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**The role of meat appetite in willfully disregarding factory farming as a pandemic  
catalyst risk**

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### Abstract

Most infectious diseases are zoonotic, “jumping” from animals to humans, with COVID-19 no exception. Although many zoonotic transmissions occur on industrial-scale factory farms, public discussions mainly blame wild animal (“wet”) markets or focus on reactionary solutions, posing a psychological obstacle to preventing future pandemics. In two pre-registered studies early in the 2020 pandemic, we examined whether British adults fail to recognize factory farming in causing epidemics, and whether such dismissal represents motivated cognition. Cross-sectional data (Study 1,  $N = 302$ ) confirmed that people blame factory farms and global meat consumption less than wild animal trade and consumption or lack of government preparedness, especially among meat-committed persons. Experimental exposure (Study 2,  $N = 194$ ) to information blaming factory farms (vs. wild animal markets) produced lower endorsement of preventive solutions than of reactionary solutions, which was exacerbated among meat-committed persons. These findings suggest that people, especially those highly committed to eating meat, willfully disregard solutions targeting animal agriculture and global meat consumption to prevent future pandemics precisely because such solutions implicate their dietary habits. Better understanding motivated beliefs about the causes of and solutions to pandemics is critical for developing interventions.

**KEYWORDS:** COVID-19, meat consumption, motivated cognition, pandemic, factory farming, policy making.

## 1. Introduction

“We are preoccupied with the production of face masks, but we appear unconcerned with the farms that are producing pandemics. The world is burning and we are reaching for more fire extinguishers while gasoline soaks through the tinder at our feet.” (Foer & Gross, 2020)

The COVID-19 pandemic has caused a global crisis, wreaking havoc in people’s lives, the economy, and healthcare systems across the globe. Governments responded to this crisis by closing businesses, cancelling flights, urging hygiene care, and enforcing social-distance measures. These sensible reactionary strategies have dominated political debates, public discussions, and the news headlines. Yet, with the dominant focus on how to be prepared and respond once pandemics hit, surprisingly few discussions address what can be done to help *prevent* future pandemics. As highlighted by the opening quote, if we are to seriously tackle the global problem of zoonotic diseases, we cannot ignore the risks posed by our industrial food systems. We need to better understand how people conceive of the risks of animal agriculture, and the psychological forces that deter people from recognizing and acting upon these risks.

### 1.1. Zoonotic Diseases

Most infectious diseases are zoonotic, that is, transferred to humans from animals (Karesh et al., 2012). Arguably, effectively addressing zoonotic disease risk includes strategies that prevent animal-human transmission of viruses. In the case of COVID-19, scientists traced the origin point to wildlife markets (or “wet” markets) in Wuhan (e.g., Wu et al., 2020), where wild animals, such as snakes, pangolins, and civet cats, are sold for human consumption. Environmental experts were quick to urge for a global ban on wildlife markets and the consumption of wildlife, widely considered an important step to prevent future

pandemics (e.g., Weston & Standaert, 2020). Such policy proposals received substantial public support, perhaps unsurprisingly, as most people, especially from Western countries, have never attended a wet market and have no investment in their continuance. However, the odds are that the next pandemic will not originate from a wet market but rather a run-of-the-mill factory farm.

Influenza outbreaks, such as the “avian flu” epidemic in 2003, “swine flu” epidemic in 2009 (and recently in Nigeria), are a common occurrence on intensive animal farms before spreading to humans (CDC, 2020; Dhingra et al., 2018; Nelson et al., 2015). Scientists have been warning for decades about the risks of intensive farming practices for public health (e.g., Aerestrup, 2012; Jones et al., 2013; Moyer, 2016). The scale of production and overcrowded conditions on factory farms make it easy for viruses to migrate and spread (Graham et al., 2008; Jones et al., 2013). Moreover, the common practice of feeding antibiotics to farmed animals (Landers et al., 2012; OECD, 2016) promotes antimicrobial resistance, threatening public health (Aerestrup, 2012; Casey et al., 2013; Van Boeckel et al., 2017). Given that the vast majority of meat consumed originates from factory farms (Reese, 2018), and intensive farming is expanding, we are edging closer to more COVID-19-like global disease outbreaks.

The urgency of the situation sharply contrasts with the limited attention this issue receives in public discussions. Polling results from the U.S. revealed a considerable gap in the public’s recognition of disease risk from animal agriculture (Beggs & Anderson, 2020). Beggs and Anderson (2020) found that, although approximately half of the respondents connected the coronavirus to animal contact, only 15% agreed that there is a direct connection between disease outbreaks and livestock farming. Increased attention and a greater public recognition of disease risk from factory farms could be expected to increase support for a ban on factory farms and a global shift away from the consumption of animal

products, parallel to the support for solutions targeting the trade and consumption of wild animals. However, rather than representing a gap in people's knowledge, many people may be *willfully disregarding* the high disease risk from factory farms.

## 1.2. The Meat-Motivated Mind

Scientists have long observed a knowledge-action gap when it comes to long-term behavioral change (e.g., to address global warming; Knutti, 2019). People can be aware of the need to act yet fail to. In the context of meat consumption, the knowledge-action gap is well documented (Wellesley et al., 2015). Many people understand the value of meat reduction for their health, animal welfare, and climate change, yet strategically avoid situations where they will be confronted by the implications of meat consumption (Bastian & Loughnan, 2017; Onwezen & van der Weele, 2016; Rothgerber, 2020).

Why is this the case? Meat is a highly valued, encultured product (Tucker, 2014; Zaraska, 2016), which poses a troublesome barrier (Bastian & Loughnan, 2017; Rothgerber, 2020). Research on sacred and political values highlights how cognitive resources are mobilized in ways that protect and preserve pre-existing values rather than openly question or challenge them (e.g., Haran et al., 2013; Taber & Lodge, 2006; Tetlock, 2003). Attitudes towards meat share many qualities with sacred values. People hold beliefs about meat in a *protective* manner and engage in a range of justification strategies to defend their meat consumption behavior, for instance by endorsing that eating meat is necessary, natural, normal, and nice (Piazza et al., 2015), denying that animals can suffer (Bratanova et al., 2011), or endorsing human supremacy beliefs (Rothgerber, 2013; see also Krings et al., in press). Meat-eaters may also portray non-meat-eaters as threats to cultural values, fueling antipathy towards these groups (Dhont & Hodson, 2014; Dhont & Stoeber, 2021; Hodson et al., 2020; MacInnis & Hodson, 2017).

Moreover, people who enjoy meat often engage in motivated-cognitive processes whereby they actively avoid, distort, or disregard relevant information that challenge current meat-eating habits (Onwezen & van der Weele, 2016; Piazza & Loughnan, 2016; Rothgerber, 2020). For example, Piazza and Loughnan (2016) found that information about the cognitive ability of animals tends to enhance concern for animal treatment. Yet such information impacts little on meat consumers' judgments of the treatment of animals they consume as food. Likewise, thinking about an animal as food rather than as a living being, or dissociating meat from its animal source, can reduce concern for animal suffering (e.g. Benningstad & Kunst, 2020; Bratanova et al., 2011; Earle et al., 2019; Rothgerber, 2013). Anticipating criticism about one's meat consumption can motivate meat eaters to deny animals morally-relevant cognitive traits (Rothgerber, 2014). Finally, meat consumers who are committed to their diets (Piazza et al., 2015) or who frequently consume meat (Graça et al., 2015) tend to think there are fewer problems associated with meat production and consumption (e.g., for their health or the environment) than less committed consumers. Engaging in such psychological strategies help consumers to feel morally okay with eating animals as it can minimize feelings of guilt or discomfort resulting from the "meat paradox", the moral tension (or dissonance) between their appetite for meat and their concern for animals (Bastian & Loughnan, 2017; Loughnan & Davies, 2020; see also Rothgerber, 2014, 2020).

These findings illustrate the potential barrier that appetite for meat poses to mobilizing public regard for the contagious-disease risk of animal agriculture. Indeed, comparable to how meat consumers disregard morally relevant information about farmed animal sentience because it discredits their dietary habits, they may be motivated to disregard proposed solutions targeting animal agriculture and global meat consumption as valid measures to redress the risks of zoonotic-disease transmission precisely because such solutions implicate their dietary habits. Moreover, based on this line of reasoning it can be

expected that especially those who are strongly committed to meat would be motivated to disregard such solutions.

### **1.3. Present Studies**

We sought to examine (a) whether people's thinking about infectious diseases is focused on short-term reactionary solutions to infectious diseases, rather than far-sighted solutions that could help prevent future outbreaks, and (b) how levels of meat commitment might exacerbate this myopia.

In Study 1, we surveyed public perceptions of three potential contributors to the spread of infectious diseases: (1) lack of human preparedness; (2) the trade and consumption of wild animals (at "wet" markets); and (3) factory farms and global meat consumption. We also surveyed beliefs regarding potential solutions to addressing or preventing future pandemics—beliefs related to (1) reactionary solutions focused on improving the human response and preparedness to emerging diseases; (2) preventive solutions focused on policies and changes to reduce or eradicate the trade and consumption of wild animals; and (3) preventive solutions focused on policies and changes targeting factory farms and global meat consumption.

We hypothesized that factory farming and global meat consumption would be a relatively under-recognized contributor to the spread of infectious disease compared to issues related to how to respond to and preparedness for a pandemic, and the consumption and trade of wild animals (Hypothesis 1). As such, we expected it to be the least endorsed target for preventive measures aimed to manage future pandemics (Hypothesis 2).

Critically, we tested the motivating influence of meat commitment on endorsement of reactionary versus preventive solutions to infectious disease. Consistent with the notion of meat as a sacred value, we predicted that individual differences in meat commitment would



be negatively related to the extent to which people consider factory farms and global meat consumption to be part of the problem (Hypothesis 3a) as well as to the perceived usefulness of preventive solutions targeting factory farms and global meat consumption (Hypothesis 3b).

Furthermore, we predicted an interaction effect between Type of Solution and meat commitment on the perceived usefulness of the proposed solutions (Hypothesis 4), such that especially individuals higher on *meat commitment* (i.e., highly committed to eating meat; Piazza et al., 2015) would be significantly less likely to endorse preventive solutions targeting factory farms and global meat consumption relative to their endorsement of reactionary solutions focused on improving the human response and preparedness to emerging diseases. We expected that the difference between types of solutions would be less pronounced for those lower on meat commitment.

In Study 2 we adopted an experimental approach, randomly assigning participants to read information that attributed the spread of infectious diseases to wild animal markets or factory farms. The information provided empirical confirmation by scientists of the causal link between disease and wild animal markets or factory farms. This experimental approach allowed for a more direct test of the motivational account proposing that people willfully disregard available information about zoonotic disease risk from factory farming, as opposed to simply lacking an awareness of the risk. We tested the effects of this manipulation on endorsement of reactionary and preventive solutions addressing future outbreaks of infectious diseases.

We preregistered the hypotheses and data-analyses of both studies (<http://aspredicted.org/blind.php?x=r76rs3>; <http://aspredicted.org/blind.php?x=cs9e8t>). The data, materials, and supplemental results of both studies are now available via the Open

Science Framework: [https://osf.io/34yrg/?view\\_only=87a6e01a26f74c93894fc2043e0da1dc](https://osf.io/34yrg/?view_only=87a6e01a26f74c93894fc2043e0da1dc).

Both studies were approved by research ethics committees at the authors' institutions.

## 2. Study 1

### 2.1. Method

#### 2.1.1. *Participants and Procedure*

Respondents were 302 British adults recruited via Prolific (76.6% women, 26.4% men, 1.0% indicated “other”), with a mean age of 32.17 years (SD = 11.90; range 18-76). Regarding diet, 85.4% indicated eating meat, 2.6% self-identified as pescatarian, and 12% self-identified as vegetarian or vegan (see Table S1 for details). Participants were invited to a study about opinions on past and present infectious diseases. After giving informed consent, they completed measures on the perceived causes of and solutions to infectious diseases, the meat commitment scale, and demographics. Upon completion they were thanked, debriefed, and compensated £0.90.

We aimed to recruit 300 participants to ensure detection of small effects and for stable estimates (e.g., Schönbrodt & Perugini, 2013). A sensitivity analysis with G\*Power (Faul et al., 2009) indicated that this sample size allowed us to detect small effects with an  $\alpha$  of .05 and power of .80 ( $f \geq .08$  and  $f^2 \geq 0.03$  for the repeated-measures ANOVA and regression analyses, respectively). Returned were 302 complete submissions.<sup>1</sup>

#### 2.1.2. *Measures*

**2.1.2.1. Perceived Causes of Infectious Diseases.** We developed a new set of items to ask participants about the extent to which several factors can be considered part of the problem causing the spread of infectious diseases now or in the past (1= *Definitely not part of the problem*; 5= *Definitely part of the problem*; see Supplemental Materials for all items). Eight items ( $\alpha = .79$ ) focused on the lack of human preparedness for a pandemic (e.g., ‘No global

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<sup>1</sup> In keeping with our preregistration, scale scores higher or lower than three standard deviations from the mean were converted to the value at three standard deviations from the sample mean (i.e., were winsorized).

information system for pandemics'), eight items ( $\alpha = .86$ ) focused on concerns related to the consumption and trade of wild animals (e.g., 'Wild animals kept in a confined space or under crowded conditions'), and seven items ( $\alpha = .83$ ) focused on concerns related to factory farms and global meat consumption ('Farmed animals kept in a confined space or under crowded conditions'). For each type of problem, items were averaged, with higher scores indicating stronger conviction that the issue is part of the problem.<sup>2</sup> A factor analysis extracting three factors with oblimin rotation showed that all items loaded on their respective factor (average factor loadings were .56, .58, and .59 for the factors representing concerns about lack of human preparedness, the consumption and trade of wild animals<sup>3</sup>, and factory farms and global meat consumption, respectively).

#### **2.1.2.2. Perceived Effectiveness of Solutions to Reduce or Prevent Infectious Diseases.**

Participants were presented with a set of newly developed items related to possible changes and policies that could be implemented to reduce or prevent infectious diseases. They were asked to indicate (1= *Definitely not useful*; 5= *Definitely useful*) the degree to which each is useful in reducing or preventing infectious diseases. Six items ( $\alpha = .83$ ) focused on reactionary solutions meant to improve the response to and preparedness for infectious diseases (e.g., 'A global information system for pandemics'). Ten items ( $\alpha = .88$ ) related to preventive solutions suggesting changes and policies targeting the consumption and trade of wild animals globally and in China (e.g., 'Ban on wet markets (i.e. live animal markets)'); Nine items ( $\alpha = .90$ ) related to preventive solutions suggesting changes and policies targeting factory farms and global meat consumption (e.g., 'Ban on keeping farmed animals in confined spaces or crowded conditions'). For each solution type the items were averaged,

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<sup>2</sup> The questionnaire also included four items on laboratory and companion animals and nine on conspiracy beliefs, which were beyond the scope of the current investigation (see Supplemental Materials).

<sup>3</sup> One item of the solutions targeting the consumption and trade of wild animals ("Wild animals kept in a confined space or under crowded conditions") also showed a cross-loading on the factor representing solutions targeting factory farms and global meat consumption,

with higher scores indicating stronger conviction that the proposed solution is useful in reducing or preventing infectious diseases.<sup>4</sup> A factor analysis extracting three factors with oblimin rotation showed that the items loaded on their respective factor (average factor loadings were .66, .56, and .67 for the factors representing solutions related to human preparedness, the consumption and trade of wild animals, and factory farms and global meat consumption<sup>5</sup>, respectively).

**2.1.2.3. Meat Commitment.** Participants completed a 7-item ( $\alpha = .96$ ) meat commitment scale (Piazza et al., 2015) (1= *Strongly disagree*; 7= *Strongly agree*; e.g., ‘I don't want to eat meals without meat’). Items were averaged, with higher scores indicating stronger meat commitment.

**2.1.2.4. Political Ideology.** We measured political ideology with three items asking participants to describe their political attitudes and beliefs in general, on economic issues, and on social issues (Skitka et al., 2002). The items were completed on 7-point scales, ranging from very liberal to very conservative, and averaged ( $\alpha = .93$ ).

## 2.2. Data-Analytic Plan

First, we tested Hypothesis 1 by conducting a within-subjects ANOVA to investigate differences in participants’ perceptions of the three types of factors that are potentially considered problematic in causing infectious diseases, followed up by planned contrasts to test each specific comparison. Next, we tested Hypothesis 2 by conducting a within-subjects ANOVA to investigate differences in the perceived usefulness of the three types of solutions

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<sup>4</sup> In addition, twelve items were included that proposed other solutions, beyond the scope of the current investigation (e.g., related to laboratory or companion animals, or investigating conspiracy theories; see Supplemental Materials).

<sup>5</sup> One item of the list of solutions targeting factory farms and global meat consumption (“Globally reducing the exploitation of animals for all purposes”) also showed a cross-loading on the factor representing the solutions targeting the consumption and trade of wild animals. One item “Avoiding close contact with wildlife” only loaded weakly on its respective factor (factor loading of .20).

for reducing or preventing infectious diseases, followed up by planned contrast to test each specific comparison.

Next, we tested Hypotheses 3a-3b by examining whether meat commitment is related to a) the extent to which people consider factory farms and global meat consumption to be part of the problem and b) the perceived usefulness of preventive solutions targeting factory farms and global meat consumption. We estimated these associations with zero-order correlations and with regression analyses, with the latter analyses controlling for age and gender (following our preregistered plan). We also conducted regression analyses with ideology as an extra control variable, which was additional to the Study 1 preregistration.

Finally, we tested Hypothesis 4 stating that those higher (*vs.* lower) in meat commitment are more supportive of reactionary solutions relative to preventive solutions targeting factory farms and global meat consumption. We conducted a moderation analysis for within-subjects designs using the MEMORE macro (Montoya, 2019), with Type of Solution as the within-subjects factor and meat commitment as the continuous moderator. We estimated the effect of Type of Solution on perceived usefulness of the solutions at higher (+1SD) and lower (-1SD) levels of meat commitment. A similar analysis was then conducted to explore whether those higher (*vs.* lower) in meat commitment are more convinced of the usefulness of preventive solutions targeting the trade and consumption of wild animals than of preventive solutions targeting factory farms and global meat consumption.

## **2.3. Results**

### ***2.3.1. Perceived Causes and Solutions***

First we investigated factors potentially problematic in causing contagion (see Table 1 for descriptive statistics and correlations). An ANOVA revealed a significant effect of Source of Diseases,  $F(2, 300) = 238.48, p < .001, \eta_p^2 = .61$ . As per our preregistered hypothesis (Hypothesis 1), respondents were less likely to consider concerns about factory farms and

global meat consumption problematic ( $M = 3.29$ ,  $SD = 0.76$ ) compared to issues related to lack of preparedness ( $M = 4.01$ ,  $SD = 0.58$ ),  $F(1,301) = 239.00$ ,  $p < .001$ ,  $\eta_p^2 = .44$ , or the consumption and trade of wild animals ( $M = 4.03$ ,  $SD = 0.64$ ),  $F(1,301) = 433.64$ ,  $p < .001$ ,  $\eta_p^2 = .59$ . No significant differences were found between the latter two,  $F(1,301) = 0.31$ ,  $p = .578$ ,  $\eta_p^2 = .001$ .

Next we conducted an ANOVA to investigate potential solutions for reducing or preventing infectious diseases, revealing significant differences between levels of perceived usefulness of different types of solutions,  $F(2, 300) = 147.16$ ,  $p < .001$ ,  $\eta_p^2 = .50$ . As predicted (Hypothesis 2), respondents considered preventive solutions targeting factory farms and global meat consumption ( $M = 3.66$ ,  $SD = 0.79$ ) less useful compared to reactionary solutions meant to improve human preparedness ( $M = 4.45$ ,  $SD = 0.53$ ) and solutions targeting the consumption and trade of wildlife ( $M = 4.12$ ,  $SD = 0.65$ ),  $F(1,301) = 283.74$ ,  $p < .001$ ,  $\eta_p^2 = .49$ , and  $F(1,301) = 149.70$ ,  $p < .001$ ,  $\eta_p^2 = .33$ , respectively. Furthermore, solutions meant to improve human preparedness were considered more useful than solutions targeting the consumption and trade of wildlife,  $F(1,301) = 69.69$ ,  $p < .001$ ,  $\eta_p^2 = .19$ .

Table 1.  
Endorsement by Problem and Solution, and Correlations between Ratings, Meat Commitment, and Key Demographics (Study 1).

	M (SD)	$\alpha$	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Problem - Response & Preparedness	4.01 (0.58)	.79	/	.21***	.29***	.53***	.19**	.33**	-.13*	.08	-.08	-.30***
2. Problem – Consumption and trade of wild animals	4.03 (0.64)	.86		/	.62***	.18***	.74***	.52***	-.11	-.05	.01	.03
3. Problem – Factory farms and global meat consumption	3.29 (0.76)	.83			/	.16**	.47***	.75***	-.35***	.06	-.14**	-.16**
4. Reactionary solution – Improved response & preparedness	4.45 (0.53)	.83				/	.30***	.29***	-.20**	.16**	.10	-.18**
5. Preventive solution – Addressing consumption and trade of wild animals	4.12 (0.65)	.88					/	.62***	-.12*	.10	.06	.06
6. Preventive solution – Addressing factory farms and meat consumption	3.66 (0.79)	.90						/	-.42***	.10	-.13*	-.22**
7. Meat Commitment	3.66 (1.83)	.96							/	-.30***	.12*	.32***
8. Gender (1 = man; 2 = woman)	/	/								/	-.05	-.09
9. Age	32.17 (11.90)	/									/	.19**
10. Conservative Ideology	3.22 (1.26)	.93										/

Note. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

### 2.3.2. *The Role of Meat Commitment*

Testing the associations between meat commitment and perceived causes and solutions with both zero-order correlations (Table 1) and regression analyses that included gender and age as controls, confirmed Hypotheses 3a and 3b. Specifically, participants higher in meat commitment were significantly less likely than participants lower in meat commitment to consider factory farms and global meat consumption (a) to be part of the problem of zoonotic disease ( $r = -.35, p < .001; \beta = -.35, p < .001$ ), and (b) in need of changing to prevent future disease outbreaks ( $r = -.42, p < .001; \beta = -.42, p < .001$ ). These patterns were largely unaffected ( $\beta = -.34, p < .001; \beta = -.39, p < .001$ , respectively) when including ideology in the regression analyses.

Next, we tested whether meat commitment moderated the effect of Type of Solution on perceived usefulness of the solutions. The analyses focusing on the comparison between reactionary solutions and preventive solutions targeting factory farms and global meat consumption confirmed Hypothesis 4. Those higher on meat commitment (+1 SD) were less convinced of the usefulness of preventive solutions targeting factory farms and global meat consumption than of reactionary solutions,  $b = 1.01, SE = .064, t(300) = 15.87, p < .001, [.889; 1.141]$ . Those lower on meat commitment (-1 SD) also endorsed changes to factory farms and global meat consumption less than reactionary solutions,  $b = 0.56, SE = .064, t(300) = 8.84, p < .001, [.439; .691]$ , but this difference was significantly diminished compared to those higher on meat commitment. Indeed, the Meat Commitment x Type of Solutions interaction was significant,  $b = .12, SE = .02, t(300) = 4.97, p < .001, [.074; .171]$  (see Figure 1).



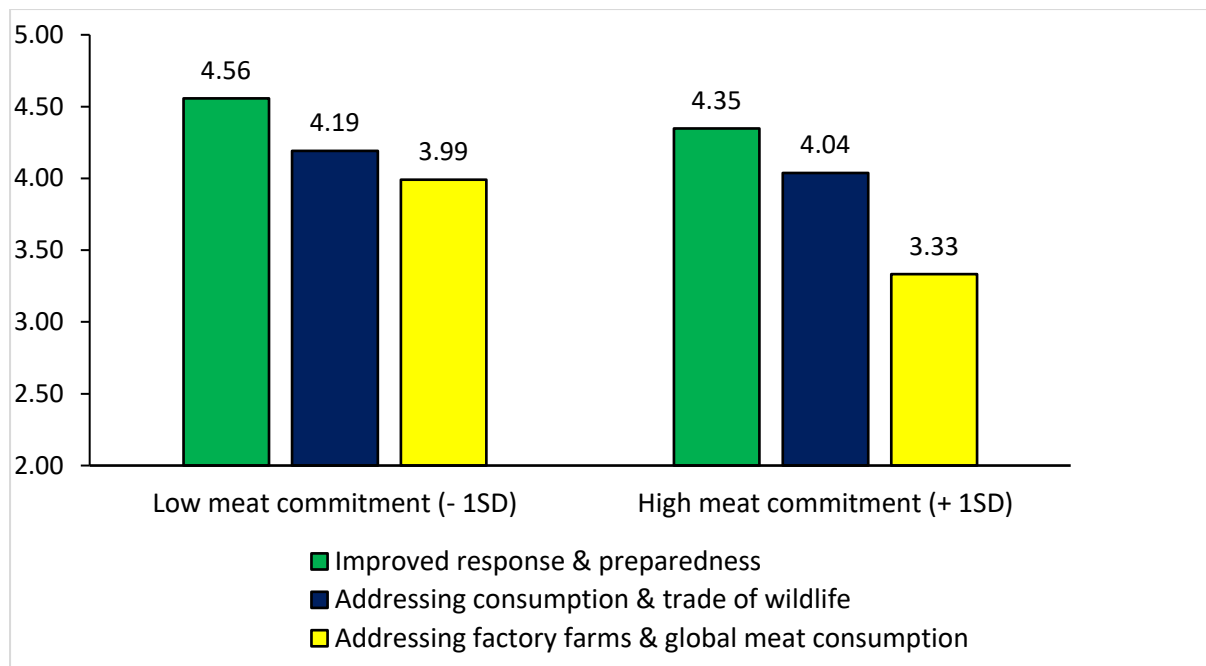


Figure 1. Endorsement of different solutions to infectious disease by level of meat commitment (Study 1).

Similarly, when comparing preventive solutions targeting factory farms and global meat consumption to preventive solutions targeting the consumption and trade of wild animals, those higher on meat commitment (+1 SD) were less convinced of the usefulness of preventive solutions targeting factory farms and global meat consumption than of preventive solutions targeting wild-animal consumption and trade,  $b = 0.70$ ,  $SE = .048$ ,  $t(300) = 14.60$ ,  $p < .001$ ,  $[.610; .800]$ . This difference was significantly less pronounced for those lower (-1SD) on meat commitment,  $b = 0.20$ ,  $SE = .048$ ,  $t(300) = 4.16$ ,  $p < .001$ ,  $[.106; .296]$ . The Meat Commitment x Type of Solution interaction was significant,  $b = .14$ ,  $SE = .02$ ,  $t(300) = 7.37$ ,  $p < .001$ ,  $[.101; .174]$  (Figure 1).

## 2.4. Discussion

Corroborating Hypothesis 1, participants considered lack of government preparation and wild-animal consumption and trade as substantial contributors to infectious disease spread, while downplaying the risks posed by factory farms and global meat consumption.

Furthermore, and in line with Hypothesis 2, preventive solutions to limit, regulate, or eliminate factory farms were endorsed significantly less than reactionary solutions aimed at better preparing and equipping society to combat infectious diseases, or than preventive solutions curbing wild-animal consumption and trade. Most critically, corroborating Hypotheses 3a-b, meat commitment was associated with reduced endorsement of factory farming as a problem linked to zoonotic disease (Hypothesis 3a) and a problem in need of correcting to prevent future pandemics (Hypothesis 3b). Furthermore, commitment to eating meat significantly moderated the extent to which participants considered reactionary solutions more useful than preventive solutions aimed at factory farms (Hypothesis 4), with meat commitment associated with reduced perceptions of the usefulness of targeting factor farms relative to reactionary solutions to zoonotic disease.

### 3. Study 2

A lack of concern for factory farms might be, at least partly, due to a lack of awareness about the problems related to factory farms rather than a willful disregard of available information. To more directly test our motivational account, in Study 2 we exposed participants to information about the contributing role of factory farms (*vs.* wild animal “wet” markets) to examine its effect on endorsement of solutions for preventing future outbreaks. Failure to be swayed by information one is directly exposed to would represent resistance or pushback, in a manner that was not possible to consider with the cross-sectional data. Much like in Study 1, participants were asked to endorse reactionary and preventive solutions. Depending on condition, the preventive solutions were either aimed at factory farms or wild animal markets. As in Study 1, we expected reactionary solutions to be endorsed above preventive solutions. However, more critically, we expected this to be true mainly when factory farms were implicated as a source of zoonotic disease. That is, we expected

(Hypothesis 5) that there would be an interaction between Source of Diseases (factory farms vs. wild animal markets) and Type of Solution (reactionary vs. preventive) on perceived usefulness of solutions, such that participants would consider preventive solutions less useful in the factory farm condition than in the animal market condition. However, we did not expect endorsement of reactionary solutions to be significantly affected by our manipulation of Source of Diseases.

Moreover, we expected that meat commitment would moderate the effect of disease source: For individuals higher in meat commitment, we expected the greatest divergence in use of information, favoring preventive solutions more when learning about wild animal markets than about factory farms (Hypothesis 6a). For those lower in meat consumption, we expected the difference in perceived usefulness of preventive solutions between the two conditions to be much smaller. Finally, meat commitment was not expected to moderate the effect of Source of Diseases on perceived usefulness of reactionary solutions.

Furthermore, a Type of Solution x Meat Commitment interaction was expected in the factory farm condition, but not in the animal market condition (Hypothesis 6b). Specifically, in the factory farm condition, we predicted that those higher in meat consumption would consider preventive solutions less useful than reactionary solutions, while the difference between preventive and reactionary solutions would be weaker for those lower in meat commitment. In the wild animal market condition, meat commitment was not expected to moderate the effect of Type of Solution.

### **3.1. Method**

#### **3.1.1. Participants**

We recruited 201 British adults recruited via Prolific; seven were removed after failing the attention check, leaving a final sample of 194 (66% women, 33% men, 1% “other”), with a mean age of 35.39 years ( $SD = 12.17$ ; range 18-69). Regarding diet, 83.0%

indicated eating meat, 3.1% self-identified as pescatarian, and 13.9% self-identified as vegetarian or vegan (see Table S1 for details).

Although Study 1 yielded medium-to-large effect sizes (i.e., the smallest effect size involved one of the interaction effects, with  $f = .28$ ), we assumed that the hypothesized interactions could be smaller in Study 2 (i.e., small-to-medium). A power analysis using G\*Power suggested a sample size of 96 participants to detect a small-to-medium effect of  $f = .20$  with  $\alpha = .05$  and  $1 - \beta = .90$ , for the mixed-measures ANOVA (one between-subjects manipulation and one within-subjects factor). Doubling this sample size to take the moderation effect of meat commitment into account (e.g., Giner-Sorolla, 2018) suggested a sample size of 192. We aimed to collect a sample of 200 (but received 201 completed submissions).

### **3.1.2. Procedure and Materials**

Participants were invited to a study on zoonotic diseases. After giving informed consent they completed the meat commitment scale followed by demographics. Meat commitment ( $\alpha = .94$ ,  $M = 3.36$ ,  $SD = 1.68$ ) and political ideology ( $\alpha = .92$ ,  $M = 3.29$ ,  $SD = 1.22$ ) were measured as in Study 1.

Participants were then randomly assigned to one of two conditions and presented with a text highlighting zoonotic disease risks from wild animal markets or factory farms. In the *wild animal market condition* the text read:

“According to scientists and the World Health Organization, the majority of all known infectious diseases are zoonotic diseases. This means that these diseases are transmitted from animals to humans through direct or indirect human exposure to animals, their products (e.g. meat), and/or their environment.

Infectious viruses often jump from animals to humans on *wild animal markets* (*‘wet’ markets*) where a large number of *wild animals* are being kept in confinement for a

prolonged time. The animals are usually kept in unhygienic circumstances before they are being sold and slaughtered for their meat. Scientists have been warning us for many years that *wild animal markets* are one of the most important causes of infectious diseases.”

In the *factory farm condition* “wild animal markets” and “wild animals” were replaced with “factory farms” and “farm animals”, respectively. The text remained for a minimum of twenty seconds before participants could proceed. Afterwards participants completed an attention check asking what scientists consider one of the most important causes of infectious diseases according to the presented text. The answer options were “Factory farms”, “Wild animal markets”, and “Pet keeping”.

We measured the perceived usefulness of different types of solutions to reduce or prevent infectious diseases with 14 items (1= *Definitely not useful*; 5= *Definitely useful*). Five items taken from Study 1 ( $\alpha = .75$ ) focused on *reactionary solutions* (i.e. improving human preparedness). To measure the perceived usefulness of *preventive solutions*, nine parallel items were created and, depending on the condition, focused on addressing wild animal markets and the treatment of wild animals (e.g., “Stiff penalties for those who keep wild animals in confined spaces or crowded conditions”) or factory farms and the treatment of farm animals (e.g., “Stiff penalties for those who keep farm animals in confined spaces or crowded conditions”). One item (“improving hygiene on wild animal markets / factory farms”) was dropped due to low item-total correlation ( $<.10$ ) in both conditions, leaving eight items ( $\alpha = .77$  and  $\alpha = .81$ , for the wild animal market and factory farm condition, respectively).<sup>6</sup>

Upon completion participants were thanked, debriefed, and compensated £0.50.

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<sup>6</sup> Following our preregistration, scale scores higher or lower than three standard deviations from the mean were winsorized.

### **3.2. Data-analytic Plan**

First, we tested the effects of Source of Diseases (factory farms *vs.* wild animal markets), Type of Solution (preventive *vs.* reactionary), and their interaction, on perceived usefulness of solutions to test Hypothesis 5. We conducted a mixed ANOVA with condition (Source of Diseases) as the between-subjects predictor, and Type of Solution as the within-subjects factor.

Next, we tested the moderating role of meat commitment, starting with a test of the three-way interaction effect between Source of Diseases, Type of Solution, and Meat Commitment, using MEMORE (Model 3, Montoya, 2018), followed by a series of regression analyses to test the hypothesized specific two-way interactions as outlined in Hypotheses 6a and 6b. Specifically, to test Hypothesis 6a, we conducted two regression analyses (using Process version 3.5, Model 1; Hayes, 2018) to test the two-way interaction of Source of Diseases (factory farms *vs.* wild animal markets) x Meat Commitment on perceived usefulness of 1) preventive solutions, and, separately, 2) reactionary solutions. Each time, we estimated the effect of the manipulation at higher (+1SD) and lower (-1SD) levels of meat commitment.

To test Hypothesis 6b, two more regression analyses were conducted to test the interaction between Type of Solution (preventive *vs.* reactionary) x Meat Commitment (lower *vs.* higher) on perceived usefulness of solutions within the 1) factory farm, and, separately, 2) wild animal market condition. For each condition, the effect of type of solution was tested at higher (+1SD) and lower (-1SD) levels of meat commitment.

### **3.3. Results**

#### **3.3.1. Effects of Source of Diseases and Type of Solution**

The results (Figure 2) of the mixed ANOVA showed main effects of Source of Diseases and Type of Solution. That is, solutions addressing zoonotic disease risk (whether reactionary or preventive) were considered overall more useful in the wild animal market

than factory farm condition,  $F(1,192) = 15.45, p < .001, \eta_p^2 = .074$ . Additionally, much like in Study 1, reactionary solutions were deemed more useful overall than preventive solutions,  $F(1,192) = 12.62, p < .001, \eta_p^2 = .062$ .

More critically, related to Hypothesis 5, these main effects were qualified by a Source of Diseases x Type of Solution effect,  $F(1,192) = 16.23, p < .001, \eta_p^2 = .078$ . Corroborating Hypothesis 5, participants considered preventive solutions less useful in the factory farm (vs. animal market) condition,  $b = .40, SE = .075, t(192) = 5.36, p < .001, [.255; .553]$ , while no significant between-condition difference occurred for reactionary solutions,  $b = .05, SE = .07, t(192) = 0.76, p = .45, [-.084; .191]$ .

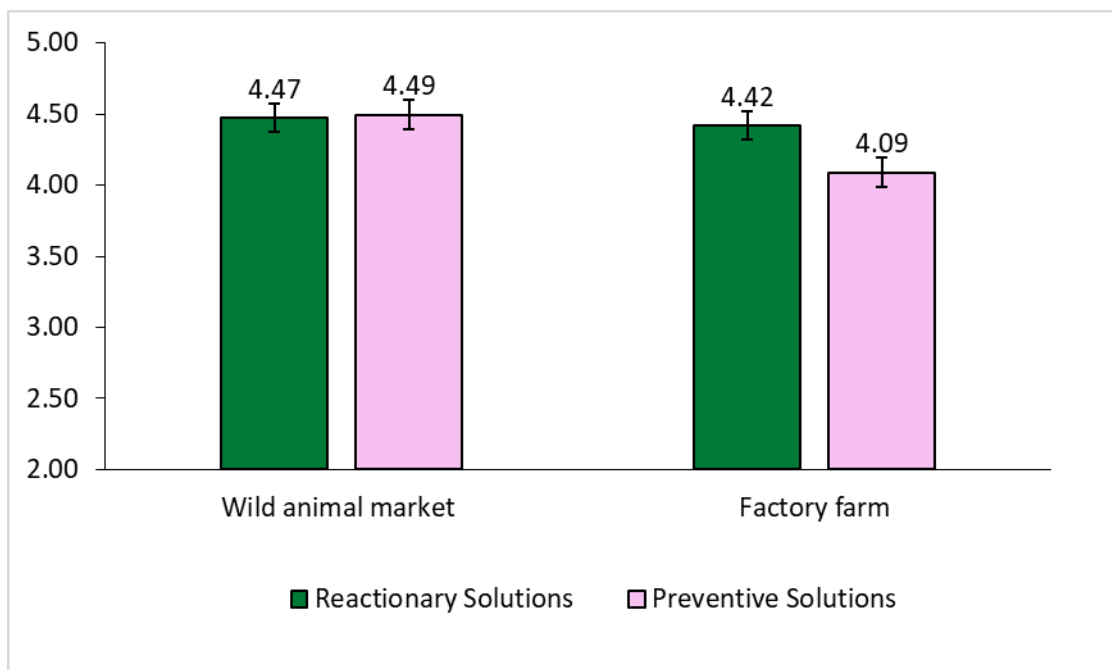


Figure 2. Endorsement of reactionary and preventive solutions by Source of Diseases (Study 2).

### 3.3.2. The Role of Meat Commitment

To investigate the potential moderating role of meat consumption, we first tested whether the Source of Diseases x Type of Solution interaction was further moderated by meat commitment. The expected three-way interaction was not significant,  $b = -.05, SE = .05, t(190) = -1.01, p = .313, [-.154; .050]$ .

Although the three-way interaction term was non-significant, we followed the preregistered analysis plan and conducted two regression analyses to test the two-way interaction of Source of Diseases (factory farms *vs.* wild animal markets) x Meat Commitment (lower *vs.* higher) on perceived usefulness of 1) preventive solutions, and, separately, 2) reactionary solutions (Hypothesis 6a). As expected, in the first analysis, those higher in meat commitment (+1SD) considered preventive solutions markedly less useful in the factory farm than wild animal market condition,  $b = .53$ ,  $SE = .10$ ,  $t(190) = 5.14$ ,  $p < .001$ ,  $[-.327; .732]$ , whereas the effect of Source of Diseases was weaker for those lower in meat commitment (-1SD),  $b = .25$ ,  $SE = .10$ ,  $t(190) = 2.48$ ,  $p = .013$ ,  $[.053; .457]$ ; the interaction term only approached significance,  $b = .08$ ,  $SE = .04$ ,  $t(190) = 1.88$ ,  $p = .061$ ,  $[-.004; .167]$ , meaning that the slopes did not differ significantly (see Figure 3 for estimated means). As expected, in the second analysis, meat commitment did not significantly moderate the effect on perceived usefulness of reactionary solutions,  $b = .03$ ,  $SE = .04$ ,  $t(190) = 0.71$ ,  $p = .480$ ,  $[-.053; .112]$  (i.e., the effect of Source of Diseases on perceived usefulness of reactionary solutions was non-significant at both higher and lower levels of meat commitment,  $b = .10$ ,  $SE = .10$ ,  $t(190) = 1.01$ ,  $p = .314$ ,  $[-.096; .297]$  and  $b = .001$ ,  $SE = .10$ ,  $t(190) = 0.01$ ,  $p = .994$ ,  $[-.195; .196]$ , respectively).

Finally, as preregistered, two more regression analyses were conducted to test the interaction between Type of Solution (preventive *vs.* reactionary) x Meat Commitment (lower *vs.* higher) on perceived usefulness of solutions within the 1) factory farm, and, separately, 2) wild animal market condition. As predicted (Hypothesis 6b), the first analysis (i.e., the factory farm condition) yielded a significant interaction effect,  $b = .09$ ,  $SE = .04$ ,  $t(95) = 2.40$ ,  $p = .018$ ,  $[.015; .163]$ , while the second analysis (i.e., the wild animal market condition) did not,  $b = .04$ ,  $SE = .04$ ,  $t(95) = 1.04$ ,  $p = .297$ ,  $[-.033; .108]$ . Decomposing the interaction within the factory farm condition revealed that those higher in meat commitment considered



solutions that focus on preventive solutions targeting factory farms to be less useful than reactionary solutions,  $b = .48$ ,  $SE = .09$ ,  $t(95) = 5.35$ ,  $p < .001$ ,  $[.305; .665]$ . By contrast, perceived usefulness of preventive vs. reactionary solutions was non-significant for those lower in meat commitment,  $b = .18$ ,  $SE = .09$ ,  $t(95) = 1.94$ ,  $p = .055$ ,  $[-.004; .356]$  (see Figure 3).

Political ideology, but not age or gender, correlated significantly with meat commitment; thus, as preregistered, we ran the regression analyses again including ideology. Including political ideology did not meaningfully change the pattern of results (see Supplemental Materials).

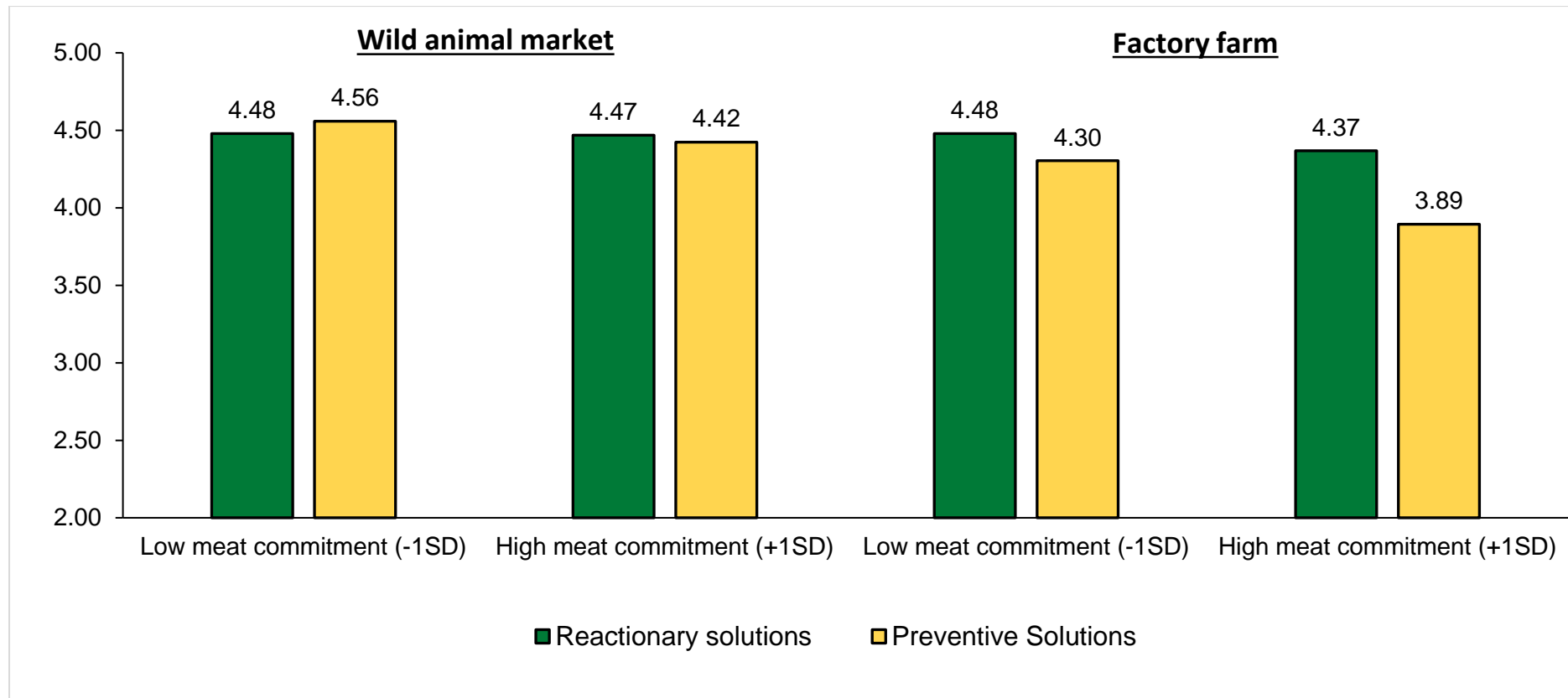


Figure 3. Endorsement of reactionary and preventive solutions by Source of Diseases and level of meat commitment (Study 2)

### 3.4. Discussion

Study 2 showed that participants respond to information about zoonotic disease sources differently depending on the nature of the source implicated. Learning about the role of factory farms in promoting zoonotic disease did not impact on judgments of disease prevention to the same degree as learning about the role of wild animal markets. Indeed, after exposing participants to information implicating wild animal markets, participants endorsed reactionary and preventive measures at comparable levels. However, as predicted (Hypothesis 5), participants exposed to the same information about infectious disease risk, attributed instead to factory farms, continued to endorse reactionary solutions over preventive solutions (see Figure 2). Thus, attributing disease risk to factory farms failed to impact on endorsement of preventive solutions to the level that attributing disease risk to wild animal markets did.

Critically, the pattern of results were also consistent with the hypothesized moderating role of meat commitment. The effect of the Source of Diseases (animal markets *vs.* factory farms) on endorsement of preventive solutions was particularly pronounced among those higher in meat commitment, compared to those lower in meat commitment, though this difference between the two groups did not quite reach levels of statistical significance ( $p = .061$ ), providing only weak support for Hypothesis 6a. However, we found clear support for the moderating role of meat commitment when comparing endorsement of reactionary solutions and preventive solutions within the factory farm condition. Consistent with Hypothesis 6b, participants higher in meat commitment tended to endorse preventive solutions aimed at factory farms and consumption of farm animals much lower than reactionary solutions focused on human preparedness, whereas participants lower in meat commitment tended to endorse both solutions at comparable levels.

#### 4. General Discussion

We investigated public perceptions of potential solutions to the spread of infectious diseases. Our findings show that without providing any background information (Study 1), participants largely focused on *reactionary* solutions (e.g., having specialized teams on standby or investing in medical equipment) to the outbreak and spread of infectious diseases and considered a lack of preparation a primary cause. Preventive solutions addressing deeper causes (e.g., targeting wildlife markets or factory farms) were significantly less endorsed (Study 1), with factory farming being particularly disregarded as a facilitator of infectious disease, despite being isolated as a key risk factor by experts (Jones et al., 2013; Moyer, 2016). Moreover, Study 2 demonstrated that after exposure to a passage implicating wild animal markets in the spread of disease, participants endorsed preventive solutions to reduce, regulate, or ban wild animal markets and the consumption of wild animals. Yet when participants were given the same information about factory farms, they were still less supportive of preventive solutions to reduce, regulate, or ban factory farms and the consumption of farm animals compared to the levels of support for preventive solutions in the wild animal market condition.

Most critically, both studies demonstrated that individual differences in meat commitment intrude on willingness to redress factory farming to prevent contagious outbreaks. Specifically, participants higher (*vs.* lower) on meat commitment were less convinced of making changes to factory farming compared to other solutions aimed at better preparing for pandemics or banning wild animal markets. Even after exposure to information detailing the risks of factory farming in zoonotic disease risk, participants higher on meat commitment primarily endorsed reactionary solutions, rather than preventive solutions targeting factory farms and meat consumption. Those lower on meat commitment were more convinced by a passage implicating factory farms, and endorsed adjustments to factory farms

almost on par with reactionary solutions. Furthermore, after exposure to information detailing the risks of wild animal markets, both those higher and lower on meat commitment supported preventive solutions targeting wild animal markets to a similar degree as their support for reactionary solutions.

These studies align with previous research showing that the motivational and appetitive power of meat can pose a serious barrier to behavioral change (e.g., Bastian & Loughnan, 2017; Piazza, 2020; Rothgerber, 2020). Past studies have shown, for instance, how meat commitment can lead people to disregard critical information about animals when forming judgments of how they should be treated (Piazza & Loughnan, 2016). Meat consumption has been associated with reduced concern for animals (e.g., Graça et al., 2015; Piazza et al., 2015), and thinking about animals as food can reduce concern for their suffering (e.g., Bratanova et al., 2011; Earle et al., 2019; Loughnan et al., 2010). Here we extended work on the meat-motivated mind by showing that having a commitment to eating meat poses a barrier to recognizing the real-world contribution of factory farms to zoonotic disease risk. People who enjoy meat and who cannot imagine replacing it in their diet find it less *believable* that factory farming poses a serious risk to public health. This is consistent with the notion of *willful disregard* for the credibility or relevance of information that has implications for a troublesome practice (e.g., Piazza & Loughnan, 2016). Indeed, because those in the analyses of Study 2 passed the attention check, we can consider any subsequent ignoring of such information as willfully disregarding the information. Although it is possible that some people (e.g., heavy consumers of meat) might be aware of additional information that influences their beliefs on zoonotic transmission, they nonetheless dismissed this information, on average, in the present studies.

More broadly, our research extends the scope of previous research on the meat paradox, where the focus has typically been on how people try to avoid or cope strategically

with the ambivalence they experience between their enjoyment of eating animals and their dislike of harming animals (Loughnan et al., 2014; Loughnan & Davies, 2020). Meat eaters have an extensive set of psychological tricks and legitimizing myths at their disposal to avoid or deal with this moral discomfort in order to maintain a positive self-image while continuing to eat meat (Bastian & Loughnan, 2017; Rothgerber, 2020). The disregard of information about the zoonotic disease risk from factory farms may suggest that meat eaters experience a similar tension between the enjoyment of eating farm animals and the realization that factory farms are breeding grounds for deadly and disruptive infectious diseases. More research is needed to directly test the reasons why people willfully disregard such information and whether similar effects can be observed when people learn about the detrimental impact of animal agriculture on the environment and climate change.

Our findings are arguably consistent with research on “solution aversion” (Campbell & Kay, 2014), whereby people exhibit motivated skepticism about the existence of a problem, not necessarily because of an aversion to the problem itself but because the associated solutions are threatening personal or ideological motives. In the context of meat consumption, meat eaters may downplay and express skepticism about zoonotic disease risks from animal agriculture, fueling the belief that efforts to eliminate or regulate animal agriculture and meat consumption lack efficacy and are destined to fail. Such skepticism may not be motivated by an aversion to the problems with factory farms or a genuine perceived inefficacy of the solutions, but because the solutions threaten their dietary practices, the symbolic value of meat, and part of their identity. To test this possibility, future studies could include measures that assess beliefs about the efficacy of different solutions.

#### **4.1. Limitations**

It should be noted that the willful disregard of information about factory farms was also observed among those lower on meat commitment, albeit to a significantly weaker extent

than among those higher on meat commitment. This adds an important nuance to our findings and suggests that also other factors than appetite for meat are likely involved. In addition to motivational pressures of meat appetite, normative pressures or ideological factors may affect both those lower and higher on meat commitment given that meat-eating is deeply ingrained in people's social lives and traditions. Future research could investigate a wider set of individual difference and demographic variables that relate to meat-consumer attitudes. For instance, speciesist beliefs (Caviola et al., 2019; Dhont et al., 2020), masculine identities (Rothgerber, 2013; Ruby & Heine, 2011; Salmen & Dhont, 2021), and perceived norms may all play a role in shaping people's attitudes towards solutions to tackle zoonotic disease risk from factory farms. Moreover, the extent to which a person has been personally affected by COVID-19, and perceives it (and other zoonotic diseases) to be a risk to personal and public health, will likely play an important moderating role in the endorsement of preventive solutions as well.

Furthermore, future studies on these topics should be conducted outside the U.K., in non-western cultures, to investigate the generalizability of our findings and test for possible cross-cultural differences. For instance, in regions where wild animal markets are common, people highly committed to eating wildlife may engage in similar motivated-cognitive processes and disregard measures targeting wild animal markets to tackle zoonotic disease risk. As a final point, we focused rather narrowly on solutions addressing the production and consumption of meat, while very limited research has focused on the consumption of other animal products. The intense confinement and poor treatment of animals in the dairy and egg industry are similarly considered severe risk factors for infectious diseases (e.g., Scott et al., 2020) and are posing similar ethical challenges to dietary habits (e.g., Francione, 2021; Singer, 2020). Future research could devote greater attention to the motivated-cognitive

processes and justification strategies related to the consumption of a wider range of animal products.

#### **4.2. Conclusion**

COVID-19 has affected everyone in various adverse ways, and collective action is necessary to prevent another pandemic. As world populations swell, our dependence upon meat is likely to grow (Ritchie & Roser, 2019), making it increasingly pressing to come to grips with the detrimental role of intensive farming and take action to turn the tide.

Undoubtedly, humankind needs to be better prepared to handle infectious diseases. However, it is equally important—arguably, more important—to identify and uproot the *causes* of infectious diseases. As we have shown here, appetite for meat can be a stumbling block for considering the role of animal agriculture in the spread of zoonotic disease. Meat is a highly enjoyable product for many, a factor inhibiting us from taking actions towards a safer future.



### Author Contributions

All authors contributed to the study concept, materials, and design. KD collected and analyzed the data. All authors interpreted the data, contributed to drafting the manuscript, provided critical revisions, and approved the final version of the manuscript for submission.

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