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***Supplement: Interventions to Reduce Meat  
Consumption by Appealing to Animal Welfare:  
Meta-Analysis and Evidence-Based Recommendations***

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## 1. SUPPLEMENTARY METHODS

## 1.1. Details of search process

## 1.1.1 Methods for searching peer-reviewed literature

The search terms used for each database were as follows.

**MEDLINE (Ovid)** (animal welfare/ OR emotions/ OR disgust/ OR fear/ OR guilt/ OR empathy/ OR morals/ OR (emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR cognitive dissonan\* OR meat paradox).ab,ti OR (animal\* adj6 (welfare OR rights OR wellbeing OR well being OR cruel\* OR abuse OR mistreat\*)).ab,ti) AND ((meat\* OR animal product\* OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) adj6 (consum\* OR eat? OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)).ab,ti

**Embase (Elsevier)** ('animal welfare'/exp OR 'emotion'/de OR 'disgust'/de OR 'fear'/de OR 'guilt'/de OR 'empathy'/exp OR 'morality'/exp OR (emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR 'cognitive dissonan\*' OR 'meat paradox'):ab,ti OR (animal\* NEAR/6 (welfare OR rights OR wellbeing OR 'well being' OR cruel\* OR abuse OR mistreat\*)):ab,ti) AND ('meat consumption'/exp OR ((meat\* OR 'animal product\*' OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) NEAR/6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)):ab,ti)

**Web of Science (Clarivate Analytics)** TS=("emotion\*" OR "affective" OR "disgust\*" OR "fear" OR "guilt\*" OR "empath\*" OR "suffer\*" OR "moral\*" OR "ethic\*" OR "humane\*" OR "anthropomorph\*" OR "belief\*" OR "cognitive dissonan\*" OR "meat paradox" OR ("animal\*" NEAR/6 ("welfare" OR "rights" OR "wellbeing" OR "well being" OR "cruel\*" OR "abuse" OR "mistreat\*"))) AND TS=(("meat\*" OR "animal product\*" OR "beef" OR "veal" OR "lamb" OR "pork" OR "poultry" OR "chicken" OR "turkey" OR "pig" OR "cow" OR "sheep") NEAR/6 ("consum\*" OR "eat" OR "eats" OR "eating" OR "ate" OR "intak\*" OR "purchas\*" OR "buy\*" OR "demand\*" OR "choos\*" OR "choice\*" OR "avoid\*" OR "prefer\*"))

**PsycINFO (EBSCO)** (DE ("Animal Welfare" OR "Animal Cruelty" OR "Animal Rights" OR "Emotional Content" OR "Emotional Responses" OR "Emotions" OR "Disgust" OR

"Fear" OR "Guilt" OR "Empathy" OR "Morality" OR "Cognitive Dissonance") OR TI (emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* N6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))) OR AB (emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* N6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))) AND (TI ((meat\* OR "animal product\*" OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) N6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)) OR AB ((meat\* OR "animal product\*" OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) N6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)))

**CAB Abstracts (Clarivate Analytics)** TS=("emotion\*" OR "affective" OR "disgust\*" OR "fear" OR "guilt\*" OR "empath\*" OR "suffer\*" OR "moral\*" OR "ethic\*" OR "humane\*" OR "anthropomorph\*" OR "belief\*" OR "cognitive dissonan\*" OR "meat paradox" OR ("animal\*" NEAR/6 ("welfare" OR "rights" OR "wellbeing" OR "well being" OR "cruel\*" OR "abuse" OR "mistreat\*"))) AND TS= (("meat\*" OR "animal product\*" OR "beef" OR "veal" OR "lamb" OR "pork" OR "poultry" OR "chicken" OR "turkey" OR "pig" OR "cow" OR "sheep") NEAR/6 ("consum\*" OR "eat" OR "eats" OR "eating" OR "ate" OR "intak\*" OR "purchas\*" OR "buy\*" OR "demand\*" OR "choos\*" OR "choice\*" OR "avoid\*" OR "prefer\*"))

**Sociological Abstracts (ProQuest)** (SU.EXACT("Animal Human Relations" OR "Emotions" OR "Guilt" OR "Fear" OR "Empathy" OR "Morality" OR "Moral Judgement" OR "Cognitive Dissonance") OR TI(emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* NEAR/6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))) OR AB(emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* NEAR/6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))) AND ((meat\* OR "animal product\*" OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) NEAR/6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*))

**ProQuest Dissertations and Theses (ProQuest)** noft((((meat\* OR "animal product\*" OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) NEAR/6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR

buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)) AND noft((emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* NEAR/6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))))))

**PolicyFile (ProQuest)** (((meat\* OR "animal product\*" OR beef OR veal OR lamb OR pork OR poultry OR chicken OR turkey OR pig OR cow OR sheep) NEAR/6 (consum\* OR eat OR eats OR eating OR ate OR intak\* OR purchas\* OR buy\* OR demand\* OR choos\* OR choice\* OR avoid\* OR prefer\*)) AND noft((emotion\* OR affective OR disgust\* OR fear OR guilt\* OR empath\* OR suffer\* OR moral\* OR ethic\* OR humane\* OR anthropomorph\* OR belief\* OR "cognitive dissonan\*" OR "meat paradox" OR (animal\* NEAR/6 (welfare OR rights OR wellbeing OR "well being" OR cruel\* OR abuse OR mistreat\*))))))

### 1.1.2 Methods for searching grey literature

The grey literature search proceeded in three stages. First, existing resources compiling relevant literature were screened; second, the websites of relevant nonprofits were searched and results screened; and, third, a bibliography of the literature discovered in the first two phases was posted to relevant forums in the animal advocacy research community to solicit more studies. Because titles and abstracts were often unavailable or uninformative in the non-academic grey literature and to simplify communication in the third stage of the search, studies were title and abstract screened to meet only the outcome and design inclusion criteria but with any intervention. All studies passing this broader screening then underwent the same full-text screening by two independent reviewers as used for the peer-reviewed literature.

**Existing resources** The Humane League Labs' existing database of 781 items was first title and abstract screened and identified studies added to full text screening. This database was generated incidentally through the daily work of three researchers at The Humane League Labs. Researchers added items on a variety of topics as needed during the course of their normal research activities spanning 34 person-months. Next, a variety of other sources known to the author were screened: the background sections from a thorough online report<sup>16</sup>, the relevant sections of a popular book<sup>9</sup>, the proceedings of two conferences<sup>2,3</sup>, an existing meta-analysis<sup>13</sup>, a data repository<sup>6</sup>, and a website aggregating societally impactful dissertations and theses<sup>1</sup>.

**Websites of nonprofits** A list of animal advocacy and other relevant nonprofits was generated via a snowball sample from author JP's existing database and professional contacts. This process identified 24 organizations for screening, listed in Table S1. The websites of each organization, when available, were first manually searched for relevant sections

describing research results, and, if such a section were not found, searched for the keywords “study”, “research”, “survey” and “evaluation”. In some cases, individuals at the nonprofit were contacted to solicit additional studies.

**Table S1:** *Websites of nonprofits searched for grey literature*

Organization	URL
Albert Schweitzer	<a href="https://albertschweitzerfoundation.org/">https://albertschweitzerfoundation.org/</a>
Anima	<a href="https://anima.dk/">https://anima.dk/</a>
Animal Aid	<a href="https://www.animalaid.org.uk">https://www.animalaid.org.uk</a>
Animal Charity Evaluators	<a href="https://animalcharityevaluators.org/">https://animalcharityevaluators.org/</a>
Animal Equality	<a href="https://animalequality.org/">https://animalequality.org/</a>
Animal Liberation	<a href="https://www.al.org.au/">https://www.al.org.au/</a>
Animal Welfare Action Lab	<a href="http://www.awalab.org/blog/">http://www.awalab.org/blog/</a>
Animals Australia	<a href="https://www.animalsaustralia.org/">https://www.animalsaustralia.org/</a>
Better Buying Lab	<a href="https://www.wri.org/our-work/project/better-buying-lab/research-and-resources">https://www.wri.org/our-work/project/better-buying-lab/research-and-resources</a>
Farm Sanctuary	<a href="https://www.farmsanctuary.org/">https://www.farmsanctuary.org/</a>
Farm Sanctuary Compassionate Communities Campaign	<a href="https://ccc.farmsanctuary.org/">https://ccc.farmsanctuary.org/</a>
Farmed Animal Rights Movement	<a href="https://farmusa.org/">https://farmusa.org/</a>
Faunalytics	<a href="https://faunalytics.org/completed-projects/">https://faunalytics.org/completed-projects/</a>
Friends of the Earth	<a href="https://foe.org/">https://foe.org/</a>
Humane Society of the United States	<a href="https://www.humanesociety.org/">https://www.humanesociety.org/</a>
Johns Hopkins Center for a Livable Future	<a href="https://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-a-livable-future/research/clf_publications/">https://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-a-livable-future/research/clf_publications/</a>
L214	<a href="https://www.l214.com/">https://www.l214.com/</a>
Meatless Monday	<a href="https://www.meatlessmonday.com/research/">https://www.meatlessmonday.com/research/</a>
Mercy for Animals	<a href="https://mercyforanimals.org/research">https://mercyforanimals.org/research</a>
One Step for Animals	<a href="https://www.onestepforanimals.org/">https://www.onestepforanimals.org/</a>
Pro Veg Netherlands/Viva Las Vega’s	None
The Humane League Labs	<a href="https://thehumaneleague.org/labs">https://thehumaneleague.org/labs</a>
Vegan Outreach	<a href="https://veganoutreach.org/">https://veganoutreach.org/</a>
Veganuary	<a href="https://veganuary.com/">https://veganuary.com/</a>

**Distribution of bibliography and snowball sampling** Finally, a working bibliography of studies identified during the first two stages of the grey literature search was distributed to various forums used in the animal advocacy community on November 20, 2019, which represents the last day of active searching. The bibliography was distributed in an interactive format, using Google Docs, so the community could add missing studies or otherwise comment directly on the document. In particular, the bibliography was distributed to the Farm Animal

Strategic Team (FAST) email list; PBCM (plant-based clean/cultured/cultivated meat) Consumer Research Collaborative group, hosted on the instant messaging platform Slack; the “Effective Animal Advocacy – Discussion” and “Helping Animals Effectively (Closed)” discussion groups hosted on the social media website Facebook; and several other experts in the field.

## 1.2. Details of data extraction

### 1.2.1 Qualitative data extraction

We extracted the following basic characteristics for each study. Names in `monospace` represent variable names in the online dataset.

1. `unique`: A unique identifier (author, year, and substudy if applicable)
2. `authoryear`: The first author’s last name and study year, used as a shorthand identifier
3. `substudy`: A name or number identifying the study within the article if the article had multiple studies
4. `title`: The article’s title
5. `journal` and `other.source`: Journal or non-peer-reviewed source (e.g., technical report)
6. `published`: An indicator for whether the study was published in a peer-reviewed journal or conference proceedings
7. `borderline`: Whether the study’s eligibility was borderline with respect to inclusion criteria
8. `exclude.main`: Whether the study was a SSWS study
9. `stats.source`: How we extracted statistical estimates (from the paper, from publicly available data, or from contacting authors)
10. `prose.population`: The subject population and recruitment strategy
11. `country`: The country in which the study was conducted
12. `n.paper`: The total analyzed number of unique subjects analyzed in the article (rather than the study)
13. `perc.male`: The percentage of male subjects
14. `age`: Subjects’ mean or median age. When only a range was reported (e.g., “18-35”), we used the midpoint. When the age breakdown was reported by categories (e.g., “<18”, “18-30”, “>30”), we estimated the mean age by taking the midpoint of each category (or the minimum of the category in cases such as “>30”) and taking a weighted average by the categories’ frequencies. When a study recruited only undergraduates and did not report any numerical age statistics, we imputed a mean age of 22 years.
15. `students`: Subjects’ status as college undergraduates. “No”: the study did not specifically restrict recruitment to undergraduates (though the sample may have contained undergraduates). “General undergraduates”: the study recruited undergraduates generally rather than from a particular major. “Social sciences undergraduates”: undergraduates recruited specifically from social sciences majors. When a study recruited undergrad-

- uates but did not indicate that they were specifically social sciences undergraduates, we coded as “general undergraduates”. When a study recruited participants from a college or university in a manner that might have included faculty and staff, we coded as “mixed”. When a study recruited subjects using an online crowdsourcing platform, did not specifically state that recruitment targeted undergraduates, and had a higher mean age than is typical for undergraduates (e.g., 35 years), we coded as “no”.
16. `prose.x`: A prose description of the intervention
  17. `prose.control`: A prose description of the control group or time period
  18. `x.tailored`: Whether the intervention was personally tailored (i.e., its content varied depending on subjects’ individual characteristics, such as their current diets)
  19. `x.has.text`: Whether the intervention contained text
  20. `x.has.visuals`: Whether the intervention contained visuals (e.g., photographs, cartoons, or videos)
  21. `x.suffer`: Whether the intervention contained graphic verbal or visual depictions of factory farm conditions
  22. `x.pure.animals`: Whether the intervention referred only to animal welfare (i.e., it did not make appeals for reduced meat consumption that were not related to animal welfare)
  23. `x.min.exposed`: The estimated total duration of the intervention in minutes, excluding any optional components of the intervention. For interventions involving multiple components, the duration included time during which the subject was actively engaged with components of the intervention and did not include time elapsed between components of the intervention.
  24. `x.rec`: The recommendation made regarding meat consumption (“go vegan”, “go vegetarian”, “reduce consumption”, mixed recommendation, or no recommendation)
  25. `x.mind.attr`: Whether the intervention used mind attribution by describing farm animal’s inner states; see Table S2
  26. `x.soc.norm`: Whether the intervention used social norms (e.g., explicitly describing trends toward decreased meat consumption or describing a group of individuals who do not eat meat); see Table S2
  27. `x.id.victim`: Whether the intervention used the identifiable victim effect by giving a proper-noun name to a farm animal; see Table S2
  28. `x.impl`: Whether the intervention gave implementation suggestions in the form of describing or depicting a specific plant-based meal, restaurant dish, or recipe; see Table S2
  29. `x.pets`: Whether the intervention described or depicted companion animals that typically live in people’s houses, with or without an explicit connection to farm animals; see Table S2
  30. `y.cat`: Whether the outcome related to meat consumption or meat purchase
  31. `y.lag.days`: The number of days elapsed between the end of the intervention and the outcome measurement
  32. `y.other.eligible.foods`: Whether the study measured and reported eligible food outcomes besides the one we extracted based on the rules given in the main text. As described in the main text, these were almost always subscales of a composite that was used as the main outcome. This only includes only other eligible *food* outcomes, not

other eligible modes of measuring the outcome (e.g., intentions versus self-reports).

33. `prose.y.other.eligible`: A prose description of any other eligible food outcomes besides the one we extracted

Because the fine-grained intervention characteristics (i.e., `x.mind.attr`, `x.soc.norm`, `x.id.victim`, `x.impl`, and `x.pets`) were more subjective than the other study and intervention characteristics, two authors (DBR and MBM) independently rated them for each study using a standardized set of criteria (Table S2), resolving conflicts through discussion. We assessed interrater reliability using Cohen’s  $\kappa$ , removing “unclear” ratings.<sup>8</sup> The  $\kappa$  estimates were 0.85 for using mind attribution, 0.87 for using social norms, 0.97 for naming an identified victim, 0.95 for giving implementation suggestions, and 0.92 for depicting pets.

We extracted the following characteristics regarding study design, analytic reproducibility, and risks of bias:

1. `design`: The study design (e.g., randomized controlled trial, cluster-randomized controlled trial, nonrandomized controlled trial)
2. `qual.y.prox`: The mode of outcome measurement (direct behavioral measure, self-reported behavior, or intended future behavior)
3. `qual.missing`: The percentage of missing data, calculated as the percentage of subjects who received the intervention or control who did *not* contribute data to our extracted point estimate. For example, for studies in which the intervention involved distributing leaflets on a college campus, the percentage of missing data was coded as the number of subjects providing outcome data divided by the number of leaflets distributed. For studies in which the outcome was measured in the same session as the intervention, we assumed there was no missing data if this information was not reported.
4. `qual.prereg`: Whether the study’s protocol and/or analysis plan were preregistered in any form
5. `qual.public.data`: Whether the study’s data are publicly available
6. `qual.public.code`: Whether the study’s analysis code is publicly available
7. `qual.exch`: The study’s risk of bias with respect to the exchangeability of the intervention and control conditions (low risk, medium risk, high risk, or unclear; see Table S3)
8. `qual.gen`: The study’s risk of bias with respect to external generalizability (low risk, medium risk, high risk, or unclear; see Table S3)
9. `qual.sdb`: The study’s risk of bias with respect to social desirability bias (low risk, medium risk, high risk, or unclear; see Table S3)

To develop this list of risk-of-bias criteria, we adapted from the Cochrane Risk of Bias Tool for randomized studies<sup>15</sup> those criteria that were relevant to the present literature (e.g., criteria related to selection bias, attrition bias, and reporting bias), removed some criteria that were not relevant or feasible for this literature (e.g., regarding blinding), and expanded the generic category “Other bias” into criteria of particular relevance to this literature (e.g., regarding the quality of outcome measurement and the potential for social desirability bias). We adapted the existing items in order, for example, to allow assessment of the stated type of bias in the



diverse study designs that we expected to encounter. To develop the tool, a group of authors (MBM, JP, DBR, JN) read studies known to meet eligibility criteria and, based on their combined expertise in meta-analysis methodology and in research on interventions to reduce meat consumption, developed the risk of bias tool through discussion, piloting on eligible studies, and iterative revision. To extract these qualitative data, one author (MBM or DBR) extracted data for each study, emailing study authors as needed to fill in missing information. The other author confirmed the entries. For three risk-of-bias criteria that were somewhat subjective and difficult to assess (exchangeability, avoidance of social desirability bias, and external generalizability), two authors (among DBR, JN, and MBM) independently rated the article using a standardized set of criteria (Table S3), resolving conflicts through discussion or adjudication by another author. We assessed interrater reliability using a weighted Cohen's  $\kappa$  to accommodate the ordinal nature of the ratings, again removing "unclear" ratings.<sup>8</sup> Because the three raters rated only partly overlapping subsets of studies, we calculated  $\kappa$  for each of the three pairs of raters. The mean  $\kappa$  was 0.27 for social desirability bias, 0.18 for external generalizability, and 0.21 for exchangeability.

We extracted the following statistical information:

1. `effect.measure`: The scale of the initial point estimate  $y_i$  and variance  $v_i$  (standardized mean difference or risk ratio) prior to any needed conversion to the risk ratio scale
2. `desired.direction`: Whether the point estimate was in the desired direction (i.e., reducing rather than increasing meat consumption or purchase)
3. `y_i`: The point estimate on the scale described above after synchronizing estimate directions using `desired.direction`
4. `v_i`: The variance estimate on the scale described above
5. `interpretation`: A prose interpretation of the extracted estimate prior to conversion to the log-risk ratio scale
6. `logRR`: The point estimate converted (if needed) to the log-risk ratio scale; **this was the estimate used in meta-analysis**
7. `varlogRR`: The variance estimate converted (if needed) to the log-risk ratio scale; **this was the estimate used in meta-analysis**
8. `RR.lo`: The lower limit of a 95% confidence interval for the estimate on the risk ratio for use in the forest plot
9. `RR.hi`: The upper limit of a 95% confidence interval for the estimate on the risk ratio for use in the forest plot

Table S2: Guidelines provided to reviewers for assessing fine-grained intervention characteristics

Rating	Mind attribution	Social norms	Identifiable victim	Implementation suggestions	Pets
<b>Yes (1)</b>	Describing any inner state of farm animals (including in the first person), including cognitive, affective, or social capacities. For example, references to “terrified cows”, “pain”, or “suffering” would all count.	Explicitly describing social norms in favor of reducing meat or animal product consumption, such as by saying that: (1) others are reducing, want to reduce, or intend to reduce, meat or animal product consumption (i.e., a description of trends); (2) many people eat little or no meat or animal products (i.e., a description of static norms). Norms regarding only a specific population count (e.g., “many college students are trying to eat less chicken”).	Giving a proper-noun name to at least one farm animal (e.g., “Betty”)	Mentioning or visually portraying at least one specific vegetarian meal, food, or restaurant dish.	Mentioning or visually portraying at least one companion animal that typically lives in people’s houses. The portrayal does not have to directly connect the companion animal to farm animals (e.g., showing a photo of a dog anywhere in an eligible intervention counts).
<b>No (0)</b>	Describing only outwardly observable behaviors (e.g., “squealing”, “struggling”, etc.) does not count, even when these behaviors seem indicative of an inner experience. A farm animal talking in the first person, but not referring to cognitive, affective, or social experiences, does not count (e.g., “Hello, I’m a dairy cow”).	Saying that others are increasing consumption or eating a lot of meat (e.g., “global meat consumption is rising” or “the average American eats X amount of meat”) does not count. Portraying case studies or testimonials from specific people or celebrities without an explicit mention of social norms as above does not count.	Not doing the above	Mentioning only meat dishes or foods (e.g., “you could start by cutting out chicken”) without mentioning a replacement does not count. Note that many other types of implementation suggestions are possible in practice, such as mentioning the names of restaurants or giving tips about how to track foods eaten, but for simplicity and objectivity we are focusing only on specific meals as described above.	Not doing the above

*\*If you cannot tell whether the intervention contains the component or not (e.g., because we don’t have access to the full contents), write “Unclear”. For the few studies that analyzed multiple interventions in aggregate, rate “1” if at least one of them contains the component and “0” if none contains the component.*

**Table S3:** Guidelines provided to reviewers for assessing subjective risk-of-bias criteria

<b>Risk of bias</b>	<b>Exchangeability</b>	<b>Avoidance of social desirability bias</b>	<b>External generalizability</b>
<b>Low risk</b>	The study is randomized with negligible dropout ( $< 10\%$ ).	(1) Subjects are likely unaware that the intervention is deliberate (e.g., because the intervention was subtly embedded in a decoy task about a topic unrelated to meat consumption); or (2) subjects are likely unaware that the outcome measurement is related to the intervention (e.g., outcomes were measured in a separate survey by a separate mode of recruitment).	The study recruited subjects from a well-defined sampling frame that did not select for pre-existing interests in animal welfare or meat consumption reduction or closely related characteristics. Examples include panel samples, samples recruited on Mechanical Turk with vague recruitment text, etc.
<b>Medium risk</b>	(1) The study is observational with strong control of confounding; or (2) the study is randomized with non-negligible dropout ( $\geq 10\%$ ), but the article presents analyses suggesting dropout was nondifferential across treatment groups or seemed not to affect results.	Subjects are likely aware that the intervention is deliberate and that outcome measurement is connected to the intervention, but the researchers made efforts to limit these biases, or they conducted analyses suggesting these biases were not large.	Situations between these two extremes, including those collected on college/university samples.
<b>High risk</b>	(1) The study is observational with poor confounding control; or (2) the study is randomized with evidence for differential and non-negligible dropout.	Subjects are likely aware that the intervention is deliberate and that outcome measurement is connected to the intervention, and no efforts or analyses to limit bias are apparent in the article.	The study specifically recruited subjects with pre-existing interests in animal welfare or meat consumption reduction (e.g., by using recruitment text related to these topics).

*\*If unclear, put the study in the weaker of the two categories you are torn between. If you really cannot tell at all, mark as "Unclear" as a last resort.*

### 1.2.2 Quantitative data extraction

To ensure that point estimates were statistically and conceptually comparable across studies, we extracted, when feasible, point estimates for each study that represented the risk ratio of “low” versus “high” meat consumption or purchase as follows. For studies reporting sufficient information or with raw data available, we defined “low” and “high” relative to the median consumption or purchasing outcome in the control condition or time period (e.g., “high” consumption for a two-group randomized trial would be defined as consumption higher than the median consumption in the control group). For studies with outcomes measured before the intervention, we used the baseline median in all subjects regardless of intervention group. Dichotomizing at the median, rather than at a more extreme value, improves statistical precision.

When raw data were available, we estimated risk ratios as follows. For studies with a single wave of data collection after the intervention, we simply estimated a marginal risk ratio for low vs. high consumption. For studies with baseline outcome measures available, we controlled for these measures by estimated the conditional risk ratio via Poisson, using<sup>27</sup>’s heteroskedasticity-consistent standard error estimator<sup>20</sup>. Controlling for baseline outcome measures increases statistical precision and helps control for confounding. For studies that used a within-subjects design without a separate control group, we calculated matched-pairs risk ratios per<sup>28</sup> using the R package `metafor`<sup>26</sup>.

Directly estimating the risk ratio for low versus high consumption as defined above was sometimes not feasible when data were not available. In this case, if the study reported a binary outcome corresponding conceptually to “low” versus “high” meat consumption (e.g., being vegetarian vs. not being vegetarian; or reducing meat consumption from one’s previous consumption versus maintaining or increasing consumption), we extracted the corresponding risk ratio. If instead the study reported a continuous outcome (e.g., servings of meat consumed), we calculated a point estimate on the standardized mean difference scale and then approximately converted the estimate to the risk ratio scale as follows. Letting  $d$  denote a standardized mean difference, the approximate odds ratio arising from dichotomizing the (approximately logistically distributed) outcome at an arbitrary cut point is  $\log OR \approx \pi d / \sqrt{3}$ <sup>14</sup>. If we assume the cut point is chosen to be near the median of the continuous outcome, in keeping with the convention we used when calculating risk ratios directly, then the odds ratio is anticonservative for the risk ratio but can be approximately converted via the transformation  $\log RR \approx \log \sqrt{\exp\{\log OR\}}$ <sup>22</sup>. We therefore have  $\log RR \approx \log \left( \sqrt{\exp\{\pi d / \sqrt{3}\}} \right)$  and, by the delta method,  $\text{Var}(\log RR) \approx (\pi^2 / 12) \text{Var}(d)$ .

For one study that reported a point-biserial correlation<sup>12</sup>, we approximated the variance as  $\text{Var}(r_{pb}) \approx (1 - r_{pb}^2)^2 / (n_1 + n_0 - 1)$ , where  $r_{pb}$  is the point-biserial correlation and  $n_0$  and  $n_1$  are the sample sizes in each exposure group<sup>17</sup>. We converted to the standardized mean

difference scale per reference<sup>17</sup>:

$$d \approx \frac{r_{pb}\sqrt{h}}{\sqrt{1 - r_{pb}^2}}$$

where  $h = \frac{n_1+n_0-2}{n_1} + \frac{n_1+n_0-2}{n_0}$ . We again used the delta method to convert the variance. We then converted these measures on the standardized mean difference to the log-risk ratio scale as above.

### 1.3. Details of sensitivity analysis for social desirability bias

To conduct the sensitivity analyses for social desirability bias across studies, we first used a nonparametric method that conducts a grid search across hypothetical values of bias severity across studies, in which bias severity is operationalized as the multiplicative factor by which bias has inflated each study's point estimate away from the null.<sup>19</sup> We conducted a separate grid search for each of the two sensitivity analyses (regarding bias required to shift the estimate to the null and to reduce to only 10% the percentage of true population effects stronger than  $RR = 1.1$ ); we obtained confidence intervals using bias-corrected and accelerated bootstrapping.<sup>19</sup> Those methods in fact apply for any type of internal bias that affects estimates multiplicatively and whose severity is independent of the studies' causal (i.e., unbiased) population effects. The multiplicative bias that can be produced by differential measurement of the outcome is, at maximum, equal to the strength of the direct effect of the exposure on the mismeasured outcome, not through the correctly measured outcome.<sup>23</sup> Given the conception of social desirability bias given in the main text, it follows immediately that the severity of social desirability bias required to produce any given multiplicative bias factor is simply equal to the bias factor itself.

## 2. SUPPLEMENTARY RESULTS

### 2.1. Reference lists of included articles

#### 2.1.1 Articles included in main analysis

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(<http://www.humaneleaguelabs.org/static/reports/E006R01-which-request-create-sthe-most-diet-change.pdf>)

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Schnabelrauch Arndt, C. A. (2016). *Tailoring feedback and messages to encourage meat consumption reduction* (Unpublished doctoral dissertation). Kansas State University. (<https://krex.k-state.edu/dspace/handle/2097/32159>)

Schwitzgebel, E., Cokelet, B., & Singer, P. (2019, July). Ethics classes can influence student behavior: Students purchase less meat after discussing arguments for vegetarianism. *The Splintered Mind*. (<http://schwitzsplinters.blogspot.com/2019/07/ethics-classes-can-influence-student.html>)

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### 2.1.2 Articles reporting on SSWS studies

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Faunalytics. (2016, March). *Veganuary 2016: 6-month survey results* (Tech. Rep.). Veganuary. (<https://animalcharityevaluators.org/wp-content/uploads/2016/11/Veganuary-results-six-month-follow-up-2016.pdf>)

Faunalytics. (2019, June). *Challenge 22+ pilot impact study* (Tech. Rep.). Faunalytics. (<https://faunalytics.org/challenge-22-pilot-impact-study/>)



Grassian, T. (2019, March). *Meat reduction vegan promotion* (Tech.Rep.). For Us All (Blog). (<https://forusallsite.files.wordpress.com/2019/03/grassian-reductionandveganpromotion-v2.pdf>)

Mensink, R. (2017). *Becoming vegan. factors influencing reduction of meat and dairy consumption by participants of the VeggieChallenge* (Bachelor thesis). Utrecht University, Netherlands. (<https://osf.io/b3xzs>)

Moleman, P. (2018, March). *Impact evaluation of 30-day VeggieChallenge, 2017* (Tech. Rep.). Viva las Vega's (Proveg). (<https://osf.io/q62uk>)

Vegan Outreach. (2019, July). *Impact of 10 Weeks to Vegan* (Tech. Rep.). (<https://veganoutreach.org/10wimpact/>)

## 2.2. Supplementary tables

**Table S4:** *Articles from which we could not extract statistics for inclusion in the meta-analysis. ID: First author's last name for published studies or name of challenge (organization) for unpublished studies. SSWS: indicator for whether the study was a self-selected within-subjects study and hence would have been omitted from main analyses even if statistics had been available.*

ID	Year	SSWS	Results reported
de Lanauze <sup>10</sup>	2019	No	In the intervention group, motivations to reduce meat consumption increased from 4.08 on a 7-point Likert scale before the intervention to 4.15 after the intervention ( $p = 0.70$ ). In the control group, motivations decreased from 4.12 to 3.81 ( $p = 0.37$ ).
Dowsett <sup>11</sup>	2018	No	None relevant. The eligible outcome measure was a free-text response to "Will you continue eating meat with the same regularity?" that was not coded quantitatively.
Summer Vegan Pledge (Animal Aid) <sup>4</sup>	2019	Yes	57% of subjects intended to stay vegan after the challenge. 35% of subjects reported reducing their animal product consumption.
Summer Vegan Pledge (Animal Aid) <sup>7</sup>	2018	Yes	53% of subjects reported staying vegan after 6 months.
Veganuary (Veganuary) <sup>25</sup>	2019	Yes	47% of subjects intended to stay vegan after the challenge.
Veganuary (Veganuary) <sup>21</sup>	2018	Yes	62% of subjects intended to stay vegan after the challenge.
Veganuary (Veganuary) <sup>24</sup>	2017	Yes	67% of subjects intended to stay vegan after the challenge.

**Table S5:** *Pairwise Pearson’s correlations ( $r$ ) between meta-regressive covariates among studies with pairwise complete data, displayed in descending order of correlation. The categorical variable regarding the type of recommendation made is dichotomized here as “making any request” versus “making no request” for brevity.*

Variable 1	Variable 2	$r$
Social norms	Implementation suggestions	0.82
Pets	Implementation suggestions	0.82
Implementation suggestions	Follow-up $\geq 7$ days	0.81
Pets	Follow-up $\geq 7$ days	0.75
Social norms	Follow-up $\geq 7$ days	0.74
Intervention $> 5$ min	Follow-up $\geq 7$ days	0.66
Social norms	Pets	0.64
Social norms	Makes request	0.61
Implementation suggestions	Makes request	0.57
Visuals	Follow-up $\geq 7$ days	0.56
Visuals	Implementation suggestions	0.55
Pets	Makes request	0.54
Makes request	Follow-up $\geq 7$ days	0.54
Visuals	Pets	0.53
Pets	Intervention $> 5$ min	0.53
ID victim	Pets	0.53
Mind attribution	Follow-up $\geq 7$ days	0.52
Graphic	Mind attribution	0.52
Text	Mind attribution	0.52
Graphic	Social norms	0.51
ID victim	Intervention $> 5$ min	0.50
Implementation suggestions	Intervention $> 5$ min	0.47
Mind attribution	Makes request	0.47
Visuals	Social norms	0.46
Mind attribution	Social norms	0.46
Mind attribution	Pets	0.43
Visuals	Intervention $> 5$ min	0.42
Graphic	Implementation suggestions	0.42
Mind attribution	Implementation suggestions	0.41
Social norms	Intervention $> 5$ min	0.40
Text	Graphic	0.40
Text	Makes request	0.40
Male	Age	0.40
ID victim	Follow-up $\geq 7$ days	0.37
Mind attribution	ID victim	0.36
ID victim	Implementation suggestions	0.36
Social norms	ID victim	0.33
Graphic	Follow-up $\geq 7$ days	0.33
Graphic	ID victim	0.28

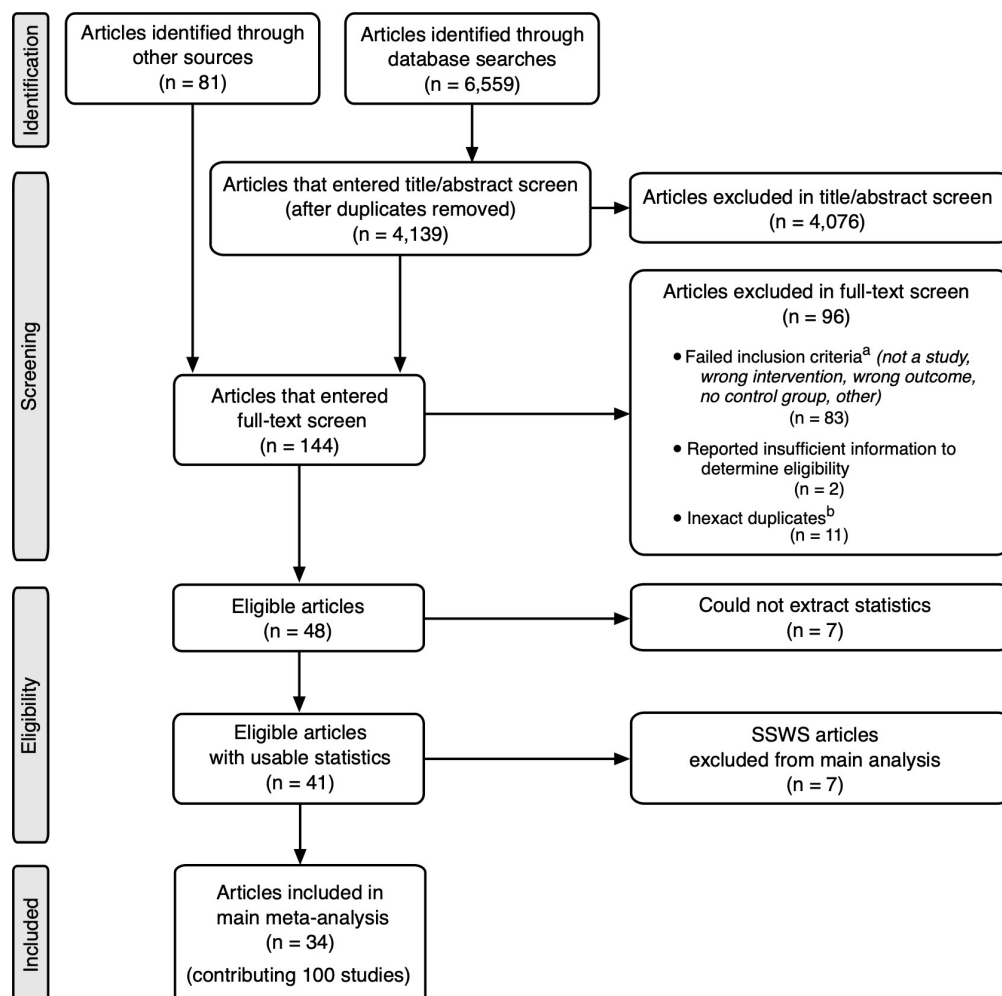
Supplement

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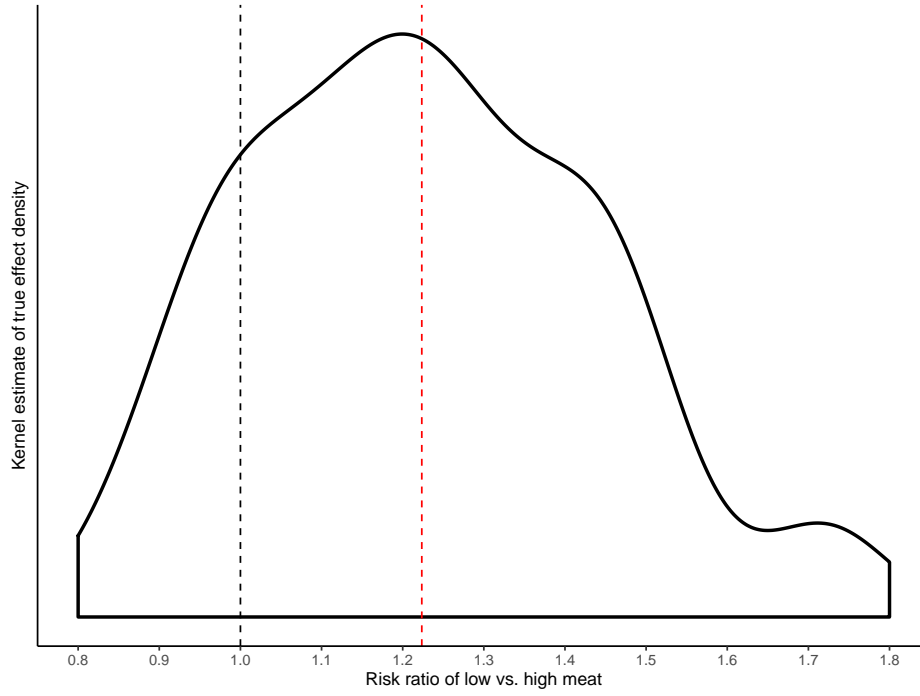
Text	Social norms	0.27
Graphic	Pets	0.26
Graphic	Male	0.25
Makes request	Intervention >5 min	0.23
Mind attribution	Intervention >5 min	0.22
Text	Implementation suggestions	0.20
Graphic	Makes request	0.19
Visuals	ID victim	0.18
Mind attribution	Male	0.17
ID victim	Makes request	0.17
Visuals	Makes request	0.17
Text	Pets	0.15
Text	ID victim	0.14
Text	Follow-up $\geq 7$ days	0.13
Graphic	Intervention >5 min	0.13
Text	Male	0.11
Visuals	Mind attribution	0.10
Text	Age	0.07
Text	Intervention >5 min	0.06
Social norms	Male	0.03
Visuals	Graphic	0.02
ID victim	Age	-0.03
Implementation suggestions	Male	-0.03
ID victim	Male	-0.05
Graphic	Age	-0.10
Makes request	Male	-0.13
Pets	Male	-0.19
Mind attribution	Age	-0.25
Makes request	Age	-0.26
Text	Visuals	-0.32
Follow-up $\geq 7$ days	Male	-0.34
Visuals	Male	-0.36
Social norms	Age	-0.38
Intervention >5 min	Age	-0.46
Intervention >5 min	Male	-0.48
Visuals	Age	-0.51
Pets	Age	-0.56
Implementation suggestions	Age	-0.61
Follow-up $\geq 7$ days	Age	-0.65

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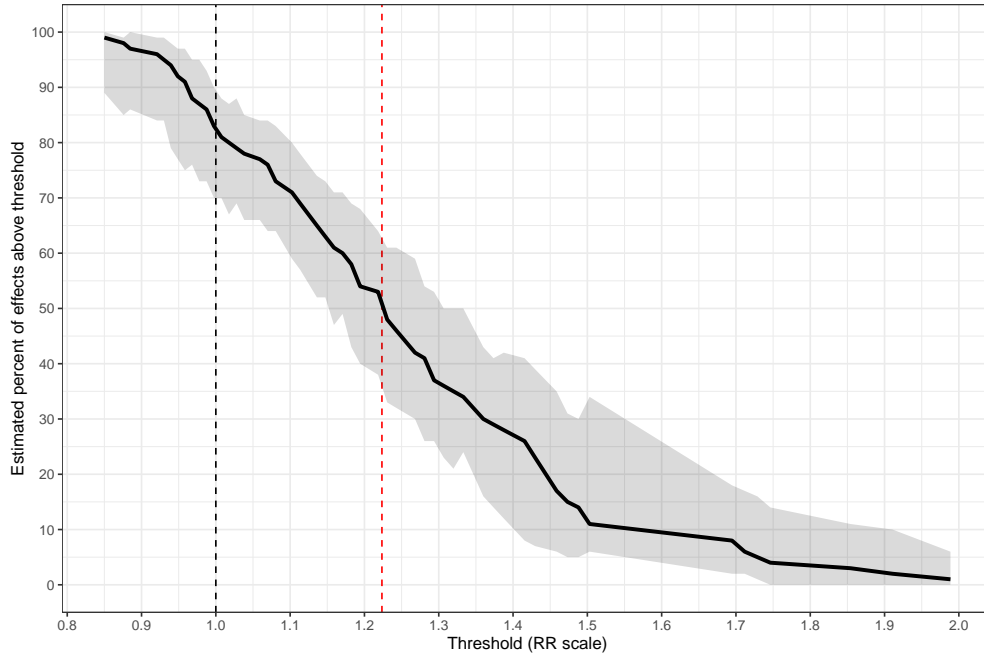
## 2.3. Supplementary figures



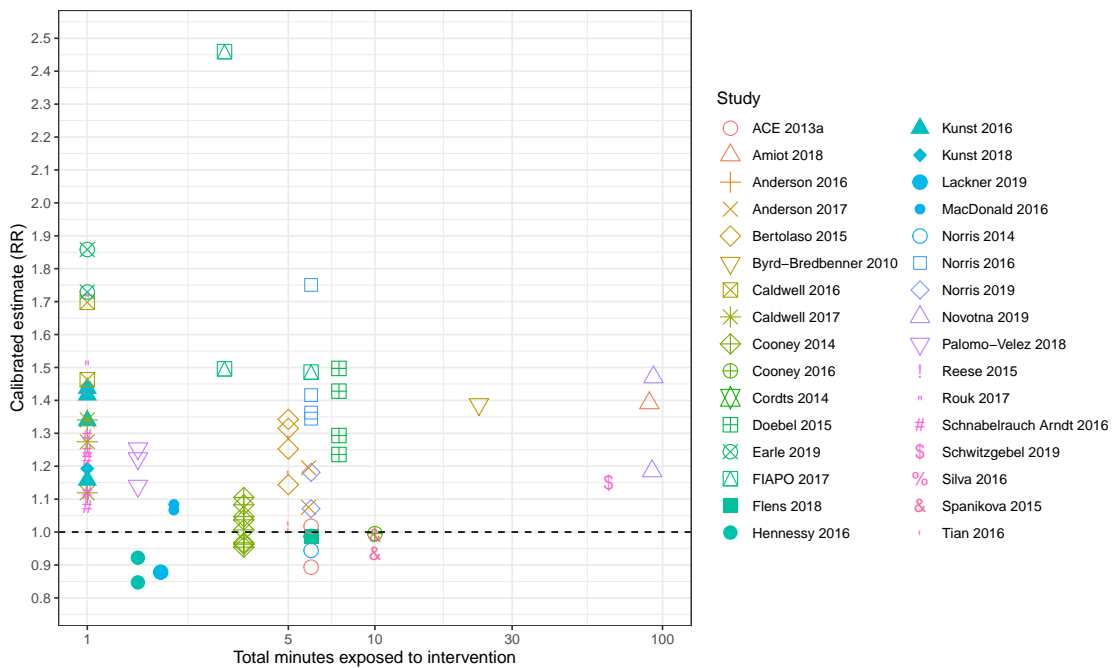
**Figure S1:** PRISMA flowchart depicting article screening, inclusion, and exclusion decisions. <sup>a</sup>: Listed reasons are shorthand for the criteria in the main text, which reviewers could view when screening articles. SSWS: self-selected within-subjects studies, as defined in the main text. <sup>b</sup>: Inexact duplicates are distinct articles referring to the same data, such as an initial report and a re-analysis of the same data. Identifying such articles was possible only upon full-text screening and comparison across screened articles.



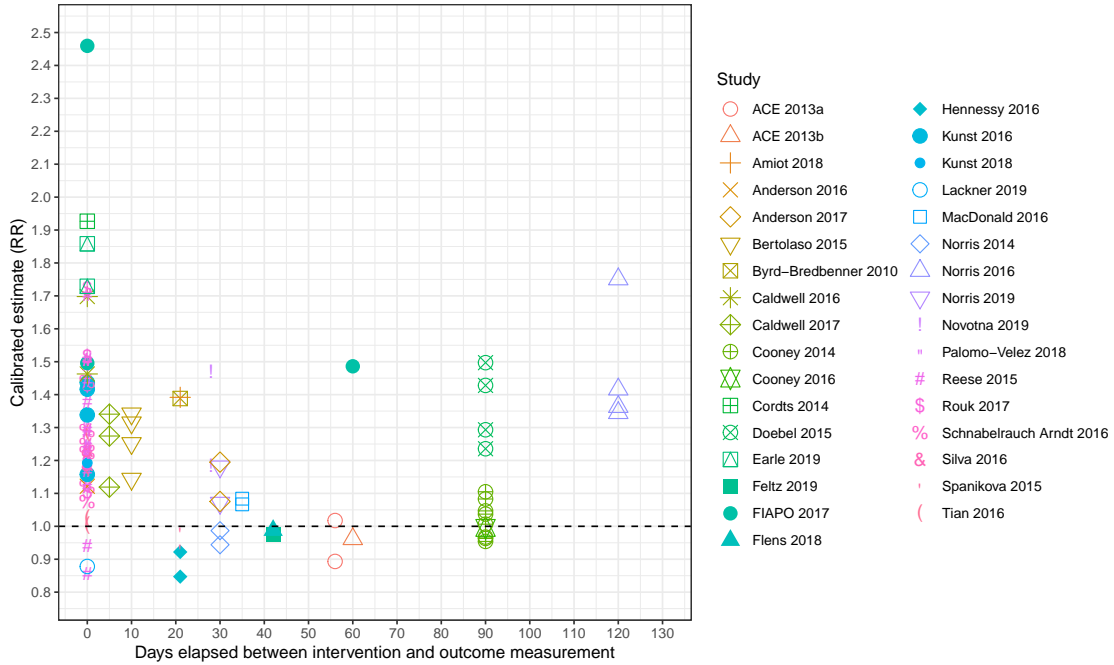
**Figure S2:** *Kernel density estimate of the true risk ratios in each study, truncated to show risk ratios between 0.8 and 1.8. The black dashed line represents the null (no intervention effect). The red dashed line represents the pooled point estimate.*



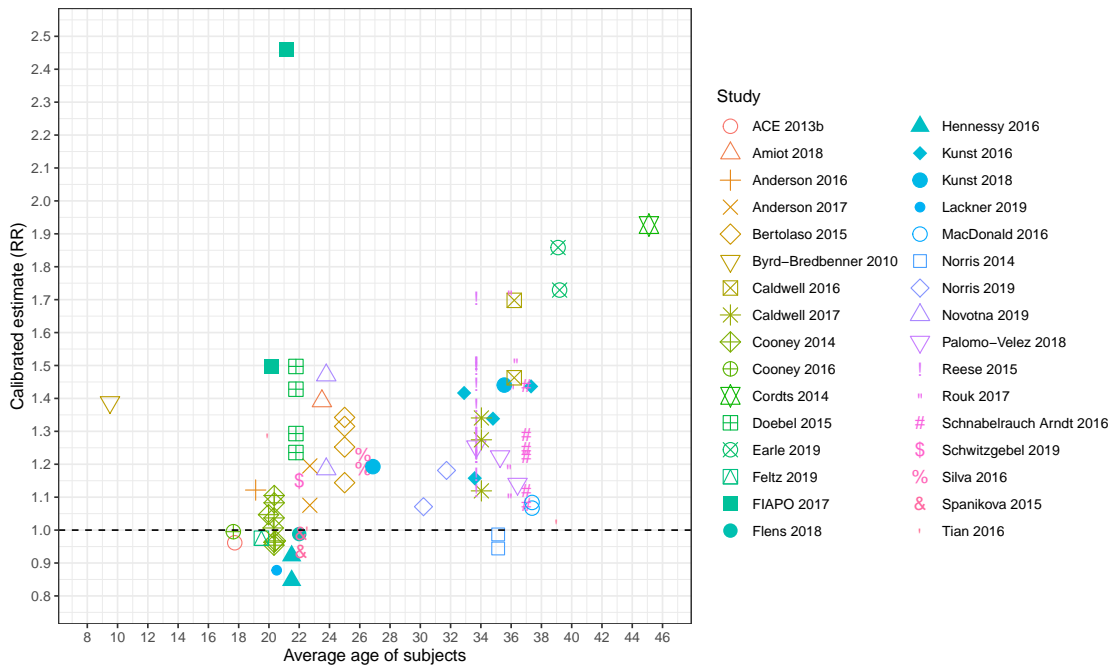
**Figure S3:** *Estimated percentages of true population effects stronger than various thresholds on the risk ratio scale. The black dashed line represents the null (no intervention effect). The red dashed line represents the pooled point estimate. Shaded bands are 95% bootstrapped pointwise confidence intervals.*



**Figure S4:** *Intervention duration versus calibrated estimate of true population effect size. Horizontal dashed line: null. The x-axis is presented on the log scale with numerical marks on the original (minutes) scale.*



**Figure S5:** Time elapsed between intervention and outcome measurement versus calibrated estimate of true population effect size. Horizontal dashed line: null.



**Figure S6:** Average subject age versus calibrated estimate of true population effect size. Horizontal dashed line: null.

### 3. CHANGES AND DEVIATIONS FROM PREREGISTERED PROTOCOL

Here, we describe the three stages in which we preregistered the protocol and describe changes and deviations from the protocol at each stage. After conducting initial searches, but before extracting data, we first registered the protocol on July 3, 2019. During data extraction, we updated the protocol to: (1) describe new plans to compare our results to those of a previous qualitative review<sup>5</sup>; (2) change the way that we would handle multiple outcomes per study (from always choosing the broadest-scoped outcome to choosing the outcome most closely matching the intervention’s scope, a change affecting only a few studies); and (3) we removed caveats about omitting certain analyses if estimates were non-normal in light of new statistical methods obviating this assumption<sup>19</sup>. With these changes, we registered the protocol again on July 16, 2019 and submitted this version to the journal *Systematic Reviews*. In response to peer review comments, we made further revisions to remove the comparison to the previous review. Ultimate analyses deviated from the published protocol paper<sup>18</sup> in four ways: (1) we extracted risk ratios rather than standardized mean differences because studies very often used pseudo-continuous, non-normal Likert outcomes, jeopardizing the validity of the needed effect-size conversions to the standardized mean difference scale; (2) we omitted the animal-centric, health-centric, environment-centric metrics; (3) we omitted sensitivity analyses that would have excluded interventions targeting consumption of only specific types of meat; and (4) we omitted self-selected within-subjects studies from main analyses. More details and reasons for these decisions are given in the main text. We also conducted several post hoc analyses, all of which are described as such in the main text.

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