The Effects of Exposure to Information about Animal Welfare Reforms on Animal Farming Opposition: A Randomized Experiment

Jamie Harris[1], Ali Ladak[1], Maya B. Mathur[2]

[1] Sentience Institute, New York, United States

[2] Quantitative Sciences Unit, Stanford University School of Medicine, California, United States

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Abstract

There is limited research on the effects of animal welfare reforms, such as transitions from caged to cage-free eggs, on attitudes toward animal farming. This preregistered, randomized experiment (N = 1520) found that participants provided with information about current animal farming practices had somewhat higher animal farming opposition (AFO) than participants provided with information about an unrelated topic (d = 0.17). However, participants provided with information about animal welfare reforms did not report significantly different AFO from either the current-farming (d = -0.07) or control groups (d = 0.10). Although these latter effects on AFO were small and nonsignificant, they appeared to be mediated by changes in perceived social attitudes towards farmed animals and optimism about further reforms to factory farming. Exploratory analysis found no evidence that hierarchical meat eating justification or beliefs about how well-treated farmed animals currently are mediated the effect. Further research is needed to better understand why providing information about animal welfare reforms did not substantially increase AFO overall, whereas providing information about current practice did somewhat increase AFO.

Keywords: Animal welfare, animal rights, attitudes, human-animal interaction, mediation analysis

Introduction

Over one hundred companies, including Unilever, Nestlé, and Aldi, have made commitments to only purchase cage-free eggs (Compassion in World Farming, 2021). Previous research has shown that awareness of the welfare standards used in particular animal products affects consumers' willingness to pay for those products (Clark et al., 2017; Lagerkvist & Hess, 2011). But what effects does exposure to information about these commitments have on individuals' opposition to animal farming? Animal farming is a leading cause of animal suffering (e.g., Singer, 1995; Scherer et al., 2018), environmental degradation (e.g., Clark & Tilman, 2017; Sakadevan, 2017), and chronic diseases among the consumers of animal products (e.g., Wang et al., 2016; Wolk, 2017), so it is important to understand the factors affecting opposition to this institution.

Some organizations are investing heavily in campaigns for cage-free reforms (e.g., Bollard, 2016; Open Philanthropy, 2021). However, animal advocates disagree about whether they should advocate for animal welfare reforms or the abolition of animal use (e.g., Wrenn, 2017). In some cases, the crux of the disagreement is ethical, based on differences between moral frameworks that prioritize either "rights" or "welfare" (e.g., Chiesa, 2016; Schmidt, 2011). Another crux is strategic, based on disagreement over whether animal welfare reforms will make further reforms for animals more or less likely (e.g., Francione, 2010; Sentience Institute, 2020; Wyckoff, 2014). The strategic advantages and disadvantages of incremental policy-making and advocacy have been explored previously (e.g., Ainsworth & Hall, 2011; Gamson, 1975), but little in the specific context of animal welfare and rights.

Evidence to date suggests that animal welfare reforms encourage momentum for further change by affecting individuals' dietary behaviors. Lusk (2010) found evidence from retail scanner data from San Francisco and Oakland that media coverage of California's Proposition 2 ballot initiative, which banned battery cages for egg-laying hens, likely caused an increase in demand for cage-free and organic eggs and a decrease in demand for other types of eggs. Tonsor and Olynk's (2011) observational analysis of the US from 1982 to 2008 showed a negative association between media coverage of farmed animal welfare and meat consumption. Caldwell's (2016) experiment found that participants who read articles about animal welfare changes "were more likely to intend to reduce their consumption of animal products than participants who read the control articles." More broadly, Mathur et al.'s (2021a) meta-analysis found that providing information about farmed animals or their welfare appeared to consistently reduce reported meat consumption or consumption intentions.

However, it is unclear whether animal welfare reforms also affect willingness to support further institutional changes (i.e. animal farming opposition); such attitudes seem likely to be crucial to the farmed animal movement's future success or failure (Reese, 2020). For example, research frequently identifies public opinion as an important factor affecting legislative and judicial outcomes (e.g., Burstein, 2003; Harris & Anthis, 2019; Monroe, 1998). There is evidence that persuasive messaging can increase opposition to animal usage practices (Braunsberger, 2014). But exposure to information about social issues can also lead to attitude change, even without explicit persuasion attempts. For

example, Graça et al. (2020) found that study participants who read a short article about the implementation of policies that promote more plant-based diets had higher support for such policies than participants who did not. Espinosa and Treich (2021) found that "welfarist" and "abolitionist" messaging both significantly reduced participants' justifications for meat eating, though neither treatment group received information specifically about animal welfare reforms. Do people change their attitudes towards animal farming as a whole when exposed to information about animal welfare reforms?

The effects of animal welfare reforms on Animal Farming Opposition

The present randomized experiment tested the effects of learning about animal welfare reforms on animal farming opposition (AFO). We included three conditions: one where participants read an article about welfare reforms (hereafter the "welfare-reforms condition"), one where participants read an article about current animal farming conditions ("current-farming condition"), and one where participants read an irrelevant control article ("control condition"). We first compared the difference in AFO between the welfare-reforms condition and the control condition. Comparison between these two groups provided evidence into the effects of an overall increase in exposure to information about animal welfare reforms on AFO. Given the evidence that learning about animal welfare reforms reduces animal product consumption or consumption intentions (Caldwell, 2016; Lusk, 2010; Tonsor & Olynk, 2011), we hypothesized it would also increase AFO.

Hypothesis 1: Participants who read an article about animal welfare reforms will report significantly higher Animal Farming Opposition (AFO) than participants who read an unrelated control article.

Since information about animal welfare reforms tends to implicitly highlight current animal farming practices, much of the indirect evidence reported in the previous section is consistent with exposure to information about the latter driving momentum for change, rather than exposure to information about the former. This is also an important question, since discussion of welfare reforms may sometimes displace discussion of current conditions or vice versa, e.g. in advocacy messaging materials.

In this study, the welfare-reforms condition was also compared with the current-farming condition. This enabled a test of whether the hypothesized effects of exposure to information about animal welfare reforms on AFO persist even when they displace other discussion of animal farming. Given that there are plausible psychological mechanisms through which animal welfare reforms might have especially strong influences on AFO (discussed below), we predicted that the effects would persist.

Hypothesis 2: Participants who read an article about animal welfare reforms will report significantly higher AFO than participants who read an article about current animal farming practices.

If the effects of animal welfare reforms on AFO arise through increased exposure to information about current animal farming conditions, it follows that directly increasing exposure to information about current animal farming conditions would also affect AFO. The final comparison, between the current-farming condition and the control condition, enabled a test of this possibility.

Hypothesis 3: Participants who read an article about current animal farming practices will report significantly higher AFO than participants who read an unrelated control article.

Mechanisms that affect Animal Farming Opposition

If our hypotheses are correct — exposure to information about animal welfare reforms increases AFO and does so more than exposure to information about current animal farming practices — what are the mechanisms that might explain this? Previous research suggests two plausible explanations, which were tested in this study through mediation analysis.

Perceived social attitudes

There are theoretical reasons to expect that individuals will seek to conform to perceived social norms (e.g., Cialdini & Trost 1998), including in their attitudes and behaviors towards farmed animals (Delon, 2018). Some studies provide evidence that emphasizing information about people's attitudes and behaviors towards animals and how this is

changing over time can affect the audience's own attitudes and behavior (e.g., Grundy et al., 2022; Sparkman & Walton, 2017). Meta-analyses find that perceived norms affect individuals' attitudes and behaviors in other contexts relating to health and the environment (e.g., Alló & Loureiro, 2014; Robinson, 2014). We expected that people reading about animal welfare reforms would infer that other people care about animals, which might lead to an increase in their own AFO. Indeed, a similar process has been demonstrated for gay rights reforms (Tankard & Paluck, 2017). Such an effect seems unlikely to occur from descriptions of current animal farming practices, which provide little evidence that people care about animals.

Hypothesis 4: The effect of reading an article about animal welfare reforms compared with reading an unrelated control article on AFO will be mediated by a measure of perceived social attitudes towards farmed animals.

Hypothesis 5: The effect of reading an article about animal welfare reforms compared with reading an article about current animal farming practices on AFO will be mediated by a measure of perceived social attitudes towards farmed animals.

Optimism about further reforms to factory farming

Increased exposure to information about animal welfare reforms could make people view the end of factory farming as more likely. Previous studies have found evidence of proportion dominance, the phenomenon whereby addressing a large proportion of a problem is preferred to making a larger absolute contribution when the proportion of the

problem that would be addressed in the latter case is lower (e.g., Bartels & Burnett, 2011). Researchers have posited that collective efficacy about the tractability and effectiveness of actions to tackle climate change likely increases support for those actions (Bonniface & Henley, 2008; Koletsou & Mancy, 2011). Similarly, we expected that people reading about animal welfare reforms would infer that change is possible and become less likely to dismiss actions to help animals as only making a small contribution to addressing a vast and unsolvable problem. Descriptions of current animal farming practices seem unlikely to increase AFO through this same mechanism, because they provide little evidence that progress is being made towards ending factory farming.

Hypothesis 6: The effect of reading an article about animal welfare reforms compared with reading an unrelated control article on AFO will be mediated by a measure of optimism about further reforms to factory farming.

Hypothesis 7: The effect of reading an article about animal welfare reforms compared with reading an article about current animal farming practices on AFO will be mediated by a measure of optimism about further reforms to factory farming.

Unexpected effects

Alternatively, it is possible that reading about current animal farming practices could in fact increase AFO more than reading about animal welfare reforms. In exploratory mediation analyses, we tested several plausible mechanisms for such effects.

If, as prominent animal rights advocates argue (e.g., Francione, 2010), increased exposure to information about animal welfare reforms leads people to think that farmed animals are currently better treated than they previously believed, it might lead them to decrease their AFO. By analogy, there is some evidence that regulation of capital punishment has encouraged the imposition of death sentences by assuaging jurors' anxiety and sense of responsibility for the decision (Steiker & Steiker, 2015). Anthis (2017) found that 75% of U.S. adults say the animal products they purchase "usually come from animals that are treated humanely," though it is unclear whether this perception has been encouraged by animal welfare reforms. Increased exposure to information about current animal farming practices might cause the opposite sort of change in beliefs about how well-treated farmed animals currently are, increasing AFO.

Relatedly, Francione (2010, p. 29) argues that animal welfare campaigns reinforce "the property paradigm," where animals' economic value is prioritized over their interests. We collected data on hierarchical meat eating justification (Rothgerber, 2013), to test this hypothesis. This is the notion that it is natural and acceptable for humans to breed, use, and eat animals, as long as their interests are taken into account to some (minimal) extent.

Methodology

The hypotheses, study design, and analysis plans were pre-registered on the Open Science Framework (https://osf.io/r9fw2). All data, code, and materials can be found in the supplementary materials (https://osf.io/gny9x/). The research was given ethical

approval by the lead author's institution, and all participants had to provide informed consent to participate.

Participants

The survey was hosted on GuidedTrack. Participants were recruited from Prolific and paid £0.75 for participating. Only individuals from the US, age 18 or over, and with a 98% historic approval rate on Prolific were invited to participate. Power analysis in G*Power (α = 0.05, β = 0.80) indicated that a sample size of 1524 would enable us to detect small effects (d = 0.2). To account for data exclusions, we aimed to recruit 1600 participants. In total, 1652 participants signed up for the study. We removed 54 participants who did not complete the survey in full, four duplicate responses, two corrupt responses, and 72 respondents who failed either of two attention checks,[1] leaving a final sample of 1520.

Procedure

After answering demographic questions, participants were randomly assigned to read one of three articles: an article about animal welfare reforms (companies' commitments to only purchase cage-free eggs), an article about current animal farming practices (usage of battery cages in egg production), or a control article about an unrelated topic (traffic jams). The articles were designed specifically for this study to represent plausible media coverage of animal welfare reforms. Participants then answered the main dependent variable, mediator, and exploratory dependent variable questions; the order of pages of questionnaire items was randomized within each of these three sections.

Measures

Baseline demographic and attitude measures

Before viewing the treatment articles, participants answered demographic questions on age, gender, ethnicity, education, income, pet ownership, vegetarianism or veganism, and political views.

Dependent variables

The Animal Farming Opposition (AFO) scale was the dependent variable in the primary analysis (Anthis, 2017; Anthis, 2020). The scale includes five questions that ask about people's willingness to support bans on animal farming, factory farming, and slaughterhouses, their willingness to join a demonstration against factory farming, and their discomfort with the way animals are used in the food industry ($\alpha = .83$, compared with $\alpha = .88$ in Anthis, 2020). The order in which these items were presented to participants was randomized. These were measured on seven-point scales (1 = *strongly disagree* or *very unlikely*, 7 = *strongly agree* or *very likely*). For all measures based on scales with multiple items, we created a composite score calculated as the mean of responses to the items.

We also collected data on several additional dependent variables for testing in exploratory analysis. Participants were asked how likely their consumption of animal products was to change over the next month (1 = *very likely to increase*, 7 = *very likely to decrease*) and questions about their support for further animal welfare reforms (further

moves towards cage-free eggs, support for another welfare measure for farmed hens, and support for a welfare measure for farmed pigs; α = .85) and intentions to participate in activism against battery cages (signing a petition, demonstrating, and donating to a relevant non-profit organization; α = .79), each using the same seven-point scales as the AFO questions.

Hypothesized mediators

Perceived social attitudes towards farmed animals were measured through two questions based on Gallup (2021) survey questions about perceived attitudes (on abortion, in that instance); participants were asked what their impression was of how most Americans feel about battery cages for chickens and factory farming (1 = *strongly favor*, 7 = *strongly oppose*; α = .81). Optimism about further reforms to factory farming was measured through four questions that ask about the perceived likelihood that battery cages for chickens or factory farming will be completely eliminated in the United States within the next 25 or 100 years (from "*0%, This definitely WILL NOT happen*," to "*100%, This definitely WILL happen*," in increments of ten, following McElwee & Brittain (2009); α = .88).

We also measured two additional potential mediators for testing in exploratory analysis. Beliefs about how well-treated farmed animals currently are is measured through two questions from Anthis (2017) which ask for agreement with the statements that "Most farmed animals are treated well" and "The animal-based foods I purchase… usually come from animals that are treated humanely" and two similar questions which ask about "farmed chickens" and "egg-based foods" specifically (α = .84). Hierarchical meat eating

justification is measured through the three "hierarchical justification" questions from Rothgerber's (2013) "meat eating justification" scale, which ask about agreement with statements that humans are "meant to eat animals," that "[i]t's acceptable to eat certain animals because they're bred for that purpose," and that, "[u]ltimately, animals are here to serve our needs" (1 = *strongly disagree*, 9 = *strongly agree*; α = .88, compared with α = .83 in study 2 of Rothgerber, 2013).

Results

Descriptive statistics

Means and standard deviations for the dependent variables and mediators are presented in Table 1. Variables 1–3 are used in the confirmatory analysis whereas variables 4–8 are used in the exploratory analyses.

[INSERT TABLE 1]

Animal Farming Opposition

The results of the confirmatory analyses are presented in Table 2; all reported effects are in raw units. A one-way ANOVA on the AFO scores revealed statistically significant variation among the three conditions, $F(2, 1517) = 3.593$, $p = 0.028$, $\eta^2 = 0.005$. A post hoc Tukey's Honest Significant Difference (HSD) test showed that AFO in the welfare-reforms condition was not meaningfully higher than the control condition (mean difference (MD) = 0.14, 95% CI [-0.07, 0.35], $p = 0.258$, Cohen's $d = 0.10$), so H1 was

not supported. Likewise, AFO in the welfare-reforms condition was not higher than in the current-farming condition (MD = -0.10, 95% CI [-.30, 0.11], $p = 0.527$, $d = -0.07$), so H2 was not supported; the difference was in fact in the unexpected direction. However, AFO in the current-farming condition was somewhat higher than in the control condition (MD = 0.23, 95% CI [0.03, 0.44], $p = 0.021$, $d = 0.17$), so H3 was supported.

[INSERT TABLE 2]

Mediation analysis

While we didn't find evidence of total effects of our treatment on AFO, total effects are not necessary for the presence of mediation (e.g., Hayes, 2009; Zhao et al., 2010). We therefore estimated a mediation model to test H4–H7 regarding mediators of intervention effects on AFO using the "mediation" R package (Tingley, 2014). The two mediators of primary interest were included simultaneously in the model:[2] (1) perceived social attitudes towards farmed animals, and (2) optimism about further reforms to factory farming. Because mediation analyses rely on certain no-confounding assumptions, we controlled for possible confounders in the model measured at baseline: age, gender, ethnicity, education, income, pet ownership, vegetarianism or veganism, and political views (VanderWeele, 2015). We also included treatment-mediator and mediator-mediator interactions in the outcome models. The indirect effects via each mediator were estimated based on 1,000 bootstrapped samples. A graphical representation of this model is shown in Figure 1.

Consistent with our mediation hypotheses, compared with the control condition, the effect of being in the welfare-reforms condition was mediated by both increased perceived social attitudes towards farmed animals (b = 0.04, 95% CI [0.01; 0.08], p < 0.001, d = 0.03) and increased optimism about further reforms to factory farming (b = 0.11, 95% CI [0.06; 0.16], p < 0.001, d = 0.08), although with very small effect sizes. Both of these mediators were associated with increased AFO. When compared instead to the current-farming condition, the effect of being in the welfare-reforms condition was again mediated by both increased perceived social attitudes towards farmed animals (b = 0.04, 95% CI [0.02; 0.07], p < 0.001, d = 0.03) and increased optimism about further reforms to factory farming (b = 0.06, 95% CI [0.02; 0.11], p = 0.002, d = 0.04). Hence, H4–H7 were all supported.

[INSERT FIGURE 1]

All the results reported in this section and the section above held with the inclusion of participants who failed the attention checks (see supplementary materials).

Exploratory analyses

The results of the exploratory analyses are presented in Table 3.

[INSERT TABLE 3]

Inclusion of additional mediators

To test possible unexpected effects of the animal welfare reforms as described above, we re-ran the mediation analysis, this time including in the model two additional mediators that we found to be negatively correlated with AFO (r = -0.24 and -0.56, respectively): (1) beliefs about how well-treated farmed animals currently are, and (2) hierarchical meat eating justification.

In this model, we again found that, compared with the control condition, the effect of being in the welfare-reforms condition was mediated by increased optimism about further reforms to factory farming (b = 0.09, 95% CI [0.04; 0.14], p < 0.001, d = 0.06), though this time not by perceived social attitudes towards farmed animals (b = 0.01, 95% CI [-0.02; 0.04], p = 0.438, d = 0.01). The effect was not mediated by beliefs about how well-treated farmed animals currently are (b = 0.002, 95% CI [-0.02; 0.02], p = 0.768, d = 0.001) or hierarchical meat eating justification (b = -0.02, 95% CI [-0.10; 0.05], p = 0.498, d = -0.02). Our analyses therefore found no evidence that exposure to information about animal reforms had negative indirect effects via either of these two mediators that might have counteracted the positive indirect effects.

In the above model, compared with the current-farming condition, the effect of being in the welfare-reforms condition was only mediated by increased optimism about further reforms to factory farming (b = 0.05, 95% CI [0.01; 0.10], p = 0.004, d = 0.04). When compared with the control condition, the effect of being in the current-farming condition

was likewise only mediated by increased optimism about further reforms to factory farming (b = 0.04, 95% CI [0.003; 0.08], p = 0.028, d = 0.03).

Intervention effects on intended behaviors

Previous research has focused more directly on whether exposure to information about animal welfare reforms alters individuals' dietary behaviors. A one-way ANOVA on our question for participants' stated likelihood of changing their consumption of animal products over the next month revealed no significant variation among the three conditions, $F(2, 1475) = 0.927$, $p = 0.396$, $\eta^2. = 0.001$. Relatedly, a one-way ANOVA on our scale combining several questions relating to intentions to participate in activism against battery cages (arguably a behavior change of roughly equal demandingness to dietary change) revealed no significant variation, $F(2, 1517) = 2.393$, $p = 0.092$, $\eta^2. = 0.003$.

Intervention effects on support for further animal welfare reforms

It seems plausible that, even if exposure to information about animal welfare reforms does not encourage AFO, it encourages momentum for further (less ambitious) welfare reforms, e.g. a ban on gestation crates for pigs rather than a ban on factory farming as a whole. We found support for this in exploratory analysis. A one-way ANOVA on our scale combining several questions relating to support for further animal welfare reforms revealed significant variation among the three conditions, $F(2, 1517) = 5.284$, $p = 0.005$, $\eta^2. = 0.007$. A post hoc Tukey's HSD test showed significantly higher support in the welfare-reforms condition than the control condition (MD = 0.19, 95% CI [0.004, 0.38], p = 0.044, d = 0.15). There was not significantly higher support in the welfare-reforms

condition than the current-farming condition (MD = -0.05, 95% CI [-0.24, 0.13], p = 0.777, d = -0.04). There was significantly higher support in the current-farming condition than the control condition (MD = 0.25, 95% CI [0.06, 0.44], p = 0.006, d = 0.19).

We re-ran the mediation analysis with support for further animal welfare reforms as the dependent variable. There were a number of significant indirect effects that were not observed in the models using AFO as the dependent variable, although all effect sizes were very small (see Table 3).

Discussion

This study tested the effects of animal welfare reforms, operationalized through an article about transitions from caged to cage-free eggs, on animal farming opposition. While AFO was somewhat higher in the welfare-reforms condition than the control condition, this difference was not significant. AFO was highest in the current-farming condition; here, the difference from the control condition was significant. These results suggest that, when those seeking to improve attitudes towards animals must choose between raising awareness of either current animal farming conditions or some of the changes that are underway to improve those conditions (i.e. animal welfare reforms), they should consider that the former may be somewhat more effective.

Using alternative dependent variables, similar patterns emerged: the scores were least favorable to animals in the control condition and most favorable in the current-farming condition, with the welfare-reforms condition somewhere in the middle. The differences

between the welfare-reforms condition and the other two conditions were not significant for any of these alternative dependent variables, except for support for further animal welfare reforms, which was significantly higher than in the control condition. This latter finding is comparable to the finding from Graça et al. (2020), where exposure to information about one type of ongoing policy change that benefits animals caused an increase in support for similar measures.

The absence of meaningfully large effects of the welfare-reforms condition on AFO and two of the three exploratory dependent variables is surprising in the light of previous studies (Caldwell, 2016; Lusk, 2010; Tonsor & Olynk, 2011). One potential explanation is that our treatment articles focused on a fairly neutral presentation of the issues, whereas more persuasive language (e.g. closer to that used by Caldwell, 2016) may have led to stronger effects. A second possibility is that pretreatment group differences on some demographic variables resulted in a reduced observed effect size.[3] Alternatively, it could simply be that exposure to information about animal welfare reforms tends to have different effects on animal product consumption and AFO. Indeed, although explicit persuasion attempts often cause attitudinal change in the intended direction (O'Keefe, 2015), studies testing specifically whether persuasive messaging can successfully modify attitudes towards animal usage has so far had mixed results (e.g., Braunsberger, 2014; Mathur et al., 2021b). Teasing apart these potential explanations merits further research.

The lack of a strong total effect of reading about welfare reforms is surprising given that the effect of being in the welfare-reforms condition was mediated by increased optimism

about further reforms to factory farming in all tested models and by increased perceived social attitudes towards farmed animals in some models. One possibility is that our study had more power to detect indirect versus total effects (Rucker et al., 2011). Another possibility is that increased exposure to information about animal welfare reforms might also have some negative indirect effects that cancel out the positive indirect effects (Hayes, 2009). Following concerns raised by Francione (2010) and other animal rights advocates, we conducted additional analyses that included hierarchical meat eating justification and beliefs about how well-treated farmed animals are as mediators. Neither of these variables mediated the effect of being in the welfare-reforms condition compared with either the control condition or the current-farming condition. Indeed, we found significantly lower beliefs that farmed animals are treated well in the welfare-reforms condition than the control condition (see supplementary materials). Nevertheless, the negative indirect effect of being in the welfare-reforms condition relative to the current-farming condition via hierarchical meat eating justification only narrowly missed the conventional cutoff for significance ($p = 0.076$) and had a larger effect size ($d = -0.04$) than several of the indirect effects that were found to be significant. Future studies should look further into the effects of hierarchical meat eating justification and other potential mediators that might help to explain the absence of significant total effects.

Of course, reforms can improve the lives of animals directly affected by updated welfare policies, such as by giving egg-laying hens more space to move around and perform natural behaviors like perching (Hartcher & Jones, 2017); animal welfare reforms may be

positive overall for animal welfare even if they have negligible effects on the likelihood of further change in animals' conditions.

The study prioritized internal validity over external generalizability, so changes to the design could lead to different results. For example, different media types can have different persuasive effects (Oskamp & Schultz, 2005, pp. 184-5), and this study has used only one type: short articles written for the experiment. Some of these design decisions may also explain why most of the statistically significant effects were below the conventional threshold for a small effect (Cohen, 1977). These very small effect sizes should be interpreted with caution, but could translate into larger effects in more authentic advocacy contexts.

The study raises additional questions amenable to further testing. Do the findings hold in different contexts (e.g. with respondents outside the US), with different messaging (e.g. more comparable to those that animal advocates would use), and with different formats (e.g. video)? While some advocates regard moderate animal welfare reforms as an end goal in themselves, others explicitly frame them as steps towards the abolition of animal farming; can such variations in framing enhance certain indirect effects and diminish others (e.g. modify perceived social attitudes without increasing hierarchical meat eating justification)?

Conclusions

In the context of high investment in animal welfare reforms but moral and strategic disagreement between advocates about whether such tactics should be employed, this study looked at the effect of learning about animal welfare reforms on animal farming opposition. We found that learning about current animal farming conditions somewhat increased opposition, but found no effect of learning about animal welfare reforms. Given that optimism about further reforms to factory farming and perceived social attitudes towards farmed animals appear to positively mediate the effect of reading about animal welfare reforms on AFO, the lack of meaningful total effects is surprising and could be a fruitful area for further research.

Endnotes

[1] Firstly, participants were asked “Which of the following best describes the topic of the article that you just read?” where the correct answer was either “Traffic jams,” “The situation of farmed chickens,” or “Changes that affect farmed chickens,” while the incorrect answers were “Vacuum cleaners,” “Courses to improve writing skills,” or “Participation in sports and physical activity.” Secondly, an additional question was included amongst the questions about beliefs about how well-treated farmed animals currently are, instructing participants to “Please select "Strongly agree" for this question to confirm you are paying attention.” Sensitivity analyses that instead included all

randomized participants, regardless of whether they passed the attention check item, yielded similar results (see supplementary materials).

[2] Including multiple mediators in the model simultaneously allows estimation of each mediator's indirect effect under the assumption that the mediators do not affect one another (VanderWeele, 2015) and provided that the model uses a collapsible link function, as was the case in our analyses. This assumption appears plausible because we measured the mediators at the same time, although it remains possible that the mediators might have affected one another in rapid succession if, for example, participants revised their perceived social attitudes upon reading about animal welfare reforms, and then these revised social attitudes immediately affected their optimism.

[3] The estimate of the total effect of the welfare-reforms condition from the mediation model (which includes pretreatment demographic controls) increased the effect size to d = 0.15. The total effect of the current-farming condition remained roughly the same at d = 0.17. This suggests that advocacy messages focusing on animal welfare reforms and current farming conditions may be similarly effective. (See supplementary materials.)

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Tables

Table 1: Dependent variables and mediators by intervention condition

	Welfare-reforms condition		Current-farming condition		Control condition	
Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*
1. Animal Farming Opposition	4.45 [4.33, 4.58]	1.41	4.55 [4.43, 4.67]	1.37	4.31 [4.19, 4.44]	1.43
2. Perceived social attitudes towards farmed animals	4.36 [4.25, 4.46]	1.20	4.06 [3.96, 4.17]	1.24	4.07 [3.96, 4.17]	1.22
3. Optimism about further reforms to factory farming	42.69 [40.59, 44.78]	23.84	38.26 [36.16, 40.36]	24.32	36.10 [34.06, 38.14]	23.36
4. Beliefs about how well-treated farmed animals currently are	3.71 [3.58, 3.84]	1.44	3.57 [3.44, 3.69]	1.44	3.95 [3.82, 4.09]	1.51
5. Hierarchical meat eating justification	5.82 [5.63, 6.01]	2.15	5.52 [5.33, 5.71]	2.17	5.63 [5.44, 5.81]	2.13
6. Likelihood of animal product consumption change	4.08 [3.99, 4.17]	1.06	4.15 [4.06, 4.24]	1.01	4.06 [3.97, 4.15]	1.01
7. Intentions to participate in activism against battery cages	4.01 [3.86, 4.15]	1.70	4.10 [3.95, 4.24]	1.66	3.87 [3.72, 4.02]	1.71
8. Support for further animal welfare reforms	5.82 [5.71, 5.93]	1.24	5.87 [5.77, 5.98]	1.22	5.62 [5.51, 5.74]	1.37

Brackets indicate 95% confidence intervals.

Table 2: Results of the confirmatory analyses

	Welfare-reforms condition vs. control condition		Welfare-reforms condition vs. current-farming condition		Current-farming condition vs. control condition	
Variable	Estimate	*d*	Estimate	*d*	Estimate	*d*
Total effect on AFO	0.14 [-0.07, 0.35]	0.10	-0.10 [-0.30, 0.11]	-0.07	0.23* [0.03, 0.44]	0.17
Indirect effects via perceived social attitudes	0.04** [0.01, 0.08]	0.03	0.04** [0.02, 0.07]	0.03	Not tested	
Indirect effects via optimism about further reforms	0.11** [0.06, 0.16]	0.08	0.06** [0.02, 0.11]	0.04	Not tested	

** p < 0.05; ** p < 0.01; brackets indicate 95% confidence intervals.*

Table 3: Results of the exploratory analyses

	Welfare-reforms condition vs. control condition		Welfare-reforms condition vs. current-farming condition		Current-farming condition vs. control condition	
Variable	Estimate	*d*	Estimate	*d*	Estimate	*d*
Indirect effects on AFO via perceived social attitudes	0.01 [-0.02, 0.04]	0.01	0.01 [-0.01, 0.04]	0.01	0.0005 [-0.01, 0.01]	0.0003
Indirect effects on AFO via optimism about further reforms	0.09** [0.04, 0.14]	0.06	0.05** [0.01, 0.10]	0.04	0.04* [0.003, 0.08]	0.03
Indirect effects on AFO via beliefs about how well-treated farmed animals currently are	0.002 [-0.02, 0.02]	0.001	-0.004 [-0.02, 0.005]	-0.003	-0.004 [-0.02, 0.01]	-0.003
Indirect effects on AFO via hierarchical meat eating justification	-0.02 [-0.10, 0.05]	-0.02	-0.06 [-0.13, 0.01]	-0.04	0.04 [-0.03, 0.11]	0.03
Total effect on likelihood of animal product consumption change	0.02 [-0.14, 0.17]	0.02	-0.07 [-0.22, 0.09]	-0.07	0.08 [-0.07, 0.24]	0.08
Total effect on Intentions to participate in activism against battery cages	0.14 [-0.11, 0.39]	0.08	-0.09 [-0.34, 0.16]	-0.05	0.23 [-0.02, 0.48]	0.14
Total effect on support for further animal welfare reforms	0.19* [0.004, 0.38]	0.15	-0.05 [-0.24, 0.13]	-0.04	0.25** [0.06, 0.44]	0.19
Indirect effects on welfare support via perceived social attitudes	0.06** [0.03, 0.10]	0.05	0.06** [0.03, 0.10]	0.05	0.001 [-0.02, 0.02]	0.001
Indirect effects on welfare support via optimism about further reforms	0.06** [0.03, 0.09]	0.04	0.02** [0.01, 0.05]	0.02	0.02* [0.0009, 0.05]	0.02
Indirect effects on welfare support via beliefs about how well-treated farmed	0.04** [0.01, 0.07]	0.03	-0.01 [-0.02, 0.01]	-0.005	0.03* [0.004, 0.05]	0.02

animals currently are						
Indirect effects on welfare support via hierarchical meat eating justification	-0.01 [-0.03, 0.01]	-0.01	-0.03 [-0.06, 0.003]	-0.02	0.01 [-0.01, 0.04]	0.01

** $p < 0.05$; ** $p < 0.01$; brackets indicate 95% confidence intervals.*

Figures

Figure 1: Mediation model testing two mediators of intervention effects on Animal Farming Opposition. This figure does not show the treatment-mediator or mediator-mediator interactions, which were included in the model.