thiele F (2009) *Pharming: Promises and risks of Biopharmaceuticals derived from genetically modified plants and animals*. Ethics of Science and Technology assessment – volume 35. Berlin-Heidelberg: Springer.

Saucier D, Cain M (2006) The foundations of attitudes about animal research. *Ethics & Behavior* 16: 117-133.

Swami V, Furnham A, and Christopher A. (2008) Free the animals? Investigating attitudes toward animal testing in Britain and the United States. *Scandinavian Journal of Psychology* 49: 269-276.

Sandøe, P, Christiansen SB (2008) *Ethics of Animal Use*. UK: Wiley-Blackwell.

Takooshian H (1988) Opinions on animal research: Scientists versus the public. *PsyETA Bulletin* 7: 8-9.

Ullrich J, Schermelleh-Engel K, and Böttcher B (2008) The Moderator Effect That Wasn't There: Statistical Problems in Ambivalence Research. *Journal of Personality and Social Psychology* 95(4): 774–794.

Verbeke W, Pérez-Cueto FJ, Barcellos MD, Krystallis A, Grunert KG (2010) European citizen and consumer attitudes and preferences regarding beef and pork. *Meat Science* 84(2): 284–92.