Title:
Attitudes towards Animals and Meat Consumption: The Role of Ideology and Individual Differences

Abstract:
Humans' relationships with non-human animals are complicated and complex. This thesis aims to address questions on how people think about animals' moral standing, how information about food animals' sentience is (mis)remembered, and how people evaluate laboratory-grown meat relative to traditional meat. The first empirical chapter of the thesis, Chapter 3, explores the question of whether higher human supremacy beliefs are associated with a greater perceived moral divide between animals of high and low status. Across two studies (N = 196 and N = 256), the findings suggest that people holding stronger human supremacy beliefs also perceive a greater moral divide between animals, which may serve as a legitimising strategy to preserve not only the existing human-animal hierarchy, but also greater hierarchical divides between other animals. The second set of studies, presented in Chapter 4 (N = 253 and N = 255), focuses on food animals specifically, investigating the ideologically motivated memory processes involved in the processing of objective information about these animals' sentience. Indeed, dominance-based ideologies were significant predictors for targeted memory errors for information on food animals' sentience, but not for information on their uses (e.g., in medical science), suggesting that differences in ideological attitudes interfere with the correct recall of sentience information for food animals. The final set of studies, presented in Chapter 5 (total N = 1,169), turns its focus to the psychological barriers to acceptance of laboratory-grown meat, which is structurally identical to traditionally farmed meat and presents solutions to the ethical, environmental, and public health issues associated with traditional animal agriculture. The three experiments consistently demonstrated that omnivores who were wearier about new food technologies evaluated clean meat more negatively than traditional meat. Experiment 3 further demonstrated that safety concerns, but not naturalness concerns, partly explained why those wearier of novel food technologies evaluated clean meat less positively. Taken together, the findings highlight the role of general concerns about the use of new food technology as a psychological barrier to clean meat acceptance. This thesis thus adds to the growing body of literature on human-animal intergroup relations, providing further evidence for the ways in which individual differences and ideology affect peoples' thinking about animals of different socio-cultural status, as well as attitudes towards meat substitutes.

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Attitudes towards Animals and Meat Consumption: The Role of Ideology and Individual Differences

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This thesis is submitted in accordance with the requirements of the University of Kent for the degree of Doctor in Philosophy in Psychology.

Declaration

The research reported in this thesis is my own work, except where indicated otherwise. Chapter 3 has been published in Anthrozoös (https://doi.org/10.1080/08927936.2021.1926712) and the work presented in Chapter 5 has been published in Food Quality and Preference (https://doi.org/10.1016/j.foodqual.2021.104409).

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Abstract

Humans' relationships with non-human animals are complicated and complex. This thesis aims to address questions on how people think about animals' moral standing, how information about food animals' sentience is (mis)remembered, and how people evaluate laboratory-grown meat relative to traditional meat. The first empirical chapter of the thesis, Chapter 3, explores the question of whether higher human supremacy beliefs are associated with a greater perceived moral divide between animals of high and low status. Across two studies (N = 196 and N = 256), the findings suggest that people holding stronger human supremacy beliefs also perceive a greater moral divide between animals, which may serve as a legitimising strategy to preserve not only the existing human-animal hierarchy, but also greater hierarchical divides between other animals. The second set of studies, presented in Chapter 4 (N = 253 and N = 255), focuses on food animals specifically, investigating the ideologically motivated memory processes involved in the processing of objective information about these animals' sentience. Indeed, dominance-based ideologies were significant predictors for targeted memory errors for information on food animals' sentience, but not for information on their uses (e.g., in medical science), suggesting that differences in ideological attitudes interfere with the correct recall of sentience information for food animals. The final set of studies, presented in Chapter 5 (total N = 1,169), turns its focus to the psychological barriers to acceptance of laboratory-grown meat, which is structurally identical to traditionally farmed meat and presents solutions to the ethical, environmental, and public health issues associated with traditional animal agriculture. The three experiments consistently demonstrated that omnivores who were wearier about new food technologies evaluated clean meat more negatively than traditional meat. Experiment 3 further demonstrated that safety concerns, but not naturalness concerns,

partly explained why those wearier of novel food technologies evaluated clean meat less positively. Taken together, the findings highlight the role of general concerns about the use of new food technology as a psychological barrier to clean meat acceptance. This thesis thus adds to the growing body of literature on human-animal intergroup relations, providing further evidence for the ways in which individual differences and ideology affect peoples' thinking about animals of different socio-cultural status, as well as attitudes towards meat substitutes.

Chapter 1: Attitudes towards Animals and Meat Consumption: The Role of Ideology and Individual Differences

"As far as Death was aware, the sole reason for any human association with pigs and lambs was as a prelude to chops and sausages. Quite why they should dress up for children's wallpaper as well was a mystery. Hello, little folk, this is what you're going to eat… He felt that if only he could find the key to it, he'd know a lot more about human beings." – Terry Pratchett in Hogfather, p.41

1.1. The Complicated Nature of Humans' Relationships with Other Animals

British author Terry Pratchett sums up in a few witty sentences the paradoxical relationship most humans have with animals. Dressed up farm animals sing and dance in children's cartoons and are then served as dinner. Children are taught not to kick a dog, but that it is perfectly acceptable to consume parts of a pig. People sign petitions to stop the cruel treatment of animals overseas but choose to turn a blind eye to the barbaric practices happening in the slaughterhouse next door.

Consider these paradoxical relationships between humans and other animals: some animals are highly valued as companions, while others are used for food and research. In Europe alone 9.5 million animals are used for medical testing, breeding and genetic modification every year, and Europeans' average meat consumption is estimated at 65.5kg per capita per annum (Directorate-General for the Environment, 2020; Statista, 2020a).

Yet, while millions of animals are being exploited for their meat, skin, and fur every year, the European companion animal market is booming, with pet food and accessories raking in billions in revenue every year (European Statistics, 2019). This stark contrast further illustrates the paradoxical nature of people's relationships with animals. Statistics reveal the presence of over 100 million companion cats in European

households, and a dog in one out of every five of these households, as well as approximately 100 million pet birds, small mammals, reptiles, and aquatic animals. Companion animal accessories and pet food markets turnover over €40 *billion* per year (European Statistics, 2019). To illustrate this paradoxical situation even further, consider the fact that France, in 2018, was the European frontrunner for both meat consumption per capita as well as cat- and dog ownership (European Statistics, 2019; Statista, 2020b).

Moreover, while global efforts to save species from extinction are becoming a pressing issue at government level, organised extermination efforts are as well. Recent reports from experts estimate that conservation efforts of the last thirty years have significantly slowed the extinction of a high number of endangered species of mammals and birds, and that without such efforts, extinction rates could have been three to four times higher than they currently are (Bolam et al., 2020). In defiance of this are organised efforts at extermination – take for example badger culling. Across the United Kingdom, badger culls have been regularly practiced each year since 2013, in an effort of controlling the spread of bovine tuberculosis (Barkham, 2020). Every year, thousands of healthy badgers are trapped and killed, with the end goal of drastically reducing their numbers - although badgers' involvement in the transmission of bovine tuberculosis is not at all clear-cut. Some evidence even suggests that intra-species transmission (i.e., cow to cow transmission) is significantly more frequent than between-species transmission and given that badger populations even tend to grow significantly larger in years following a cull, this practice seems unnecessarily cruel and even counterproductive (Crispell et al., 2019).

As illustrated with the examples above, people tend to consider animals as inferior to humans and as a result, as less deserving of moral concern (Caviola & Capraro, 2020;

Dhont et al., 2020; Herzog, 2011; Joy, 2010). However, as illustrated through the above statistics, not all animals are judged equally either. Research on how much moral concern people are willing to show to animals indicates that moral concern is tied to the animal's species membership. Philosophers and psychologists alike describe this as an expression of speciesism, or prejudice based on species membership alone (e.g., Caviola et al., 2019; Dhont et al., 2020; Horta, 2009; Plous, 2003; Singer, 1975; e.g., Caviola & Capraro, 2020). Furthermore, Leite and colleagues (2019) demonstrated that, in a US-American sample, moral concern for animals widely differed between different social-functional categories of animals. We refer to this difference in moral status awarded to animals of different categories as the *moral divide* between animals. The *moral divide* has been observed across different contexts and may happen regardless of the animals' actual cognitive and emotional capabilities. Instead, it is more closely related to the animal's socially constructed status as either companion, appealing wild, unappealing wild, or food animal.

Indeed, some animals possess a relatively high status in Western societies, such as *companion animals* and *appealing wild animals* (Leite et al., 2019). Companion animals, like cats and dogs, tend to constitute part of the family and are active participants in people's day-to-day lives, providing comfort and company. As such, they usually receive high levels of moral concern (e.g., Leite et al., 2019) and people tend to be highly empathetic towards these animals, expressing care and concern for their wellbeing (Hodson et al., 2014; Preylo & Arikawa, 2008). Similarly, some wild animals like chimpanzees, dolphins, and pandas are also highly valued in society. Such *appealing wild animals* are typically perceived as highly intelligent, as more similar to humans, or as deserving of protection due to species endangerment, as is the case for example for pandas (Batt, 2009; Plous, 1993).

In contrast, *unappealing wild animals* typically hold a lower status, are perceived as less similar to humans, and are oftentimes linked to danger and disease. This category includes animals such as badgers, rats, snakes, and snails (Batt, 2009; Kellert, 1993). Over (2021) argued that the associations made with animals of different social-functional categories may also transfer to human outgroups. Comparing human outgroups to pandas for example would not be considered particularly offensive, whereas a comparison with rats or snakes evokes the negative associations typically made with those animals.

Hence, people typically express much less moral concern to unappealing wild animals than to companion animals and appealing wild animals (Leite et al., 2019). However, the literature on perceptions of unappealing wild animals is still scarce as most research to date has been focusing on yet another category of low-status animals, that is the category of farmed animals or those animals that are typically perceived as *food animals*.

1.2. The Psychology of Eating Animals

Animals that are traditionally eaten, such as pigs and cows, are known to receive much less moral concern than companion animals or appealing wild animals and research has demonstrated that the animals' status as food itself is a critical factor causing this difference. For example, Bratanova and colleagues (2011) presented participants across four conditions with information on "Bennett's tree kangaroo", described as an animal native to Papua New Guinea. Two conditions presented the animal as food, in one through human involvement by hunting, and in another as being scavenged after accidental death. The other two conditions presented the animal as non-food, describing either just its habitat or its accidental death. The results indicated that the categorisation of the animal as food, regardless of humans' active or passive

involvement in its death, led to participants judging the tree kangaroo as significantly less capable of suffering than did participants in the non-food conditions. Importantly, this study showed that simply categorising an animal as food led to perceptions of the animal as less capable of suffering and feeling pain. As a result, the animal was awarded less moral concern.

However, it is also important to note that the animals making up the categories of food vs. non-food may change depending on cultural and geographic contexts, further supporting the notion that such categories are socially constructed and not depending on some innate qualities of the animals. For instance, animals that are typically viewed as food in one location may be seen as protected, appealing wildlife in another. Take for example the practice of whaling, which is seen as barbaric in most European countries but holds cultural importance in Iceland and Norway (Murata, 2007). Hence, whales would likely fall into the category of appealing wild animals and receive higher levels of moral concern in many European countries. However, in those countries (e.g., Norway) where whale hunting is part of the cultural practices and whales are considered a food animal, people might express much less moral concern towards whales, in a more similar manner to how other Europeans view cows. When considering food animals specifically, a range of factors are at work in upholding the status quo of meat consumption and animal exploitation.

1.3. The Meat Paradox and Cognitive Dissonance Strategies

While most people would likely state that they care for animals, these same people also typically engage in behaviours that harm animals, such as eating animal-based foods and using goods produced using animal products (e.g., Dhont et al., 2020). This phenomenon has been coined the "Meat Paradox" (e.g., Loughnan & Davies, 2020). The meat paradox refers to the inconsistency between claiming to care for animals yet

simultaneously engaging in practices that perpetuate animal suffering (e.g., Rothgerber, 2020b). When such inconsistencies are highlighted or made salient, individuals typically experience negative emotions, entering into a state of cognitive dissonance which usually leads to engagement in dissonance reduction strategies, either through a change in behaviour, or a change in cognition (e.g., Festinger, 1957; Loughnan & Davies, 2017).

Scholars specifically refer to *meat-related cognitive dissonance* to denote the discomfort experienced by meat eaters in the dissonance state of caring deeply for animals yet engaging in eating meat (e.g., Rothgerber, 2020a). Rothgerber (2020a) reviewed the evidence on a wide range of strategies omnivores may use to avoid and reduce this meat-related cognitive dissonance. Such strategies include, but are not limited to, behavioural changes, the use of the "Four Ns", avoidance, dissociation, and denial of animal mind, among others.

1.3.1. Behavioural change. In order to feel less guilty about harming animals, people may change their behaviour altogether and become vegetarians or even vegans, ceasing consumption of animal products, thus reconciling their behaviour and cognitions about caring for animals. However, research indicates that a large percentage of self-proclaimed vegetarians report still consuming meat, indicating that performative behavioural changes can be enough to assuage the negative arousal experienced as a result of meat-related cognitive dissonance, while not truly or not fully changing the behaviour (e.g., Rothgerber, 2014b).

1.3.2. The four Ns. Among individuals who are unwilling or unable to change their behaviour to align more closely with their cognitions about animal, some common justifications for continued meat consumption have been observed. The four most

common reasons people state in defence of their meat consumption are that they enjoy the taste of meat (i.e., it's *nice*), they consider eating meat as *natural*, they claim it is *necessary* to eat meat in order to be healthy, and that meat consumption is considered normal because it is the societal status quo (Piazza et al., 2015; see also Joy, 2010). . Bastian and Loughnan (2016) argued that strategies like the use of the four Ns serve to reduce meat-related cognitive dissonance and protect people from the moral discomfort that would arise in the face of potentially immoral actions, such as meat consumption, which involves the death of an animal. However, these "Four N's" are, on their own, not enough to explain why people continue to eat meat while simultaneously claiming to care deeply for animals (Loughnan & Davies, 2020; Piazza et al., in press).

1.3.3. Avoidance. Besides the use of the four Ns, many omnivores may avoid information acknowledging the ethical, environmental and health concerns surrounding meat consumption and the related industries, for example by actively remaining ignorant and avoiding exposure to information on farming and slaughterhouse practices (Rothgerber, 2020b). Avoidance may also be seen in the physical isolation of factory farms and the extreme removal of animal agriculture from general visibility (Rothgerber, 2014a). As a result, many omnivores remain wilfully ignorant regarding the lives and suffering of farmed animals, thus avoiding meat-related cognitive dissonance (Onwezen & van der Weele, 2016).

1.3.4. Dissociation. Related to avoidance is the dissociation of the animal and meat from one another. Dissociation may happen at a large-scale level, for example in supermarkets, with cuts of meat processed and packaged in such a way that consumers can no longer recognise the animal the meat is coming from and will not be reminded of the animal origin. This meat-animal dissociation can also be observed in the everyday language used to describe live animals as compared to meat products: grazing

on a pasture, we see a cow, yet when buying a burger in the supermarket, it is called beef – these everyday euphemisms help to preserve the dissociation between the living animal and the meat for consumption (Benningstad & Kunst, 2020; Plous, 2003; Rothgerber, 2020b). Kunst and Hohle (2016) demonstrated this phenomenon in a series of experiments. Greater dissociation between meat and animal, for example by using euphemistic terms like *harvest* instead of *slaughter*, or by presenting processed meat rather than unprocessed (i.e., presenting a roasted pig without vs. with its head), increased participants' willingness to eat meat, and reduced both empathy and disgust.

These findings do however depend to a certain degree on cultural context and participants' familiarity with seeing unprocessed meat, as the latter appears to desensitise individuals to the negative affect usually associated with meat-related cognitive dissonance. As shown in a later study by Kunst and Haugestadt (2018), participants who were more familiar with seeing unprocessed meat indeed showed weaker dissociation effects when viewing processed vs. unprocessed meat. Conversely, participants who were less familiar with seeing unprocessed meat experienced more disgust and empathy when viewing images depicting unprocessed types of meat.

1.3.5. Denial of animal mind. Behavioural changes and the use of common strategies like the use of the four N's, avoidance, wilful ignorance, and dissociation are indeed some of the most prevalent strategies for reducing meat-related cognitive dissonance. However, some other ways to reduce mental discomfort and meat-related cognitive dissonance focus instead on people's perceptions of food animals directly (see also Rothgerber & Rosenfeld, 2021 for an overview). Specifically, previous research has focused on the denial of mind of food animals, or the fact that food animals are ascribed significantly fewer mental and emotional capabilities than animals of a higher status, when objectively they have similar cognitive capabilities. Bastian and colleagues

(2012) showed across three studies that food animals were ascribed significantly lower mental capacities, and that this effect was more pronounced when meat-related cognitive dissonance was heightened, either by reminding participants of their meat's living animal origin, or by having them anticipate meat consumption. Their results suggest that denying the mind of food animals can indeed reduce the mental discomfort associated with meat-related cognitive dissonance.

While Bastian and colleagues' (2012) work focused mostly on typical food animals (i.e., sheep and cows), this denial of mind does not appear to occur only for traditional food animals, but rather for any animal that is framed as edible. Bratanova and colleagues (2011) showed for example that simply categorising an animal as a food source led people to perceive the animal as less able to suffer, as compared to ratings of the same animal described in a non-edible context. In turn, participants felt less inclined to show moral concern to the animal, but only when it was framed as edible. Bilewicz and colleagues (2011) further demonstrated that omnivores ascribed fewer secondary emotions, or emotions that are typically perceived as uniquely human (like guilt and regret), to animals than vegetarians and vegans did. Moreover, omnivores ascribed significantly fewer secondary emotions to pigs than they did to dogs, further supporting the notion that the perceived edibility of an animal significantly impacts people's cognitions about the animal.

Similar results have also come to light in other studies. Loughnan and colleagues (2010) conducted an experiment in which participants were given either dried nuts or dried beef before judging a cow's mental states and rating how much moral concern the animal was deserving of. Their findings showed that those who consumed the dried beef expressed more moral disengagement as they felt less inclined to show moral concern for animals and ascribed fewer mental states to a cow than

participants who consumed dried nuts. Piazza and Loughnan (2016) further showed that the moral standing of pigs was not influenced by manipulations of the animal's intelligence, whereas information about intelligence did affect the perceived moral standing of tapirs and fictional animals. Moreover, they demonstrated that while people believed they would be inclined to show more moral concern for pigs after learning about their intelligence, this was not true in practice. Thus, a breadth of research supports the notion that edible animals are ascribed significantly fewer mental capabilities, including emotions, especially so when their status as a food animal is highlighted.

1.4. Mnemic Neglect: A self-protective Memory Mechanism

While the aforementioned justifications for continued meat consumption as well as other strategies associated with the avoidance or reduction of meat-related cognitive dissonance are well-documented, a question on the topic of denial of mind does remain: is this a conscious process that people engage in, or might it be rooted deeper, in earlier stages of information processing? Do people actively *disregard* information about food animals' intelligence and sentience when making moral judgements about these animals (i.e., Piazza & Loughnan, 2016), or do they also encode and remember this information incorrectly, especially if they are ideologically motivated to do so? This distinction, if present, could have important implications for activists and researchers alike.

Sedikides and Green (2009) described the process of mnemic neglect, a motivated memory process that acts as a self-protective mechanism. When information is learned that is incongruent with one's positive self-image and attitudes, this information is encoded more poorly and subsequently incorrectly recalled (Green et al., 2005; Sedikides et al., 2016). Hennes and colleagues (2016) demonstrated this phenomenon

in the context of climate change denial. In their studies, memory for scientific information about climate change was directly linked to participants' need to justify the economic system and perceptions of how well this system was doing. Their findings indicate that ideological attitudes, like the need to justify the economic system, motivated participants to misremember facts about climate change, especially when they were led to believe the economic system was suffering, in order to protect the societal status quo. In other words, people did not simply choose to disregard information that was incongruent with their own beliefs but instead appeared to show biased memory processes that had an impact on the correct encoding and recall of the information.

This research into mnemic neglect opens up interesting possibilities for research, not only in the context of climate change denial, but also in the context of human-animal intergroup relations. While killing animals for human consumption and enjoyment clearly carries severe ethical implications, it is also the societal status quo and widely accepted, similar to the behaviours contributing to climate change as described by Hennes and colleagues (2016). Moreover, as discussed in the above section, some research demonstrates that people deny or disregard food animals' cognitive and emotional capabilities when making moral judgements about them, especially so when the animals' status as food is highlighted (e.g., Bastian et al., 2012; Bratanova et al., 2011). However, based on the available evidence on morally and ideologically motivated memory biases (e.g., mnemic neglect) it could be suggested that, rather than simply choosing to disregard this information, it might be poorly encoded and therefore later recalled incorrectly. Moreover, greater endorsement of dominance-based ideologies has been linked to greater endorsement of and support for various practices related to animal exploitation like meat consumption. Some studies have shown that

individuals higher on measures of dominance-based ideologies also tend to feel more threatened by the vegetarian movement (e.g., Dhont & Hodson, 2014; MacInnis & Hodson, 2015), with the latter oftentimes being perceived as a threat to social values, traditions of meat consumption, and the national economy (Judge & Wilson, 2019; Stanley, in press). It is therefore likely that people who are motivated by dominance-based ideologies may make more memory errors about food animals' sentience, in order to uphold and protect the societal status quo of meat consumption and animal exploitation.

1.5. The Role of Socio-Ideological Attitudes

Although moral concern for and perceptions of animals are clearly driven by the animals' socially constructed classifications, some important individual difference variables also shape perceptions of animals and are crucial to understanding the complex nature of people's relationships with animals of different kinds (Dhont & Hodson, 2014; Dhont et al., 2020; Loughnan et al., 2014). Research shows that, in general, dominance-based ideologies are heavily implicated in how people perceive, treat, and think about animals. Indeed, two key dominance-based ideologies widely studied within intergroup relations literature are right-wing authoritarianism (RWA), and social dominance orientation (SDO), and are the two main constructs in the dual-process model of ideology and prejudice, proposed by Duckitt (2001; Duckitt & Sibley, (2009). While these constructs have been mostly studied in the context of human intergroup relations, they have been receiving increased research attention in the domain of human-animal intergroup relations in the last years and have been investigated in relation to speciesism, meat consumption, attitudes towards animals, and vegetarianism (e.g., Dhont & Hodson, 2014; Salmen & Dhont, 2020).

RWA reflects a desire to maintain cultural stability, a resistance to change and is rooted in conventionalism (Altemeyer, 1981). Duckitt and Sibley (2007) theorised that RWA is driven by fear and a desire to maintain social stability and cohesion. This view in turn helps to explain why individuals higher in RWA tend to exhibit greater prejudice towards outgroups who are viewed as threatening to the societal status quo, social security, or stability. RWA is indeed a strong predictor for a multitude of outgroup prejudices, including sexism and racism (e.g., Nicol & Rounding, 2013; Sibley et al., 2007; Meeusen & Dhont, 2015), yet individuals scoring higher on RWA also tend to report higher levels of meat consumption and greater support for animal exploitation (Allen et al., 2000; Dhont & Hodson, 2014). Indeed, meat consumption and many other cultural practices involving animal exploitation can be considered as traditional practices that uphold the dominant carnist ideology and societal cohesion, which may explain why they are considered particularly important by individuals higher in RWA. Moreover, high RWA individuals also tend to feel more threatened by vegetarianism and veganism as a non-exploitative ideological alternative to the status quo of carnism (Dhont & Hodson, 2014).

Although closely related to RWA, the distinct concept of SDO refers more broadly to a desire for group-based dominance and support for inequalities between social groups and is a key component of social dominance theory (Pratto et al., 1994; Sidanius & Pratto, 1999). Similar to RWA, SDO is typically a strong predictor of prejudiced attitudes across a myriad of human intergroup contexts and especially towards low-status and marginalised human outgroups (e.g., Akrami et al., 2000; Kteily et al., 2012; Kteily et al., 2011; Sibley et al., 2007). Kteily and colleagues (2011) demonstrated the predictive value and relative stability of SDO in relation to prejudice over a four-year period, supporting the notion that this construct reflects stable

ideological attitude. While RWA acts to uphold traditions, norms, and adherence to authority, SDO is thus more strongly implicated in ingroup superiority and dominance over outgroups. Pratto and colleagues (1994) argued that SDO is a precursor to prejudiced attitudes, which further act as *hierarchy-enhancing legitimising myths*, or views that help to support and enhance existing social hierarchies and inequalities. Such legitimising myths play an important part in social dominance theory, which suggests that these myths can disguise prejudices and discrimination in a culturally acceptable manner, further enhancing group inequalities (Pratto & Stewart, 2011).

While SDO has been well documented and researched in the realm of human intergroup relations since its conceptual inception, more recently it has become a focal point of interest within the study of human-animal relations, revealing striking parallels to prejudiced human intergroup relations. For example, individuals higher in SDO tend to exhibit stronger support for the use of animals for human gain (Dhont & Hodson, 2014; Dhont et al., 2016; Hyers, 2006) and have been shown to deny food animals' cognitive and emotional capabilities, especially so when the animals' status as food is highlighted (e.g., Piazza et al., 2015; Bilewicz et al., 2011). Importantly, SDO has been shown to be positively and significantly correlated with measures of both speciesism and beliefs in human supremacy over animals, supporting the notion that motives of dominance and hierarchy underpin prejudiced attitudes towards both human and non-human outgroups in a similar manner (Dhont et al., 2016; Dhont et al., 2014; Salmen & Dhont, 2020).

Connecting theorising on human-intergroup relations and human-animal relations Dhont and colleagues (2016), proposed the Social Dominance Human-Animal Relations Model (SD-HARM). SD-HARM posits that SDO underpins and connects prejudiced attitudes towards human and non-human outgroups, more-so than other

ideological predictors like RWA. Dhont and colleagues conducted systematic investigations across different countries and found that SDO did indeed explain the positive connection between speciesism and ethnic prejudice (see also Dhont et al., 2014). Moreover, the authors argue that the emphasis of hierarchy and dominance expressed in the construct of SDO is the linking factor between speciesism and ethnic prejudice. This notion is supported by the fact that RWA and political ideology, as included in their models, could not account for these associations. Evidently, prejudices towards human and non-human outgroups share a common ideological core, and the processes driving them are deeply intertwined.

Jackson's (2019) work further illustrated the relationships between SDO and prejudiced attitudes towards humans and animals. In their university student sample, speciesism was significantly related to negative attitudes towards low-status human outgroups (e.g., disabled people), with SDO accounting for this observation. These findings provided additional evidence for the importance of SDO in underpinning biases in both human intergroup and human-animal relations. As stated by Dhont et al. (2016), these findings illustrate how useful the application of known theoretical frameworks from human intergroup relations research can be to the growing field of human-animal intergroup relations. However, new concepts are emerging, and are equally deserving of researchers' attention.

1.6. Human Supremacy Beliefs and Moral Concern for Animals

Conceptually related to the dominance-based ideological beliefs typically studied in human intergroup relations (i.e., SDO and RWA), is the belief in human supremacy over animals. Research has shown that the extent to which people believe they are inherently superior over animals, or the extent to which they endorse *human supremacy beliefs*, is related to greater acceptance and support for a wide variety of

exploitative practices such as industrial factory farming and the use of animals for entertainment (Caviola et al., 2019; Dhont & Hodson, 2014). People who more strongly endorse human supremacy beliefs are more likely to believe humans have an innate right to dominate over and use animals for their personal gain and entertainment, and that this exploitation is justified by the animals' inferior social hierarchical status (Dhont & Hodson, 2014; Dhont et al., 2020). Human supremacy beliefs have also been found to be closely related to SDO, with people higher in SDO also typically exhibiting higher beliefs in human supremacy over animals and over nature (see also Dhont & Hodson, 2014; Graça et al., 2018; Salmen & Dhont, 2020). Moreover, human supremacy beliefs are considered to be a key component of speciesism (e.g., Caviola et al., 2019; Dhont et al., 2020). While speciesism refers more broadly to prejudice based on species membership, the construct of human supremacy beliefs encompasses the specific elements of supremacy and dominance in the human-animal intergroup relationships (Caviola et al., 2019; Dhont et al., 2020; Leite et al., 2019).

Leite et al. (2019) conducted a longitudinal study to investigate the theoretical links between human supremacy beliefs and the moral exclusion of animals. They showed that over 16 months, individuals who more strongly endorsed human supremacy beliefs were also more likely to exclude animals of both high- and low-status categories from their moral circle. This evidence supports the notion that human supremacy beliefs can be likened to a hierarchy-enhancing legitimising myth, in this case for human dominance over animals. As such, this legitimising myth helps to preserve and enhance hierarchy in human-animal relations, allowing individuals to exclude animals from their moral circle and to justify their exploitation (Dhont & Hodson, 2014).

This phenomenon also draws parallels to the legitimising myths observed in human-human intergroup relations, as discussed in the above section, which are usually closely related to SDO. However, while SDO can be seen as a more general predictor of dominance-based attitudes and prejudices, in the case of human-animal relations, human supremacy beliefs may be a more proximal variable. Furthermore, although human supremacy beliefs predict lower moral concern for animals overall, stronger associations might be expected for moral concern for low-status animals, similarly to how SDO is related to outgroup prejudice particularly towards low-status human outgroups. Thus, human supremacy beliefs may be an especially relevant measure for investigations into the moral divide, possibly widening the divide between low and high-status animals.

1.7. The Need for Reducing Meat Consumption

The previous sections focussed on the processes that contribute to moral judgements about food animals relative to other animal categories, as well as the cognitive processes that play a part not only in these judgements, but also in the encoding and recall of sentience information about food animals. Many food animals, like pigs, have been shown to possess advanced cognitive abilities, similar to those of higher status animals like dogs (Marino & Colvin, 2015). However, as described previously, most people are apt at disregarding information that highlights the sentience of food animals (Bratanova et al., 2011). Moreover, factors such as human supremacy beliefs significantly impact how much moral concern people are willing to extend to animals, especially to those of a lower status, like food animals (Leite et al., 2019). Additionally, meat consumption is seen as nice, as necessary, as normal, and as natural, reinforcing a status quo of consuming animals (Piazza et al., 2015). Unsurprisingly perhaps, most people are therefore reluctant to reduce or completely cease their meat

consumption, although experts warn that meat reduction is a necessary step in combatting the climate crisis (e.g., Piazza, 2020; Steinfeld et al., 2006).

Scientists predict the global demand for meat to almost double in the next 30 years, when already industrial animal agriculture and farming contributes 14.5% of greenhouse gas (GHG) emissions, takes up 80% of arable land globally, and is one of the largest and most severe causes of deforestation (Gerber et al., 2013; Ritchie, 2017a; Steinfeld et al., 2006). Besides its implications within the climate crisis, industrial factory farming also poses a serious health risk to both animals and humans. Conditions on livestock farms are the perfect breeding ground for zoonotic diseases, which easily spread amongst animals in overcrowded conditions, before being transmitted to humans (Graham et al., 2008; Greger, 2007; Jones et al., 2013; Wiebers & Feigin, 2020). Furthermore, livestock farming poses serious ethical challenges, with questions surrounding animal welfare and the morality of meat consumption being at the forefront (e.g., Dhont & Hodson, 2020; Foer, 2009; Joy, 2010; Singer, 1975). Taken together, these ethical, environmental, and health implications of animal agriculture form a trifecta of arguments against it, and in favour of the development and consumption of alternative sources of protein.

1.8. Clean Meat

Scientists have been highlighting and pointing towards the pressing need for a change in global dietary behaviours – a change that needs to move us towards a more sustainable future to address not only the looming climate crisis, but also to address global health threats posed by zoonotic diseases and the ethical concerns linked to the animal farming industry (e.g., Godfray et al., 2018; Tilman & Clark, 2015; Willet et al., 2019). Yet, meat consumption is deeply ingrained into our culture and people are generally reluctant to give up meat or change their habits around meat consumption and

other animal products (e.g., Bastian & Loughnan, 2016; Piazza, 2020). A recent study revealed that people who were more committed to eating meat were also less likely to endorse preventative solutions addressing factory farming as a serious zoonotic disease risk, further supporting the notion that people are generally unwilling to change their dietary habits even in the light of global health threats (Dhont et al., 2021).

While animal-free proteins are growing in popularity, laboratory grown meat poses a solution to those people who are unwilling to give up "real" meat. Given that many people are unlikely to be swayed by information on animal sentience, it is therefore important to consider the factors that affect attitudes towards novel innovations such as laboratory grown meat, in order to move forward into a world where the large-scale exploitation of animals for food is no longer necessary. Chapter 4 explores the individual differences variables that are related to acceptance of laboratory grown meat, also known as clean meat.

Clean meat presents a revolution in food science, borrowing its techniques from advanced medical research. Mark J. Post of Maastricht University has been one of the leading scientists working on the development of clean meat, a product which is structurally identical to meat from a real animal. In 2013, the first laboratory-grown hamburger made headlines both for its surprisingly authentic taste and skyrocketing price - at the time one burger would cost hundreds of thousands of dollars to produce (e.g., BBC News, 2013; Cassiday, 2018).

The production process involves taking muscle-specific stem cells from a live animal, placing them around a 3D-skeleton which shapes the cells into whatever form is preferred, and adding growth media which include nutrients such as amino acids and vitamins (Post, 2013). These growth media are added to help the cells differentiate and develop into muscle fibres, but fat tissue can also be grown to produce fattier types of

meat. The end product can then be processed into steaks, burgers, sausages, chicken wings, with some companies even developing laboratory-grown fish using the same methods (Stephens et al., 2018). The production process means that the meat grown in the lab can be structurally identical to the meat of a real animal but also does not have to be, as it can be modified to fit different taste and nutrient profiles (Mattick et al., 2015). Moreover, leading companies in clean meat (e.g., Upside Foods) are developing techniques to transition to completely animal-free meat production by developing self-renewing starter cells and plant-based growth media that would totally remove any remaining animal welfare concerns currently linked to clean meat production.

Another important point in the case for clean meat is that the risk of zoonotic disease spread associated with traditional livestock farming could be completely eliminated with a move towards clean meat, which is produced in laboratory conditions that are significantly cleaner and safer than traditional animal agriculture environments. Most importantly perhaps, the environmental impact of clean meat is expected to be significantly lower than that of traditional livestock farming. Specifically, clean meat is projected to require up to "…45% lower energy use…. 78-96% lower GHG emissions, 99% lower land use, and 82-96% lower water use…" than traditionally farmed meat (Tuomisto & Teixeira De Mattos, 2011, p. 6117).

Clean meat thus presents itself as the perfect solution to many of the issues facing traditional farming practices, since it eliminates many of the environmental, ethical and health concerns associated with traditional meat while being structurally identical to it (Mattick et al., 2015). However, while clean meat certainly appears perfect on paper, there are certain important barriers to overcome in terms of consumer acceptance before clean meat can become widely produced and affordably available. Identifying these barriers and examining the factors influencing attitudes towards clean

meat is thus an important first step in hopefully moving away from intensive livestock farming.

1.9. Psychological Barriers to Clean Meat Acceptance

Previous research into consumer attitudes towards clean meat has identified two key psychological barriers relating to clean meat's perceived unnaturalness and safety concerns associated with the production technology. Clean meat may be structurally identical to traditional meat, but it is grown in a laboratory, far removed from pastures, blue skies, and real animals. Siegrist and Sütterlin (2017) suggested that consumers might therefore perceive clean meat as unnatural, and in turn hold less favourable attitudes towards it. Cross-cultural evidence shows that indeed, perceived (un)naturalness is a major hurdle for clean meat to overcome – people find the production method, and in turn the product itself, off-putting (see also Shaw & Mac Con Iomaire, 2019; Tucker, 2014; Verbeke et al., 2015; van der Weele & Tramper, 2014). Some may even perceive the product itself as disgusting, or as interfering with "natural processes", and therefore as being unethical (Bryant & Barnett, 2018; Laestadius, 2015; Laestadius & Caldwell, 2015). Laestadius and Caldwell (2015) have compared consumer reactions to clean meat with those to other technological innovations in food science, for example genetic modification and geoengineering. Moreover, greater perceived unnaturalness of clean meat significantly reduces the acceptability of perceived risks associated with the product and the novel production technology in consumers' eyes (Siegrist & Sütterlin, 2017). Further studies have supported the notion that indeed, perceived (un)naturalness of clean meat significantly impacts peoples' willingness to purchase and consume the product (Siegrist et al., 2018).

Another important barrier to the acceptance of clean meat is the perceived safety of the product. A wide range of research supports the idea that novel food technologies, such as those used in the production of clean meat, elicit anxiety in consumers regarding the perceived negative health effects, alleged inadequate nutritional profiles and uncertainty about the production methods, all of which typically stems from a lack of scientific knowledge and understanding of the procedure on consumers' part (e.g., Bryant & Dillard, 2019; Gómez-Luciano et al., 2019; Shaw & Mac Con Iomaire, 2019; Zhang et al., 2020). Bryant and Dillard (2019) for example demonstrated that a high-technology framing of clean meat in the media increased perceptions that clean meat is unsafe. Other studies have also identified safety concerns as a major barrier to clean meat acceptance, findings that hold true across a wide variety of contexts and cultures (see for example Circus & Robison, 2019; Gómez-Luciano et al., 2019; Mancini & Antonioli, 2020; Rolland et al., 2020; Shaw & Mac Con Iomaire, 2019; Zhang et al., 2020). However, some studies have yielded more optimistic results, showing that when consumers learn more about the actual safety of clean meat and the production process, they also perceive greater health and safety benefits of clean meat compared to traditional meat, suggesting that such beliefs can be manipulated through educational strategies (e.g., Mancini & Antonioli, 2020; Rolland et al., 2020). Moreover, Wilks and Phillips (2017) report that participants recognised the lower zoonotic disease risk and ethical benefits associated with clean meat, even when it was perceived as less natural.

Evidently, perceived naturalness and perceived safety are the two major hurdles standing in the way of clean meat acceptance. Previous studies into these barriers have revealed mixed findings, and a more nuanced approach is needed to further disentangle and gain insight into the processes that can potentially stand in the way of clean meat acceptance. While some people might be concerned with the naturalness of their food,

others may not care about this a great deal. Similarly, although some people may be anxious in the face of foods produced using novel technologies, others might perceive the technology as perfectly safe and sound. Specifically, people widely differ in the extent to which they value the naturalness of food products (i.e., food naturalness importance, e.g., Román et al., 2017) as well as in the extent to which they fear novel food technologies (i.e., food technology neophobia, e.g., Cox & Evans, 2008). Both of these constructs have been extensively tested and confirmed in past research, but few studies have examined their predictive roles in relation to attitudes towards clean meat relative to traditional meat. For example, Michel and Siegrist (2019) reported that participants who valued their foods' naturalness more also perceived clean meat as less natural and were less willing to eat it. Wilks et al. (2019) results indicated however that a more generalised naturalness bias was not related to attitudes towards clean meat. These and other studies thus reveal mixed findings, and neither of the two studies discussed above compared attitudes towards clean meat and traditional meat, leaving open the question of whether this naturalness concern affects attitudes towards all types of meat, or only laboratory grown meat.

Wilks and colleagues (2019) also found that the extent to which participants were afraid of new foods (i.e., food neophobia) predicted a lower willingness to eat clean meat. Food neophobia is the extent to which participants are averse to trying new foods (including ethnic, foreign, or unknown foods) – the researchers suggest that those higher in food neophobia may not accurately perceive the actual safety risks and benefits of clean meat, and therefore hold less favourable attitudes towards the food. However, this does not accurately capture the high-technology element of clean meat production, which has been shown in previous studies to be more closely related to attitudes towards clean meat. Food technology neophobia on the other hand has been

shown to reliably correlate with attitudes towards foods produced using novel food technologies, such as the use of genetic modification, food irradiation, or nanotechnologies which have also faced consumer opposition on grounds of being perceived as both unsafe and unnatural (e.g., Cox et al., 2007; Evans & Cox, 2006; Evans et al., 2010; Siegrist & Hartmann, 2020).

Chapter 2: Research Overview

The ways in which we think about animals and treat them are complex, deeply engrained in most of society, and usually taught from birth. This thesis aims to add to the existing and rapidly growing literature examining human-animal intergroup relations from a social psychological viewpoint, drawing on parallels with human intergroup relations. Aiming to fill several gaps in the literature, this thesis presents three distinct, yet interconnected research lines across three empirical research chapters. Broadly speaking, these three empirical chapters address questions on how people think about animals in a moral sense, how people remember information about these animals, and how people evaluate traditional meat dishes relative to "clean" meat dishes, which are produced in the laboratory, using novel technologies characterised by animal- and cruelty-free methods.

The first set of studies (Chapter 3) of this thesis focuses on moral concern for animals and the factors that contribute to how we think morally about animals belonging to different social-functional categories, with special attention on food animals relative to other animal categories (e.g., appealing wild animals, unappealing wild animals, and companion animals). Specifically, the central question of Chapter 3 is whether human supremacy beliefs are a significant predictor of not only generalised moral concern for animals, but also of the moral divide between animal categories, above and beyond the effects of SDO. Across two studies we followed the categorisations of animals as reported by Leite and colleagues (2019), classifying them into two high-status categories including appealing wild animals (chimp, kangaroo, whale, dolphin, bear, lion) and companion animals (dog, cat, horse), and two low-status categories including unappealing wild animals (bat, snake, snail, and frog) and food animals (pig, cow, chicken, turkey, sheep, duck). The central hypothesis was an

interaction effect between animal category and human supremacy beliefs on moral concern for animals such that, although human supremacy beliefs would be associated with lower levels of moral concern for all animal categories, this effect was expected to be more pronounced for low-status animals as compared to high-status animals.

While Chapter 3 deals with the topic of moral concern for animals overall, Chapter 4 focuses only on food animals and considers how information about these animals is remembered based on participants' differing levels of endorsement of dominance-based ideologies. Specifically, Chapter 4 extends the research on denial of animal mind by employing a social-cognitive methodology to test for motivated memory biases in relation to sentience information for food animals, and whether motivated memory errors specifically for sentience information are more likely to arise in participants higher in dominance-based ideologies like SDO and RWA. In two studies, participants learned information about the cognitive and emotional capabilities of pigs. Pigs were chosen due to their typical status as food animals in the UK which are rarely kept as pets yet have been shown to have high cognitive abilities and are known to be highly social animals (see Mendl et al., 2010 for an overview of research into pig cognition). Therefore, the information presented to participants accurately represented the cognitive abilities of pigs and presented them as intelligent animals.

The first study sought to establish whether ideologically motivated (i.e., by RWA and SDO) individuals make more memory errors when remembering sentience information about food animals. The second study sought to establish whether such memory errors arise only for sentience information, or for any information about food animals. This was implemented through the addition of non-threatening information, relating to the uses of pigs. Specifically, we added information on how different parts of a pig can be used for medical and culinary purposes. Crucially, this would allow us

to disentangle whether memory errors arise for any information relating to food animals, or whether this is solely the case for information that may potentially be threatening. If the latter were confirmed, we would observe memory errors for information pointing to the advanced cognitive abilities of pigs, but not for information relating to their uses for humans. This effect was also expected to be more pronounced for people higher in dominance-based ideologies, as opposed to those lower in such ideologies. This set of studies thus focuses on memory performance for facts regarding animal sentience, investigating the ideologically motivated memory processes underlying the recollection of sentience information for food animals, relative to information relating to the uses of these animals.

The final set of experiments (Chapter 5) focuses not on human perceptions and evaluations of animals directly, but instead on human consumption and evaluations of animal and non-animal products by comparing people's evaluations of traditional meat dishes with their evaluations of laboratory-grown (also known as clean) meat dishes. The latter is a promising scientific innovation, which has the potential to disrupt the traditional animal farming industry at a large scale by presenting a cruelty-free and significantly more sustainable analogous option to traditional meat. Across three experiments, consumers' attitudes towards clean meat relative to traditional meat were examined. An important difference to note between previous research and the current experiments is that while most other research used written descriptions of clean meat, across the current experiments images of real food were presented to participants. Images were labelled as either clean or traditional meat, with the labelling counterbalanced and randomised across conditions to control for image content. Participants who are warier of novel food technologies and those who value the naturalness of their food more strongly were expected to prefer images labelled as

traditional meat, and this effect was expected to be mediated by perceived safety and perceived naturalness, respectively. The results and implications are discussed in detail in Chapter 5.

While these three research lines each have a distinct focus, they are interconnected in important ways. All three research lines examine people's thinking about animals and meat: spanning moral evaluations, memory performance, and evaluations of traditional and non-traditional meats and meat substitutes. These evaluations and ways of thinking are oftentimes rooted in self-serving biases, which in turn are qualified by differences in ideological and psychological beliefs relating to how people think about and interact with animals of different statuses.

Taken together, this thesis aims to contribute to the growing body of literature and research conducted in the domain of human-animal intergroup relations. Understanding cognitions about animals and the psychological barriers to the acceptance of meat substitutes like clean meat are of utmost importance should we wish to address the climate crisis, as well as the ethical and public health concerns associated with traditional animal agriculture. The final chapter of the thesis, Chapter 6, closes with a discussion of the three research lines and details some important limitations as well as future directions.

Chapter 3: The Moral Divide between High- and Low-status Animals: The Role of Human Supremacy Beliefs[1]

3.1. Introduction

Animals come in many shapes – some are cute and fluffy, some elicit disgust, and some are considered the perfect lunch. We love our companion animals, considering them part of the family, yet eat farmed animals (Bastian & Loughnan, 2016; Joy, 2010; Loughnan et al., 2014) and recoil at the thought of wild animals linked to disease or danger (Herzog, 2011; Piazza et al., 2014). These differences between non-human animal categories are also reflected in the extent to which people care morally about different animals. People attribute different moral value to different animals based solely on their species membership, even if these animals have comparable mental and emotional capabilities (e.g., dogs and pigs). The differential treatment and moral valuation of animals has been observed across various contexts (Caviola et al., 2021; Herzog, 2011; Joy, 2010) and described as an expression of speciesism by scholars in philosophy (e.g., Horta, 2009; Singer, 1975) and psychology (e.g., Caviola & Capraro, 2020; Caviola et al., 2019; Dhont et al., 2020; Plous, 2003). We refer to this difference in attributed moral status between different animals as the moral divide. For instance, Leite, Dhont, and Hodson (2019) demonstrated that people show much less moral concern for low-status animals such as food animals (e.g., pigs) and unappealing wild animals (e.g., snakes) than for high-status animals such as companion animals (e.g., dogs) and appealing wild animals (e.g., dolphins and chimps) (see also Bratanova et al., 2011; Leach et al., 2021; Piazza, 2020). Although the tendency to value some animals over others has been intensively discussed by

[1] This chapter has been published in Anthrozoös with co-authors Kristof Dhont and Alina Salmen. Some minor changes were made to the manuscript before inclusion in this thesis. The published article can be accessed at: https://doi.org/10.1080/08927936.2021.1926712

philosophers and animal rights advocates, the psychological factors that are potentially related to this phenomenon received only scant research attention in the psychological literature.

Moral concern for animals is not only shaped by the animals' socially constructed classifications, but also driven by stable individual difference variables (Dhont & Hodson, 2014; Dhont et al., 2020; Loughnan et al., 2014). Specifically, the extent to which people believe that humans are inherently superior to other animals (i.e., human supremacy beliefs) is related to a greater acceptance of using animals for a wide range of practices, including industrial factory farming, breeding animals for their skin (e.g., fur coats), and the use of animals for entertainment (e.g., circus, rodeos) and cosmetic testing (Caviola et al., 2019; Dhont & Hodson, 2014). Dhont and Hodson (2014) argued that this belief in human supremacy serves as a legitimising strategy to preserve and enhance hierarchy in human-animal relations and allows individuals to exclude all types of animals from moral circles (see also Leite et al., 2019). Indeed, if animals are considered inherently inferior to humans, then it is easier to justify the continued consumption of animal products and the use of animals for human benefits (Dhont & Hodson, 2014; Dhont et al., 2020).

It is presently unclear, however, whether human supremacy beliefs also relate to a greater perceived moral divide between different animal categories. The central hypothesis tested in the present research is that those who more strongly endorse human supremacy beliefs will make greater moral distinctions between low- and high-status animals when indicating their moral concern for animals. Indeed, although previous research showed that human supremacy beliefs longitudinally predict lower moral concern for both low- and high-status animals (Leite et al., 2019), we expected that human supremacy beliefs would be more strongly associated with moral concern for

low-status animals than moral concern for high-status animals, thereby further increasing the moral divide between low- and high-status animals.

Drawing on theorising and findings from research on human intergroup relations, it is well-established that those strongly driven by motives of power and group-based dominance (i.e., those higher on social dominance orientation, SDO) express greater prejudice towards low-status and disadvantaged human outgroups and endorse hierarchy-enhancing legitimising myths (e.g., holding racist or sexist views) to preserve and enhance existing social hierarchies (Hodson et al., 2010; Kteily et al., 2012; Sidanius & Pratto, 1999). Moreover, people higher on SDO not only tend to justify inequality in human intergroup relations, they are also more likely to hold speciesist attitudes (e.g., Dhont et al., 2014; Dhont et al., 2016) and to justify or rationalise the consumption and exploitation of animals, for example, by denying the cognitive and emotional capabilities of farmed animals or focusing on the presumed normality or necessity of eating or harming animals (e.g., Hyers, 2006; Jackson & Gibbings, 2016; Piazza et al., 2015). In other words, desires for group-based dominance and inequality are implicated in people's prejudiced attitudes and behaviours both towards human and non-human social groups, with SDO underpinning both types of biases (Dhont et al., 2014; Dhont et al., 2016; Jackson, 2019; Salmen & Dhont, 2020).

Extending the scope of this research line, Jackson (2019) investigated the associations between SDO, speciesism, and attitudes towards a wide range of human social groups in two samples of university students. The findings showed that higher levels of speciesism were associated with more negative attitudes towards low-status and hierarchy-attenuating groups (e.g., disabled people) but not with attitudes towards high-status or hierarchy-enhancing groups (e.g., bankers). Furthermore, and in line with previous research, SDO explained the relation between speciesism and negative

attitudes towards low-status and hierarchy-attenuating groups, confirming its role as common ideological root of biases in human intergroup and human animal-relations (Dhont et al., 2016).

However, whereas SDO refers to general desires for group-based dominance in human intergroup relations, we focused specifically on desires for dominance over non-human animals (rather than humans), i.e., human supremacy beliefs. In other words, the construct of human supremacy beliefs is theoretically parallel to SDO and both constructs are significantly, positively correlated (e.g., Dhont & Hodson, 2014), yet given the current focus on status differences between animal categories, a measure of human supremacy beliefs is arguably a more proximal variable. Indeed, if endorsement of human supremacy beliefs functions as a strategy to maintain and enhance the status hierarchy between different groups of animals, then higher levels of human supremacy beliefs can be expected to be particularly related to lower moral concern for low-status animals, akin to how SDO is primarily related to prejudice towards human low-status groups.

Theoretically, the belief in human superiority over other animals is closely related to the concept of speciesism, which refers broadly to the "differential treatment (behavioural) or moral evaluation (attitudes and beliefs) of animals merely based on their species membership" (Dhont et al., 2020, p 30; see also Caviola et al., 2019). Indeed, human supremacy beliefs are considered a key component of a speciesist belief system (Caviola et al. 2019; Dhont et al., 2020). However, in terms of measurement, the speciesism scale developed by Caviola et al. (2019) tends to tap into people's levels of moral acceptance of different *expressions* of speciesist beliefs such as whether it is morally acceptable to keep animals in circuses for human entertainment. Hence, the items of the speciesism scale do not directly tap into the principled or ideological belief

in human supremacy over animals. The human supremacy beliefs scale developed by Dhont and Hodson (2014) is better suited to tap into preferences for dominance and hierarchy in human-animal relations, that we expect to underly the moral divide (e.g., Leite et al., 2019).

Across two studies, we extended the growing body of research by investigating the associations between human supremacy beliefs and moral concern for different animal groups. Specifically, we presented participants with a list of animals belonging to low-status groups (i.e., food animals in Studies 1 and 2, and also unappealing wild animals in Study 2) and high-status groups (companion animals and appealing wild animals in Studies 1 and 2) and asked them to rate how much moral concern they feel compelled to show each animal. In line with previous research (e.g., Leite et al., 2019), we expected that participants would show higher levels of moral concern for animals belonging to a high-status category than for animals belonging to a low-status category. Furthermore, we expected an interaction effect between animal category and human supremacy beliefs on moral concern for animals such that, although human supremacy beliefs would be associated with lower levels of moral concern for all animal categories, this effect was expected to be stronger for low-status than for high-status animal categories. As a result, a greater perceived moral divide between low- and high-status animals among those higher on human supremacy beliefs was expected.

3.2. Study 1

The aim of Study 1 was to test the hypotheses in a heterogeneous sample of British adults. We focused on the moral divide between food animals, which are typically attributed a lower status, and two high-status animal categories, namely, companion animals and appealing wild animals.

3.2.1. Methods

Participants and Procedure. Ethical approval to conduct this study was given by the research ethics committee at the authors' institution and all participants provided informed consent electronically before taking part. The sample of Study 1 consisted of 196 British Prolific Academic participants (M_{age}= 35.4 years, SD = 12.8; 30.1% male, 68.9% female, 1% identified as transgender/other) who completed an online survey including measures of human supremacy beliefs, moral concern for animals and demographics. Most participants self-identified as meat eaters (72.4%), 14.8% as flexitarians; 2.6% as pescatarians; 7.1% vegetarians, 2.6% as vegans and the remaining 0.5% identified as other. A sensitivity analysis using G*Power (Faul et al., 2009), assuming $\alpha = 0.05$ and 95% power, indicated that the weakest effect size detectable with this sample size was f = .09 (i.e., a small effect).

Measures. Respondents completed the 6-item human supremacy beliefs scale (1, *strongly disagree*; 7, *strongly agree*; Dhont & Hodson, 2014). To measure moral concern for animals, we presented a written list of 15 animal names, all on the same page in a randomised order, including 1) companion animals: dog, cat, horse 2) food animals: pig, cow, chicken, turkey, sheep, duck; and 3) appealing wild animals: chimp, kangaroo, dolphin, bear, lion (based on Laham, 2009; see also Leite et al., 2019[2]). Participants were asked to indicate to what extent they feel morally obligated to show concern for each animal on 7-point scales (1, *Not at all;* 7, *Very much so*). Moral concern for each animal category was computed by calculating the average score of moral concern across all animals belonging to that category. Scale reliability scores for each animal category indicate good to excellent internal consistency of categories.

[2] These animal categories are based on previous research, with factor analyses supporting these categorisations (Leite et al., 2019).

Correlations, means, standard deviations, and scale reliability scores are reported in Table 3.1. The data and materials used in this chapter can be accessed via the Open Science Framework: https://osf.io/7hb8z/ and the full materials for this study can be found in Appendix A.

3.2.2. Results

First, we tested whether moral concern for animals significantly differed between animal categories. A repeated measures ANOVA showed significant differences between moral concern for the three animal categories, $F(1.69, 329.34) = 90.39$, $p < .001$, $\eta_p^2 = .317$[3]. Participants showed greater moral concern for companion and appealing wild animals than for food animals, $F(1, 195) = 135.84$, $p < .001$, $\eta_p^2 = .411$ and $F(1, 195) = 91.00$, $p < .001$, $\eta_p^2 = .318$ (see Table 3.1. for Ms and SDs). Moral concern for appealing wild and companion animals did not significantly differ from each other, $F(1, 195) = 3.17$, $p = .076$, $\eta_p^2 = .016$.

[3] F-test results of the main effect of animal category are estimates adjusted for lack of sphericity using the Greenhouse-Geisser correction. Indeed, Mauchly's test for sphericity indicated that sphericity had been violated, potentially inflating the F-value if not corrected for. The Greenhouse-Geisser correction is robust to violations of sphericity and applies a correction to the degrees of freedom, leading to a valid F-ratio (e.g., Abdi, 2010).

Table 3.1. *Descriptive statistics, scale reliabilities, and zero-order correlations between moral concern for different animals, human supremacy beliefs, and demographic variables in Study 1.*

	M	SD	α	1	2	3	4	5	6	7
1. Food animals	4.47	1.71	.98	-	.70**	.64**	-.48**	.16*	.09	.34**
2. Companion animals	5.49	1.26	.81		-	.77**	-.40**	.16*	-.01	.23**
3. Appealing wild animals	5.38	1.35	.94			-	-.35**	.14*	.06	.21**
4. Human Supremacy Beliefs	3.51	1.30	.90				-	-.20**	.08	-.34**
5. Gender	/	/						-	-.01	.17*
6. Age	35.40	12.83								.04
7. Diet	1.52	1.02								-

Note. Gender 1 = Male, 2 = Female; Diet ranges from 1 (Meat Eater) to 5 (Vegan); * $p < .05$; ** $p < .001$.

Next, we tested the hypothesis that human supremacy beliefs moderate the effect of animal category on moral concern for animals by including human supremacy beliefs as a continuous predictor of moral concern for animals in the repeated measures ANOVA. The results revealed a significant interaction between human supremacy beliefs and animal category, $F(1.730, 335.69) = 11.84$, $p < .001$, $\eta_p^2 = .058^2$, indicating that the moral divide between categories depended on human supremacy beliefs. Specifically, human supremacy beliefs moderated the moral divide between companion and food animals, $F(1, 194) = 14.65$, $p < .001$, $\eta_p^2 = .070$, and between appealing wild and food animals, $F(1, 194) = 15.04$, $p < .001$, $\eta_p^2 = .072$. However, human supremacy beliefs did not moderate the moral divide between the two high-status animal categories appealing wild *vs.* companion animals, $F(1, 194) = 0.25$, $p = .615$, $\eta_p^2 = .001$.

To further decompose and understand the significant interaction effects, we conducted moderation analysis for within-subjects designs using the MEMORE macro for SPSS (Montoya, 2019). Specifically, extending the analytic procedures proposed by Judd et al. (2001), MEMORE allowed us to test and probe the effect of animal category (i.e., the within-subjects factor) on moral concern for animals at high (+1 SD) and low (-1 SD) levels of human supremacy beliefs (i.e., the moderator). The results of these analyses are reported in Table 3.2. and presented in Figure 3.1. Corroborating our hypothesis, both those higher and lower on human supremacy beliefs indicated to feel less moral concern for food animals than for companion animals and for appealing wild animals, yet this perceived moral divide was significantly larger for those higher on human supremacy beliefs. In other words, those with stronger beliefs in human supremacy over animals perceived larger differences between high- and low-status animal categories in terms of their moral status.

Furthermore, in line with our expectations, the results revealed that human supremacy beliefs predicted lower levels of moral concern for all animal categories, yet this effect was particularly pronounced for food animals (b = -0.64, SE = .08, t(194) = -7.70, p < .001, 95% CI [-0.80, -0.47]). Human supremacy beliefs also predicted lower moral concern for companion animals (b = -0.39, SE = .06, t(194) = -6.02, p < .001, 95% CI [-0.51, -0.26]) and appealing wild animals, (b = -0.36, SE = .07, t(194) = -5.17, p < .001, 95% CI [-0.50, -0.22]), yet these latter associations were significantly weaker than the association between human supremacy beliefs and food animals (b = 0.25, SE = .07, t(194) = 3.83, p < .001, 95% CI [0.12, 0.38] and b = 0.27, SE = .07, t(194) = 3.88, p < .001, 95% CI [0.14, 0.41], respectively).

Finally, to check the robustness of these findings, we tested the interaction effects again but additionally considered the demographic variables that were significantly correlated with any of the key variables of interest. Specifically, both gender and diet were significantly related to the moral concern variables and human supremacy beliefs, and thus we included these variables as additional predictors to adjust for their possible confounding influence. However, this did not meaningfully change the pattern of results; both human supremacy beliefs X animal category interaction effects were still significant (b = 0.19, SE = .07, t(189) = 2.73, p = .007, 95% CI [0.05, 0.33] when considering companion vs. food animals, and b = 0.22, SE = .07, t(189) = 2.89, p = .004, 95% CI [0.07, 0.38] when considering wild appealing vs. food animals).[4]

[4] Given that gender and diet were included as control variable in these analyses, only the data of those participants who indicated to belong to the gender category of men or women, and only those who did not indicate "other" as dietary category were included in these analyses. Based on these criteria, the data of three participants was excluded from these additional analyses in Study 1.

Figure 3.1. *Moral concern ratings as a function of animal category at low (–1 SD) and high (+1 SD) levels of Human Supremacy Beliefs (Study 1)*

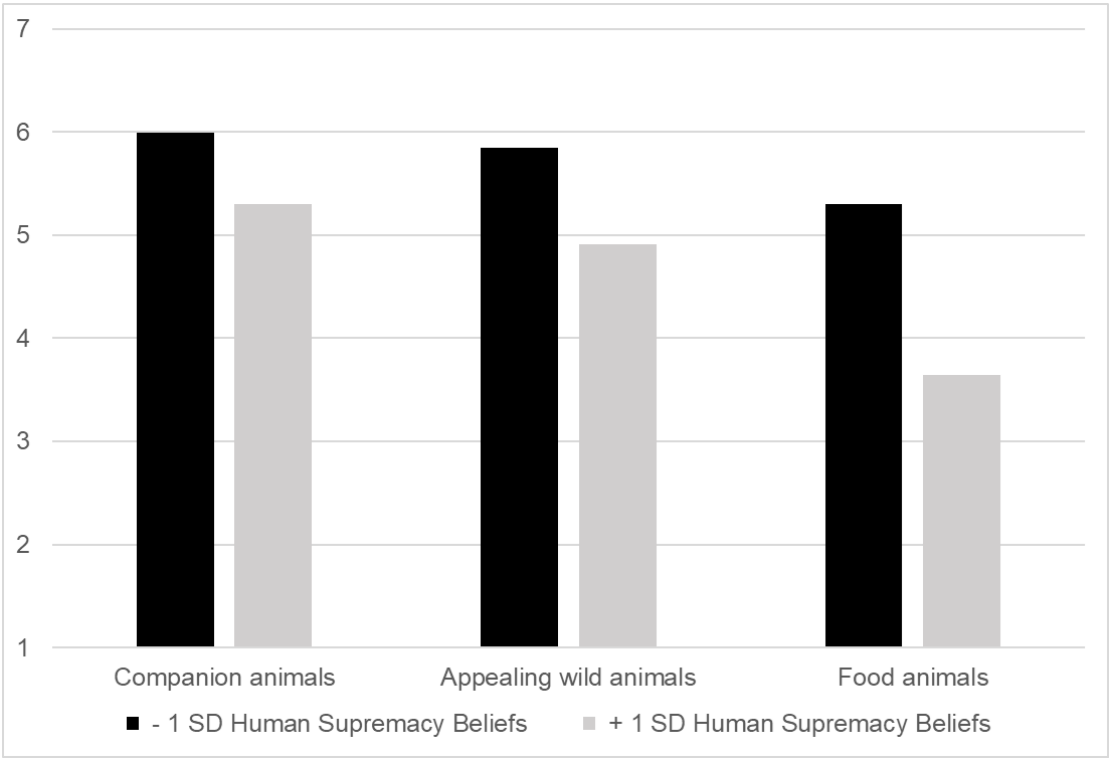


Table 3.2. *Results of moderation analyses in Study 1 testing the interaction between animal category X human supremacy beliefs on moral concern for animals.*

	Animal category X human supremacy interaction					Low levels (-1SD) of human supremacy beliefs					High levels (+1SD) of human supremacy beliefs				
	b	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*
Companion vs. food animals	0.25	.07	3.83	<.001	[0.12, 0.38]	0.69	.12	5.80	<.001	[0.46, 0.93]	1.34	.12	11.22	<.001	[1.11, 1.58]
Appealing wild vs. food animals	0.27	.07	3.88	<.001	[0.14, 0.41]	0.55	.13	4.23	<.001	[0.29. 0.81]	1.26	.13	9.72	<.001	[1.01, 1.52]
Companion vs. appealing wild animals	-0.02	.05	-0.50	.615	[-0.12, 0.07]	0.15	.09	1.61	.109	[-0.03, 0.32]	0.08	.09	0.90	.370	[-0.10, 0.26]

3.3. Study 2

The aim of Study 2 was to replicate and extend the findings of Study 1 by testing whether similar patterns would occur when including non-food animals holding a low status. Specifically, we additionally included unappealing wild animals such as snakes and bats as a separate low-status group (Leite et al., 2019). Furthermore, given the pronounced associations between SDO and human supremacy beliefs (e.g., Dhont & Hodson, 2014; Salmen & Dhont, 2020), we statistically controlled for SDO to demonstrate the unique role of human supremacy beliefs in predicting the moral divide between high- and low-status animal groups.

3.3.1 Methods

Participants and Procedure. Ethical approval to conduct this study was given by the research ethics committee at the authors' institution and all participants provided informed consent electronically before taking part. Respondents were 254 British Prolific Academic participants[5] (M_{age} = 31.2, SD = 10.6; 44.1% female), who completed the relevant measures in an online survey, with 80.7% self-identified as omnivores, 11.8% flexitarians, 1.6% pescatarians, 3.5% vegetarians, 1.6% vegans, and the remaining 0.8% as other. A sensitivity analysis using G*Power (Faul et al., 2009), assuming $\alpha = 0.05$ and 95% power, indicated that the weakest effect size detectable with this sample size was f = .09 (i.e., a small effect).

Measures. We measured human supremacy beliefs and moral concern for companion animals, food animals and appealing wild animals in a similar way as in Study 1, and we added several animals belonging to the category of unappealing wild animals to the list of animals (i.e., bat, snake, snail, and frog) in the moral concern measure[1]. As in the first study, the list of animals was presented on one page in a randomised order. We

[5] Two participants were excluded due to incomplete data.

also measured SDO with the short, eight-item measure (1, *strongly disagree*; 7, *strongly agree*) developed by Ho et al. (2015). For all correlations, means, standard deviations and scale reliability scores, see Table 3.3. The full materials can be found in Appendix A.

Table 3.3. *Descriptive statistics, scale reliabilities, and zero-order correlations between moral concern for different animals, human supremacy beliefs, and demographic variables in Study 2.*

	M	SD	α	1	2	3	4	5	6	7	8	9
1. Food animals	5.02	1.44	.96	-	.55**	.63**	.69**	-.42**	-.21**	.20**	.03	.23**
2. Companion animals	6.06	1.06	.84		-	.61**	.31**	-.27**	-.24**	.15*	-.11	.13*
3. Appealing wild animals	5.60	1.22	.85			-	.64**	-.32**	-.29**	.18**	.06	.23**
4. Unappealing wild animals	4.00	1.79	.92				-	-.40**	-.29**	.16*	.03	.26**
5. Human Supremacy Beliefs	4.09	1.34	.86					-	.32**	-.28**	.03	-.28**
6. SDO	2.92	1.10	.82						-	-.22**	.02	-.13*
7. Gender	/	/								-	.05	.18**
8. Age	16.23	10.61									-	.001
9. Diet	1.32	0.81										-

Note. Gender 1 = Male, 2 = Female; Diet ranges from 1 (Meat Eater) to 5 (Vegan); * $p < .05$; ** $p < .001$.

3.3.2. Results

Replicating Study 1, a repeated measures ANOVA confirmed that the moral concern scores varied significantly between the categories, $F(2.18, 553.54) = 225.16$, $p < .001$, $\eta_p^2 = .471$[6]. Participants showed greater moral concern for companion and appealing wild animals than for food animals, $F(1, 253) = 179.02$, $p < .001$, $\eta_p^2 = .414$, and $F(1, 253) = 63.81$, $p < .001$, $\eta_p^2 = .201$. Moral concern was also higher for companion and appealing wild animals than for unappealing wild animals, $F(1, 253) = 340.47$, $p < .001$, $\eta_p^2 = .574$, and $F(1, 253) = 341.06$, $p < .001$, $\eta_p^2 = .574$. Furthermore, participants showed greater moral concern for food animals than for unappealing wild animals $F(1,253) = 156.26$, $p < .001$, $\eta_p^2 = .382$, and greater concern for companion than for appealing wild animals $F(1, 253) = 50.15$, $p < .001$, $\eta_p^2 = .165$.

Next, testing the moderating role of human supremacy beliefs yielded a significant interaction between human supremacy beliefs and animal category, $F(2.24, 564.64) = 11.87$, $p < .001$, $\eta_p^2 = .045$[2]. Specifically, human supremacy beliefs significantly moderated the moral divide between companion and food animals and between companion and unappealing wild animals, $F(1, 252) = 18.30$, $p < .001$, $\eta_p^2 = .068$ and $F(1, 252) = 16.28$, $p < .001$, $\eta_p^2 = .061$. Furthermore, human supremacy beliefs also moderated the moral divide between appealing wild and food animals, $F(1, 252) = 9.36$, $p = .002$, $\eta_p^2 = .036$, and between appealing wild animals and unappealing wild animals, $F(1, 252) = 15.86$, $p < .001$, $\eta_p^2 = .059$. However, human supremacy beliefs did not moderate the moral divide between the two high-status animal categories: appealing wild vs. companion animals, $F(1, 252) = 2.49$, $p = .116$, $\eta_p^2 = .010$, nor

[6] F-test results of the main effect of animal category are estimates adjusted for lack of sphericity using the Greenhouse-Geisser correction. Indeed, Mauchly's test for sphericity indicated that sphericity had been violated, potentially inflating the F-value if not corrected for. The Greenhouse-Geisser correction is robust to violations of sphericity and applies a correction to the degrees of freedom, leading to a valid F-ratio (e.g., Abdi, 2010).

between the two low-status animal categories: food animals vs. unappealing wild animals, $F(1, 252) = 2.04$, $p = .154$, $\eta_p^2 = .008$.

To further decompose these interaction patterns, we conducted moderation analysis for within-subjects designs (using MEMORE for SPSS; Montoya, 2019) and tested the effect of animal category on moral concern for animals at high (+1 SD) and low (- 1SD) levels of human supremacy beliefs. The results of these analyses are reported in Table 3.4. and presented in Figure 3.2. Replicating the findings of Study 1, both those higher and lower on human supremacy beliefs indicated to feel less moral concern for food animals than for companion animals and for appealing wild animals, yet this perceived moral divide was significantly stronger for those higher (vs. lower) on human supremacy beliefs. Extending the findings of Study 1, both those higher and lower on human supremacy beliefs felt less moral concern for unappealing wild animals than for companion animals and for appealing wild animals, yet again, this perceived moral divide was significantly stronger for those higher (vs. lower) on human supremacy beliefs. Taken together, those with stronger human supremacy beliefs perceived a larger moral divide between high- and low-status animal categories.

Furthermore, replicating the results of Study 1, human supremacy beliefs showed pronounced associations with lower levels of moral concern for low-status animals (i.e., for food animals, $b = -0.45$, $SE = .06$, $t(252) = -7.35$, $p < .001$, 95% CI [-0.57, -0.33]; and for unappealing wild animals, $b = -0.54$, $SE = .08$, $t(252) = -6.99$, $p < .001$, 95% CI [-0.69, -0.39]). Moreover, human supremacy beliefs also predicted lower moral concern for high-status animals (i.e., for companion animals, $b = -0.21$, $SE = .05$, $t(252) = -4.42$, $p < .001$, 95% CI [-0.31, -0.12]; and for appealing wild animals, ($b = -0.29$, $SE = .05$, $t(252) = -5.29$, $p < .001$, 95% CI [-0.39, -0.18]), yet the significant interaction terms (see Table 3.4.) indicated that the associations for the low-status

animal categories were significantly stronger than the associations for the high-status animal categories.

Finally, as a robustness check, we conducted the same analyses again with the additional inclusion of SDO, gender and diet as predictors of moral concern because these variables were significantly correlated with the key variables of interest (i.e., see Table 3.3.). Adjusting for the variance explained by SDO, gender, and diet did not meaningfully change the pattern of results. All expected interaction effects remained significant, with significant differences between the effects of human supremacy beliefs on moral concern for companion vs. food animals $b = 0.22$, $SE = .06$, $t(240) = 3.47$, $p < .001$, 95% CI [0.09, 0.34], moral concern for companion vs. unappealing animals ($b = .24$, $SE = .09$, $t(240) = 2.61$, $p = .010$, 95% CI [0.06, 0.42]), moral concern for appealing wild vs food animals ($b = .19$, $SE = .06$, $t(240) = 3.14$, $p = .002$, 95% CI [0.07, 0.31]), and moral concern for appealing wild animals vs. unappealing wild animals ($b = .21$, $SE = .07$, $t(240) = 2.94$, $p = .004$, 95% CI [0.07, 0.35]).[7]

[7] Given that gender and diet were included as control variable in these analyses, only the data of those participants who indicated to belong to the gender category of men or women, and only those who did not indicate "other" as dietary category were included in these analyses. Based on these criteria, the data of three participants was excluded from these additional analyses in Study 1, and the data of nine participants was excluded from these additional analyses in Study 2.

Figure 3.2. *Moral concern ratings as a function of animal category at low (–1 SD) and high (+1 SD) levels of Human Supremacy Beliefs (Study 2)*

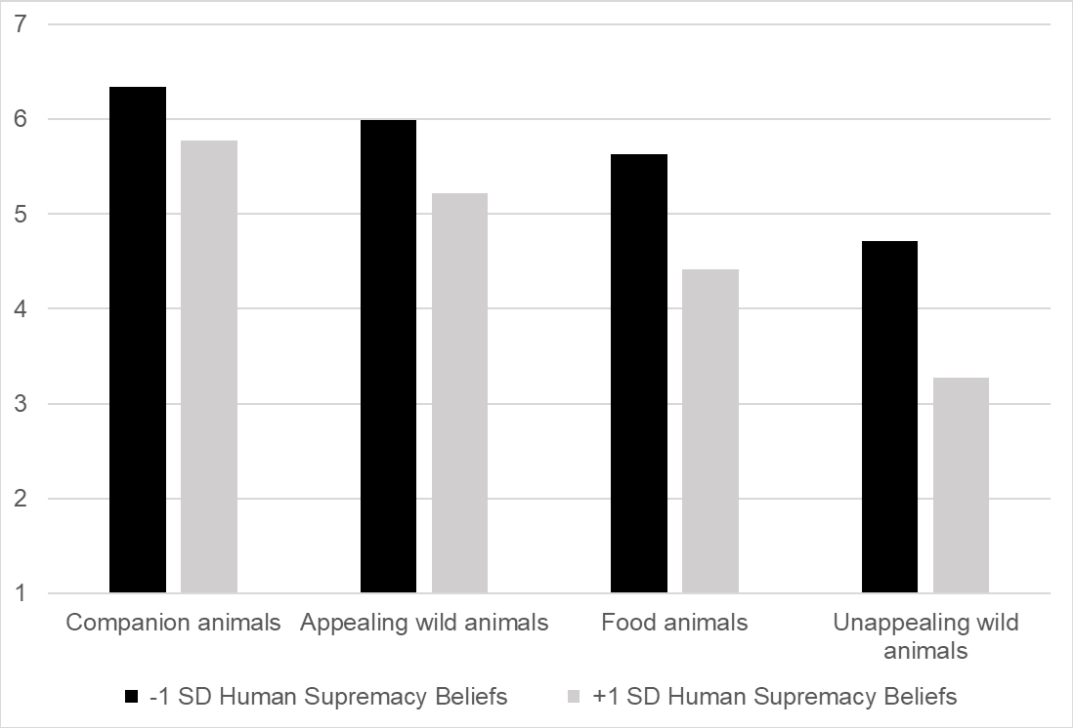


Table 3.4. *Results of moderation analyses in Study 2 testing the interaction between animal category X human supremacy beliefs on moral concern for animals.*

	Animal Category X Human Supremacy interaction					Low levels of human supremacy beliefs					High levels of human supremacy beliefs				
	b	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*
Companion vs. food animals	0.24	.06	4.28	<.001	[0.13; 0.35]	0.72	.11	6.74	<.001	[0.51; 0.93]	1.36	.11	12.80	<.001	[1.15; 1.57]
Appealing wild vs. food animals	0.16	.05	3.06	.003	[0.06; 0.27]	0.36	.10	3.57	<.001	[0.16; 0.56]	0.81	.10	7.90	<.001	[0.60; 1.01]
Companion vs. unappealing wild animals	0.33	.08	4.04	<.001	[0.17; 0.49]	1.62	.15	10.57	<.001	[1.32; 1.93]	2.50	.15	16.28	<.001	[2.20; 2.80]
Appealing vs. unappealing wild animals	0.25	.06	3.98	<.001	[0.13; 0.38]	1.27	.12	10.60	<.001	[1.04; 1.51]	1.95	.12	16.24	<.001	[1.71; 2.18]
Food vs. unappealing wild animals	0.09	.06	1.43	.154	[-0.03; 0.21]	0.91	.12	7.84	<.001	[0.68; 1.14]	1.14	.12	9.86	<.001	[0.91; 1.37]
Companion vs. appealing wild animals	0.08	.05	1.58	.116	[-0.02; 0.17]	0.35	.09	3.90	<.001	[0.17; 0.53]	0.55	.09	6.13	<.001	[0.38; 0.73]

3.4. General Discussion Chapter 3

Whether people care morally for animals varies widely between species and is directly linked to how the animals are typically treated and (de)valued in society (Dhont et al., 2020; Herzog, 2011; Joy, 2010; Leite et al., 2019; Plous, 2003). Across two heterogeneous British samples, we confirmed that most people care a great deal about the welfare and interests of companion animals and some wild animals, but significantly less about food animals and unappealing wild animals, replicating the findings of Leite et al. (2019) from the USA. Moreover, we revealed that these perceived moral divisions between high-status and low-status animal categories were greater for those holding stronger beliefs in human supremacy over animals. These findings were demonstrated after controlling for gender, diet, and SDO, highlighting the critical role of individual differences in human supremacy beliefs in relation to how people think morally about animals. More specifically, similar to how preferences for dominance and inequality in human intergroup relations is primarily related to greater negativity and lower concerns for human low-status groups, our findings showed that preferences for dominance and inequality in human-animal relations was primarily related to lower moral concern for low-status groups. Consistent with our theorising, the present findings thus suggest that human supremacy beliefs may operate as a hierarchy-enhancing motive to preserve hierarchical distinctions between animals.

Our findings extend previous research showing that the belief in human supremacy is a strong correlate of speciesist expressions and support for practices of animal exploitation (e.g., Dhont & Hodson, 2014). As we did not test the associations with scores on the speciesism scale developed by Caviola et al (2019), future research could further investigate how human supremacy beliefs and moral concern for different types of animals (and the moral divide) are related to scores on this scale. Arguably, the speciesism scale largely focuses on the moral acceptance of practices of animal exploitation for human benefits rather than on the general principle or ideological endorsement of species-based prejudice or human superiority. More

research and detailed item analyses are, however, first needed to clarify whether there is any conceptual and item overlap between these different scales. Indeed, as this research area is growing rapidly, with researchers developing different scales to measure ostensibly similar or closely related concepts, the field would benefit from greater conceptual and methodological clarity in order to avoid jingle and jangle fallacies (Gonzalez et al., 2020; Hodson, 2021).

Several psychological processes may explain why those higher on human supremacy beliefs perceive a greater moral divide between high- and low-status animal categories. Indeed, past research has identified a myriad of psychological strategies that enable people to justify the lack of concern for the welfare and interests of certain animals but not others (e.g., Piazza, 2020; Rothgerber, 2020a). For example, a series of studies has demonstrated that people tend to perceive food animals as lacking certain mental capacities, often denying the animals' intellectual abilities (i.e., capacity for agency/thinking) and their ability to experience or feel emotions (e.g., Bilewicz et al., 2011; Bratanova et al., 2011; Loughnan et al., 2010). In contrast to food animals, companion animals such as cats and dogs, and certain wild animals such as wolves and pandas, are perceived as highly intelligent and sentient (e.g., Possidónio et al., 2019). These perceptions of animals' mental sophistications or the lack thereof have direct implications for people's judgement of animals' moral standing. Indeed, people rely on intelligence and sentience information to make moral judgements and attribute moral value to individuals (e.g., Bastian et al., 2012; Gray et al., 2007; Leach et al., 2021). Dementalising food animals makes it easier not to care morally for them, which in turn helps to justify harming or eating them (e.g., Bastian et al., 2012; Hodson et al., 2014; Piazza et al., 2014). Motivated by desires to keep low-status animal groups at the bottom of the moral hierarchy, those higher on human supremacy beliefs may be more strongly motivated to engage in such justification strategies. This could, in turn explain the differential ratings of moral concern between food animals and high-status animals.

Furthermore, those higher on human supremacy beliefs may be motivated to exaggerate or may be more sensitive to the undesired or negative characteristics of low-status wild animals. Specifically, companion animals and high-status wild animals are considered cuter and more similar to humans than low-status animals (e.g., snakes), whereas low-status wild animals are considered more harmful or disgusting. Moreover, high-status animals tend to be more similar to humans in terms of phylogenetics, many of them being mammals, while low-status animals tend to be more dissimilar to humans, comprising reptiles, amphibians, and gastropods. Previous research has shown that dimensions of perceived harmfulness, repulsiveness, and dissimilarity to humans are all associated with lower moral standing and decreased desires to care for or protect the animals (Knight, 2008; Piazza et al., 2014; Possidónio et al., 2019). To maintain and enhance the animal hierarchy and to dominate especially low-status animals, those higher on human supremacy beliefs may be more inclined to perceive negative or undesirable features of these animals or may be more likely to focus on animals' dissimilarity to humans, which would explain why they show a greater moral divide between unappealing wild animals and high-status animals. Future research could examine the psychological processes underpinning the observed patterns by investigating whether those higher in human supremacy beliefs are more likely to dementalise low-status animals or show a greater attentional focus on negative characteristics of these animals, especially of those phylogenetically more dissimilar to humans (i.e., reptiles, amphibians, etc.).

Furthermore, due to the cross-sectional research design, our findings cannot speak to the causal directions of the relationships. Moreover, while the zero-order correlations in the study of Leite et al. (2019) showed a similar pattern of results as in the current studies (i.e., weaker associations of human supremacy beliefs with moral concern for companion animals than for food and unappealing wild animals) the longitudinal effects of human supremacy beliefs on moral inclusion of animals did not seem to substantially differ across animal

categories. To further investigate this issue, future research could experimentally manipulate the perceived gap between animals and humans, for instance by describing animals as more similar to humans (e.g., Bastian et al., 2012). Closing this *human-animal divide* could not only increase moral concern towards animals, but it may also help in closing the moral divide between different animals, by increasing moral concern towards low-status animals in particular.

3.4.1. Conclusion

To conclude, the present research provides further evidence for the role of human supremacy beliefs in people's moral thinking about animals and their considerations of which animals are valued or devalued. Specifically, our findings suggest that human supremacy beliefs may serve as a legitimising motivation not only to preserve hierarchy in human-animal relations but also to maintain and enhance hierarchical and moral divides between different animal categories.

Chapter 4: No Memory for Meat: Omnivores make targeted Memory Errors for Food Animal Sentience Information[8]

4.1. Introduction

The findings from the previous chapter illustrated the paradoxical nature of the relationships humans have with other animals, with some animals being raised solely to be eaten or to be used for their skin, while others are loved members of the family and cherished companions. Moreover, the findings of Chapter 3 suggest that some individuals are ideologically motivated to perceive a greater moral divide between animals of high- and low-status, upholding differences in status and perpetuating moral divides between animal categories. Meat consumption in the EU is estimated at 65.5kg per capita per annum (Statista, 2020a), which translates to almost 70 million *tonnes* of animals slaughtered per year in Europe alone (Ritchie, 2017b). In stark contrast to these figures on animal suffering are the statistics on the companion animal market and related industries. European statistics reveal over 103 million companion cats living in domestic settings, a companion dog in every one out of five households, and a further 100 million small mammals (e.g., bunnies), pet birds, aquatic life and reptiles kept in households across Europe[9]. People clearly value their pets' wellbeing and comfort: the pet accessory market (e.g., pet beds, leashes, clothing etc.) is valued at €8.5 billion, while the pet food and related industries turnover approx. €38.5 billion per year (European Statistics, 2019). These numbers are but a small dive into the paradoxical relationship people have with animals.

Evidently, most people's attitudes and behaviours towards animals do not align – conflicting between opposing animal suffering while contributing to animal suffering through

[8] The work presented in this chapter was carried out in collaboration with Kristof Dhont, Stefan Leach, and Robbie Sutton.

[9] While the previous chapter has stated animals like snakes and snails as mostly belonging to the unappealing wild animal category, it is likely that owners of such animals would instead classify them as companions, further demonstrating that the boundaries of these classifications are flexible and depend upon context.

the purchasing and consumption of animal products (e.g., meat, dairy, eggs etc.) (Tian et al., 2020; Šedová et al., 2016). It is this inconsistency which has prompted scholars to ponder the question of "Why we love dogs, eat pigs and wear cows" (Joy, 2010), and has been dubbed the "Meat Paradox" (Loughnan & Davies, 2020). The meat paradox refers to the disconnect between people enjoying the consumption of meat, but not wanting to be associated with or responsible for animal suffering (e.g., Buttlar & Walther, 2019; Dowsett et al., 2018; Loughnan & Davies, 2020; Rothgerber, 2020b). This inconsistency in behaviour and attitudes can create negative emotions that most people aim to resolve, either by ceasing meat consumption (e.g., vegetarians and vegans), or by changing their cognition about animals (e.g., Rothgerber, 2014a). One prominent example of the latter is the denial of food animals' emotional and cognitive abilities when people are reminded about the animals' status as food (e.g., Bastian et al., 2012; Loughnan et al., 2014; Loughnan et al., 2010; Rothgerber, 2014a). By morally disengaging in this manner, people do not need to confront the negative emotions that would otherwise arise surrounding their meat consumption.

But is our paradoxical relationship with animals also reflected in the way we process objective information about these animals? How well do people remember information that directly relates to food animals' sentience? These are the questions this chapter aims to address and explain from a social-cognitive psychological viewpoint.

4.1.1. Justification Strategies

Most omnivores believe that eating meat is normal, natural, necessary, and nice (Piazza et al., 2015; see also Joy, 2010). These "four Ns" help explain the social conditioning of meat consumption – most people are taught from birth that meat is necessary for health, that it tastes nice, that it is widely accepted as a normal societal practice, and that meat is natural.

However, these four reasons are not the only ways in which the consumption of food animals is commonly justified and rationalised. For instance, the living animal and the meat

for consumption are usually dissociated from one another, in order to avoid reminding people of their food's origin and creating negative emotions surrounding this. This dissociation also occurs at the linguistic level, in the words used to describe dead animals as food: grazing on a pasture, we see a cow, yet when buying a meat burger in the supermarket, it is called beef. Descriptors such as "veal", "beef" and "pork" function almost as euphemisms, with the French-originating words now dominating English nomenclature of edible animal parts, but not the living animals themselves (Benningstad & Kunst, 2020; Plous, 2003; Rothgerber, 2020b).

Moreover, a breadth of research has observed what is commonly described as "denial of mind", or how an animal's perceived sentience (or perceived lack thereof) plays a significant role in justifying its treatment (Piazza et al., 2014; Rothgerber, 2014a; Rothgerber, 2020a). While some companion and food animals, like dogs and pigs, actually show similar levels of cognitive ability, the latter are usually seen as much less capable (e.g., Bastian et al., 2012). For instance, Bratanova and colleagues (2011) showed that animals framed as edible are perceived as less able to feel pain and experience suffering, and in turn are awarded less moral concern than animals framed as non-edible. Similarly, Loughnan and colleagues (2010) showed that reminding people of an animal's edibility impacts judgements of moral standing. Specifically, participants who consumed dried beef before the experiment exhibited higher moral disengagement and ascribed fewer mental states to a cow than participants who consumed dried nuts before the experiment.

This difference in perceived animal mind also translates into the number of secondary emotions ascribed to food animals as compared to companion animals, which further supports the acceptability of the exploitation and suffering of food animals because of their perceived reduced mental capacities (Bilewicz et al., 2011; Wilkins et al., 2015). Thus, simply categorising an animal as food, or framing it as edible, significantly affects

perceptions of its cognitive abilities and its moral standing. Such results suggest that perceptions of animal mind are flexible, and that people might use such information in a motivated manner when making moral judgements.

Piazza and Loughnan (2016) experimentally tested this idea by manipulating animals' perceived intelligence and observing in which cases this information affected moral judgements. When comparing pigs (a traditional food animal), tapirs (not a traditional food animal), and trablans (a fictional animal), they found that providing intelligence information affected the moral standing of tapirs and trablans, but not that of pigs. The second study showed that the animal's relevance to the self is also of importance: pigs are used for food in our culture (self-relevant), while tapirs are eaten elsewhere and trablans are fictional (other-relevant). Manipulating (other-relevant) tapirs' and trablans' intelligence led to increases in their moral standing, but this was not the case for (self-relevant) pigs. The last study of the paper showed that participants expected to feel greater moral responsibility towards pigs after reading about their intelligence, yet this was not the case in practice. Together, the findings from these studies and those discussed above indicate that information about animals' intelligence is used in a motivated manner when making moral judgements about the animals, and that this depends on the animal's relevance to the self and its edibility or status as a food animal. Essentially, people use sentience information in ways that suit their interests and motives.

However, it is presently unclear whether information relating to food animals' sentience, intelligence, and emotional states are consciously dismissed, or whether there are more deeply rooted processes at play. Is it possible that information relating to food animals' sentience is not only disregarded, but also encoded and recalled more poorly?

4.1.2. Motivated Memory Mechanisms

Research has shown that when people are being exposed to information that threatens their positive self-image, this can trigger motivated memory processes. Mnemic neglect is such a motivated memory process, referring to memory errors and biases that arise when incoming information, like feedback from a superior or a friend, are incongruent with one's own positive self-image (Sedikides & Green, 2009). For example, a boss might provide an employee with some positive and negative feedback. If this employee views themselves as punctual and organised, but their boss points out they are organised yet oftentimes late, the latter (negative) information would be inconsistent with this person's positive self-view of punctuality. In turn, this person may later remember the positive feedback more strongly and recall the negative feedback more poorly, in order to uphold the belief that they are indeed punctual. Essentially, mnemic neglect is a self-protective memory mechanism leading to poorer encoding and recall of potentially self-threatening information in order to preserve a positive view of the self and avoid potential cognitive distress (Green et al., 2005; Sedikides et al., 2016).

However, such motivated memory mechanisms may not only occur for feedback and similar types of information. In the context of climate change denial, Hennes and colleagues (2016) demonstrated that participants who learned scientific facts about climate change later recalled this information more poorly if it was inconsistent with their ideological attitudes about the climate change.

The authors concluded that some participants, due to their ideological views, are more motivated than others to misremember facts about climate change in order to preserve the societal status quo and justify their own behaviours, such as driving and flying a lot.

Essentially, motivated memory processes can occur when information or behaviours are inconsistent with one's positive self-image, and also when one has an ideological

motivation to misremember something. A similar process may be at play in the context of meat-related cognitive dissonance. Similar to Hennes and colleagues' reasoning, we theorise that remembering information relating to animals' sentience poses a potential threat to the societal status quo of meat consumption and the use of animals for humans' benefit. More specifically, we believe ideologically motivated memory mechanisms may interfere with the encoding and recall of information that suggests food animals are highly intelligent, sentient, and have developed emotional capabilities. We wondered whether, rather than simply disregarding information relating to food animals' sentience, people may actually be engaging in ideologically motivated memory patterns, similar to those described by Hennes and colleagues (2016) in a climate change context. In the context of food animals, information relating to such animals' sentience is likely threatening to the societal status quo of using animals for food, potentially especially so if individuals are ideologically motivated to uphold this status quo. Specifically, dominance-based ideologies may be a motivating factor for misremembering sentience information for food animals.

4.1.3. Ideology

Stronger endorsement of Right-Wing Authoritarianism (RWA) or Social Dominance Orientation (SDO) are two ideological constructs that are known to be related to higher meat consumption, support for animal exploitation, as well as more broadly to negative attitudes towards animals (Dhont & Hodson, 2014). Right-Wing Authoritarianism, coined by Altemeyer (1981), is reflected in a desire to maintain cultural stability, a resistance to change, and is thought to be rooted in conventionalism and authoritative submission. In relation to animals, this is reflected in a higher meat intake and greater support for animal exploitation in individuals with higher levels of RWA (Allen et al., 2000; Dhont & Hodson, 2014). Moreover, individuals higher in RWA tend to view meat consumption and related

exploitative practices as holding cultural and social importance and tend to feel more threatened by vegetarianism (e.g., Dhont & Hodson, 2014; Dhont et al., 2016).

While RWA is more implicated in traditionalism and resistance to change, SDO reflects a generalised desire for group-based dominance and social inequality (Pratto et al., 1994; Sidanius & Pratto, 1999), and is expressed both in human intergroup relations and in human-animal intergroup relations. Indeed, individuals higher in SDO are not only more likely to hold prejudiced views about human low-status outgroups (e.g., ethnic, or anti-LGTB prejudice), they also tend to support human dominance over animals, and in turn, more likely to accept animal exploitation (Dhont & Hodson, 2014; Dhont, et al., 2016). Individuals higher in SDO have also been shown to deny food animal's cognitive and emotional capacities more so than individuals lower in SDO, especially when the animal's status as food is highlighted (e.g., Hyers, 2006; Jackson & Gibbings, 2016; Piazza et al., 2015).

Moreover, both RWA and SDO have been linked to greater endorsement of justifications for rationalising meat consumption (e.g., Becker et al., 2019; Piazza et al., 2015). Given these findings, it is plausible that these ideological factors, RWA and SDO, play a role in processing and remember information about food animals. Specifically, dominance-based ideologies (i.e., RWA and SDO) might predict memory errors relating to a food animal's intelligence and sentience, as this information can be considered threatening to the societal status quo of carnism.

4.1.4. The present Research

Two studies were conducted to test whether ideologically motivated individuals make more memory errors when recalling previously learned information on food animals' sentience. We expected dominance-based ideologies (i.e., RWA and SDO) to predict memory errors for information on food animals' sentience. In order to test this hypothesis, a new paradigm was developed to test for such motivated memory mechanisms in relation to

information learned about the intelligence and sentience of food animals, in this case pigs. Pigs were chosen as the subject of the learning materials, since they have been shown to possess fairly high cognitive abilities. For example, pigs are known to form episodic-like memories (i.e., remembering what happened where) and have advanced visuo-spatial skills, which makes them apt at completing mazes and foraging. Pigs are also able to learn about the visuo-spatial properties of mirrors, can recognise other individuals and form strong social bonds and even exhibit deceptive behaviours surrounding foraging locations being kept secret from other pigs (see for example Broom et al., 2009; Held et al., 2010; Kouwenberg et al., 2009; Mendl et al., 1997; Mendl et al., 2010).

Both studies presented in this chapter consisted of a learning phase, a distraction phase, and a two-part recall phase. During the learning phase participants read an article on pigs' sentience and emotional capacities, presenting pigs as intelligent and sentient. After a distraction task to avoid rehearsing the information, participants were asked to freely recall everything they remembered, and then responded to multiple choice questions including a tick-box list of primary and secondary emotions. We expected that individual differences in SDO and RWA would predict memory errors made shortly after learning sentience information about food animals. In the second study, we added information relating to the uses of pigs (e.g., their uses in medical science) to the learning text alongside the sentience information, expecting the memory errors to arise for sentience information only, and not for use information, as the latter should not be threatening to the status quo.

4.2. Study 3

The main aim of this study was to establish whether memory biases arise shortly after learning information about food animals. Furthermore, we were interested in examining whether individual differences in dominance-based ideologies (i.e., RWA and SDO) can accurately predict this memory performance.

4.2.1. Methods

Participants and Procedure. Two-hundred and fifty-three British adults were recruited via the online survey platform Prolific to participate in the study. Ages ranged from 18 to 69 years (Mage = 31.23, SD = 10.61). Participants were first asked to read an article during the learning phase, then completed a distraction task followed by the free and cued recall phases. They also completed measures of RWA and SDO and provided demographic information. Gender was not recorded due to an oversight. However, gender differences were not expected for this type of memory exercise. Upon completion, they were debriefed and received financial compensation for their time.

Design and Materials.[10,11] During the learning phase participants were presented with a text describing the cognitive and emotional capacities of pigs (e.g., number of neurons found in pigs' brains and a range of emotions pigs are thought to experience). Alongside sentience information we also included distractions (e.g., habitat and diet of pigs) that were not relevant in the subsequent free and cued recall tasks. Participants were informed they may be asked to recall some information from this text later in the study. An extract from the text reads:

> *Pigs' brain to body ratio is relatively small, with an Encephalization Quotient (EQ) of only 0.38 (an EQ of greater than 1 indicates a large brain to body ratio). In comparison, that of humans is typically greater than 7. Pigs enjoy playing with simple*

[10] The materials used in the Learning, Free Recall and Cued Recall phases of this study were developed by the researchers, piloted (N = 223) and adjusted accordingly prior to this study.
[11] See Appendix B for a full list of the materials used.

objects, such as sticks and balls. They oftentimes play in groups and express sympathy and affection with others. They also experience joy when chasing other individuals and play fighting.

The learning phase was followed by a distractor task. A shortened version of the Big Five Inventory (BFI; John & Srivastava, 1999) with five items per facet was used. This task was chosen as having no connection to the memory paradigm and the data collected were not used in the analyses.

Following the distractor task, participants completed the free recall test phase. During the free recall test phase participants were requested to write down everything they remembered from the learning phase, write down all relevant information, and to be as precise and detailed as possible. To avoid participants skipping this question, a minimum character limit of 25 characters was set. Participants' memory performance on this test was scored by two independent coders who scored the responses according to a gist criteria (i.e., points given for correct information even if worded slightly differently from the learning text) whilst ignoring intrusions (e.g., recalling a statement that was not present, writing the same statement twice, recalling of distractor information etc.). Each coder summed the number of correctly recalled statements for each participant, achieving a high level of agreement between the two coders (r = .94; M = 6.30, SD = 3.56).

Participants then completed the recognition test phase, which consisted of two parts. First, participants answered ten multiple-choice questions, each with seven response options with room for under- and over-estimation relative to the correct response. The correct answer was distributed and balanced around the midpoint across questions.

An example of a question is: *How many neurons can be found in pigs' brains?*

- *345,000,000 (under-estimation)*
- *375,000,000 (under-estimation)*
- *415,000,000 (correct response)*
- *435,000,000 (over-estimation)*
- *455,000,000 (over-estimation)*
- *475,000,000 (over-estimation)*
- *505,000,000 (over-estimation)*

The second part of the recognition test included a list of emotions presented in the learning text, with participants instructed to select all those they remembered out of the following: Joy; Anger; Sadness; Fear; Relief; Disgust; Sympathy; Longing; Affection; Pride; Optimism; Nervousness; Surprise; Love; Contentment; Envy; Disappointment; Shame; Lust; Irritation; Annoyance. Memory performance scores on the recognition test was calculated by summing the number of correctly classified targets across the multiple choice and emotion recognition questions (M = 9.84, SD = 3.19).

Finally, participants completed a 9-item RWA scale, adapted from Duckitt and colleagues (2010). SDO was assessed using the 8 items of the short SDO scale (Ho et al., 2015). Both scales are measured on 7-point scales ranging from *Strongly Disagree* to *Strongly Agree* and include items such as *It's great that many young people today are prepared to defy authority* (RWA, α = .80) and *An ideal society requires some groups to be on top and others to be on the bottom* respectively (SDO, α = .82).

4.2.2. Results

Main Analysis.

We sought to test if memory for information related to animal sentience was associated with individual differences in RWA and SDO. Measures of recall and recognition performance together with RWA and SDO were standardised as Z-scores prior to the main analysis to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012). To provide the most robust estimate of memory performance we focus on performance across memory tasks (recall and recognition). As type of memory task (recall, recognition) is nested within participants our data lend themselves to multilevel modelling. As such, we fit a number of models including random intercepts with homogenous variances to the memory data. These models included fixed coefficients to estimate the effect of memory task (recall vs. recognition) and RWA and/or SDO. Full details on all variance estimates and coding schemes are provided in Appendix C (Table S1-S3).

Confirmatory Analyses. These models showed that both RWA and SDO were associated with lower memory performance, coeffRWA = -0.24, SE = 0.05, 95% CI [-0.34, -0.14], p < .001, coeffSDO = -0.12, SE = 0.05, 95% CI [-0.23, -0.01], p = .030; suggesting that dominance-related beliefs are associated with impaired memory for information related to animal sentience.

Additional Analyses. Next, we sought to test the robustness of our findings. Taking the aforementioned effects at face value, it seems that RWA may be a more robust predictor of memory performance (compared to SDO). To formally test this assumption, we fit a new model including both RWA and SDO, thereby controlling for any shared variance between the two constructs (for further details see Table S3). In these analyses only RWA remained a significant predictor of memory performance, $coeff_{RWA}$ = -0.23, SE = 0.06, 95% CI [-0.34, -0.11], $p < .001$, $coeff_{SDO}$ = -0.03, SE = 0.06, 95% CI [-0.14, 0.08], $p = .600$. These analyses support the idea that RWA (more-so than SDO) is associated with memory distortions related

to food animals. Finally, we looked back at our original model (see Table S1) to examine if the effect of RWA differed for measures of recall and recognition, respectively. We found no evidence of this, $coeff_{MemoryTask \times RWA} = 0.04$, SE = 0.03, 95% CI [-0.02, -0.10], $p = .243$; further supporting the idea that RWA is associated with reduced memory performance for information related to food-animal sentience.

4.2.3. Discussion Study 3

With this study we aimed to establish whether memory errors arise shortly after learning sentience information about food animals. We expected this to be the case especially for individuals who more strongly endorse dominance-based ideologies such as RWA and SDO.

Our initial analyses revealed that both SDO and RWA, as expected, were associated with poorer memory performance regarding information on pigs' sentience. However, RWA appeared to be a stronger predictor for this effect than SDO, and follow-up analyses revealed that only RWA, but not SDO, was a significant predictor of memory performance. This effect was present across the different recall tasks, indicating further that RWA affects the recall of information relating to animal sentience significantly and across different types of memory tests. These results are largely in line with our hypotheses, showing that individuals with greater endorsements of RWA, appear to encode and recall information relating to pigs' intelligence less well than individuals lower on this individual difference measure. RWA is characterised by a desire to maintain cultural stability, a resistance to change and is rooted in conventionalism and authoritative submission (Altemeyer, 1981), all of which could explain why these individuals made more memory errors regarding a food animal's sentience. Individuals who endorse RWA more strongly are also known to consume more meat (e.g., Allen et al., 2000; Dhont & Hodson, 2014) and may therefore be more motivated to misremember information about food animals' sentience for both self-serving motives as well

as motives relating to the societal status quo of carnism. However, we expected to also see an effect of SDO, which in this sample was not the case when controlling for the shared variance between RWA and SDO.

4.3. Study 4

Study 4 follows up and expands on the findings of Study 3. Having established that memory errors do arise, and are associated with higher levels of RWA, this study aimed to establish whether such memory errors arise for any information relating to food animals (i.e., pigs), or whether they are exclusive to sentience information. To this end, the learning materials were expanded to include not only sentience information, but also use information. As such, we added a range of information on the medical, culinary and fashion uses of pigs; all information that does not indicate sentience. The use information was added in order to distinguish between information that may be threatening (i.e., sentience information) and information that is unlikely to be threatening to omnivores (i.e., use information). We expected to replicate the findings of Study 3, specifically that participants higher (vs. lower) in RWA would make more memory errors. Moreover, we expected the targeted memory errors to occur mostly for threatening (sentience) information, but not for non-threatening (use) information. The predictions and data analyses of Study 4 were preregistered, and this information can be accessed at the following link: https://osf.io/ht3uq?view_only=1831882b90ad4c529fc80a8c4dd6ac6d .

4.3.1. Methods

Participants and Procedure. The sample included 255 British adults recruited through Prolific. Ages ranged from 18 to 71 years (M_{age} = 37.68, *SD* = 13.64). 93 participants identified as male, 160 as female, and one participant indicated their gender as non-binary. Participants first completed the learning phase, followed by the BFI as the distractor task, and

then completed the free recall test phase and the cued recall test phase. Finally, participants completed the RWA and SDO measures as well as demographic questions.

Design and Materials[12]. For the learning phase of Study 4, the materials from Study 3 were reworked to appear as website article titled *Surprising Facts About Pigs* to increase credibility of the information presented. We included information relating to pigs' sentience and different uses of the animal (e.g., in medicine) alongside the same emotions as included in Study 3. We informed participants that they would be asked about their impression of the information presented during this task later in the study. No distractor information was included in this learning text.

The distractor task was the same as that used in Study 3 (BFI, John & Srivastava, 1999).

For the free recall test phase participants were instructed to recall everything they remembered from the text presented to them, and a minimum character limit of 25 was imposed on the text box to avoid participants leaving this blank.

During the cued recall test phase 22 multiple-choice questions were presented to participants, of which 10 related to sentience information, 10 related to use information (e.g., in medical science), one question included a multiple-selection list of emotions, and one question included a multiple-selection list of cuts of pork. As in Study 3, the multiple-choice questions were designed to allow room for both under- and overestimation around the correct response.

Finally, participants completed the same RWA and SDO scales as in Study 3. (RWA, $\alpha = .85$; SDO, $\alpha = .84$).

[12] See Appendix B for a full list of the materials used.

4.3.2. Results

Data Preparation. In what follows we adhere to our pre-registered data analytic approach. As in Study 3, we computed measures of memory performance for each task (recall, recognition). Two independent coders scored the responses to the recall task according to the same criteria as in Study 3. Each coder summed the number of correctly recalled statements related to (a) sentience information and (b) use information achieving a high level of agreement (r = .91; M = 4.71, SD = 2.85). We summed the number of correctly classified targets in the recognition task (M = 8.83, SD = 3.34). Measures of memory performance and individual differences were again standardised as Z-scores prior to the analyses to obtain coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Main Analysis. We sought to examine if (a) memory performance was associated with individual differences in RWA and SDO, and (b) whether this association varied for information related to animals' sentience compared to animals' uses. We again focused on trends in memory performance across tasks (recall and recognition). We fitted a number of multi-level models including random intercepts and slopes with homogenous variances to the memory data. These models included fixed coefficients to estimate the effect of memory task (recall vs. recognition), information type (sentience vs. use) and either RWA or SDO. Full details on all variance estimates and coding schemes are provided in Appendix C (Table S4-S10).

Confirmatory Analyses. These models showed that RWA was associated with lower overall memory performance, $coeff_{RWA}$ = -0.13, SE = 0.04, 95% CI [-0.22, -0.04], p = .003. Crucially and as predicted, RWA differentially predicted memory performance for sentience and use information, $coeff_{Info.Type \times RWA}$ = 0.06, SE = 0.03, 95% CI [0.01, 0.11], p = .026. That is, RWA predicted poorer memory for information related to animals' sentience, $coeff_{RWA}$ = -

0.19, SE = 0.05, 95% CI [-0.28, -0.10], $p < .001$, but not for information related to animals' uses, $coeff_{RWA}$ = -0.07, SE = 0.05, 95% CI [-0.16, 0.02], $p = .139$.

Turning to SDO, we again found that SDO was associated with poorer overall memory performance, $coeff_{SDO}$ = -0.09, SE = 0.04, 95% CI [-0.18, -0.00], $p = .042$; although this relationship did not vary across different information, $coeff_{Info.Type \times SDO}$ = 0.02, SE = 0.03, 95% CI [-0.04, 0.07], $p = .600$. These data support the idea that RWA (more-so that SDO) is associated with a specific pattern of targeted memory loss specifically for information related to animal sentience.

Additional Analyses. Lastly, and as in Study 3, we sought to explore the robustness of our findings in a series of further analyses. We examined a number of models in which we controlled for any shared variance between RWA and SDO (for further details see Table S8-S10). The expected effects of RWA held in these models whilst SDO did not. RWA predicted poorer overall memory performance, $coeff_{RWA}$ = -0.11, SE = 0.05, 95% CI [-0.20, -0.02], $p = .018$, that varied as a function of information, $coeff_{Info.Type \times RWA}$ = 0.06, SE = 0.03, 95% CI [0.01, 0.12], $p = .032$. SDO, on the other hand, was not associated with any differences in memory performance, $ps > .165$. Lastly, we found little evidence that the effects of RWA varied across memory tasks, $coeff_{MemoryTask \times RWA}$ = 0.05, SE = 0.03, 95% CI [-0.00, 0.11], $p = .066$, $coeff_{MemoryTask \times Info.Type \times RWA}$ = 0.02, SE = 0.02, 95% CI [-0.01, 0.06], $p = .186$.

4.3.3. Discussion Study 4

With this study we aimed to replicate and extend the findings of the Study 3. The materials were revised for this study to appear as a news-style article in order to add credibility to the information presented. Moreover, in addition to sentience information, we added a range of facts relating to the uses of pigs across medical applications, fashion, and the food industry. This information was added in order to distinguish between information that may be threatening (i.e., sentience information such as intelligence) and information that

should not be threatening (i.e., use information such as cuts of meat). We expected to replicate the findings of Study 3, specifically that participants higher in RWA would make more memory errors than those lower in RWA. Moreover, we expected the targeted memory errors to occur only for threatening sentience information, but not for non-threatening use information.

As in Study 3, RWA was a significant predictor for motivated memory mechanisms. Specifically, and in line with our hypotheses, RWA was related to targeted memory errors specifically for sentience information, but not for use information of pigs. Furthermore, we found some evidence that SDO may be more broadly related to poorer overall memory performance across sentience and use information, but RWA explained most of the variance of this effect.

4.4. General Discussion Chapter 4

Across two studies we demonstrated that mnemic neglect, or motivated memory mechanisms, are indeed implicated in remembering information about food animals. We show that dominance-based ideologies are significant predictors for targeted memory errors in relation to food animals' sentience, and that such targeted memory errors do not extend from sentience to use information. Furthermore, RWA, more-so than SDO, effectively explained these targeted memory errors made by participants across our studies. We thus show across both studies that, while both individual difference measures are linked to memory performance, it is indeed mostly RWA, and not SDO, that predicted targeted memory errors for sentience information. As both RWA and SDO are implicated in attitudes and behaviours towards animals, we hypothesised that either of these constructs may be related to targeted memory errors. However, having found little evidence for the role of SDO, we offer some potential explanations. SDO may be more closely linked to a generalised support for hierarchies and human dominance over animals, rather than applying to attitudes towards food animals specifically (e.g., Dhont & Hodson, 2014; Dhont et al., 2016).

Conversely, RWA is known to be more closely linked to heightened meat consumption and support for animal exploitation as a traditional and culturally important practice, which may explain the observed effects (e.g., Allen et al., 2000; Dhont & Hodson, 2014). Those higher in RWA may perceive food animals' sentience as more threatening due to the societal status quo of meat consumption, along with its traditional and cultural implications, and therefore be more ideologically motivated to misremember facts about food animals' sentience.

Interestingly, we found some evidence that participants higher in SDO made more memory errors overall (across tasks and types of information), although this finding did not hold up when controlling for the shared variance between RWA and SDO. It is possible that

individuals higher in SDO may be more likely to misremember information about animals more generally. Future studies could further investigate these effects.

Our findings may have important implications for the domains of education and activism, as mere information-based strategies to improve attitudes towards food animals may not be the most useful. Especially for people higher in dominance-based ideologies, information-based campaigns may have little effect given the motivated memory mechanisms observed across our studies.

Furthermore, while previous research has suggested people disregard sentience information when making moral judgements about food animals (Piazza & Loughnan, 2016), our studies demonstrate that this process may also have deeper roots in the encoding and recall of such information, rather than in the conscious or subconscious disregard of it. While we did not measure moral concern, we did demonstrate that those higher in RWA made targeted memory errors for sentience information, but not use information.

4.4.1. Limitations and Future Directions

While our studies established that targeted memory errors arise for sentience, but not use information for pigs, it is unclear whether this effect would hold up across other common food animals, such as cows and chickens. Future studies could expand on the animals included and test whether the observed effect applies to a wider range of food animals. Additionally, it would be interesting to see whether there is a significant difference between food and non-food animals. Specifically, we would expect memory for companion animals' and appealing wild animals' sentience to be more accurate since such information should not be threatening, whereas memory for sentience information for unappealing wild animals may be more similar to the current results on food animals.

Interestingly, we found some evidence that participants higher in SDO made more memory errors overall (across tasks and types of information), although this finding did not

hold up when controlling for the shared variance between RWA and SDO. It is possible that individuals higher in SDO may be more likely to misremember information about animals more generally. Future studies could further investigate these effects.

4.4.2. Conclusion

In this chapter, we present evidence supporting the notion that ideological factors drive motivated cognitions about animals. More specifically, we demonstrated that individual differences in ideological attitudes are associated with motivated memory mechanisms, suggesting that they interfere with the correct recall of sentience information for food animals.

Chapter 5: Food Technology Neophobia and Food Naturalness Importance as Psychological Barriers to Clean Meat Acceptance[13]

5.1. Introduction

By 2050, the global demand for meat is predicted to more than double (Alexandratos & Bruinsma, 2012), despite the scientifically documented environmental, health, and ethical problems of current factory farm practices. Animal agriculture contributes 14.5% of total greenhouse gas (GHG) emissions (Gerber et al., 2013), takes up almost 80% of all arable land (Ritchie, 2017a), and is a leading cause of deforestation (Steinfeld et al., 2006). It also poses a serious risk to public health (e.g., high zoonotic disease risk, see for example Jones et al., 2013; Wiebers & Feigin, 2020) as well as ethical challenges for current animal welfare values and norms (e.g., Dhont & Hodson, 2020; Foer, 2009; Singer, 1975).

Scientists have long recognised the pressing need for a global change in dietary habits and shift towards more sustainable technologies to seriously address the climate crisis, as well as the health risks and ethical dilemmas, linked to the meat industry (e.g., Godfray et al., 2018; Tilman & Clark, 2015; Willet et al., 2019). However, people are generally reluctant to change their meat consumption habits (e.g., Bastian & Loughnan, 2016; Dhont et al., 2021; Piazza, 2020). Thus, a better understanding of the psychological barriers to consuming meat substitutes is needed. Here we focused on people's perceptions of, and willingness to eat, laboratory-grown meat, also known as *clean meat* (Bryant & Barnett, 2019). More specifically, we examined how general concerns about new food technologies and preferences for natural food products are implicated in people's evaluations of clean meat.

[13] This chapter has been published in Food Quality and Preference, co-authored by Kristof Dhont and Gordon Hodson. The published article can be accessed at: (https://doi.org/10.1016/j.foodqual.2021.104409). Some minor changes were made to the manuscript before inclusion in this thesis.

5.1.1. Clean Meat

Clean meat, also referred to as synthetic, in vitro, or cultured meat, is structurally identical to traditional animal-based meat at the cellular level and is grown in a cell culture based on techniques borrowed from medical science (Mattick et al., 2015; Post, 2013). The cells develop into muscle tissue, which can be processed into common meat products such as steaks, burgers, and sausages (Stephens et al., 2018). Leading clean meat companies expect their starter cells to become self-renewing and are transitioning to growth media that are completely animal-free, removing almost all animal welfare concerns (e.g., *FAQs*, 2020).

Clean meat also presents a range of environmental and health benefits (e.g., Post, 2012). Indeed, scientists project that clean meat production at an industrial scale will use up to 45% less energy, 78-96% less GHG emissions, 99% less land use, and 82-96% less water use relative to traditionally farmed meat (Tuomisto & Teixeira De Mattos, 2011). Moreover, clean meat is grown under laboratory-conditions, which are significantly cleaner and safer than traditional livestock farms. Indeed, disease risks associated with traditional farming are significantly reduced or even eliminated (Bryant & Barnett, 2020; Post, 2012).

Given these benefits, combined with the fact that clean meat is structurally identical to traditional meat, meat eaters might readily welcome the introduction of clean meat products. However, this is not yet the case: recent survey data suggests that although a majority of people would indeed be willing to *try* clean meat, fewer people seem to be willing to buy it or regularly eat it (Bryant & Barnett, 2020). Furthermore, those who abstain from eating meat (i.e., vegetarians and vegans) tend to be more positive about clean meat than omnivores but are less willing to try or buy it than omnivores (Mancini & Antonioli, 2019; Valente et al., 2019; Wilks & Phillips, 2017). Despite its clear advantages over traditional meat, clean meat faces several barriers to be overcome before receiving wide-scale public acceptance.

5.1.2. Psychological Barriers to Clean Meat Acceptance

Recent research revealed that the *perceived unnaturalness* of clean meat and concerns about its *safety* are two key psychological barriers to clean meat acceptance (Bryant & Barnett, 2018). Specifically, consumers often describe clean meat as unnatural, artificial, or as fake food, and would therefore not eat it (Shaw & Mac Con Iomaire, 2019; Tucker, 2014; Verbeke et al., 2015). Some find it disgusting, which can be linked to the idea that unnatural products are inherently unethical because of the assumed interference with "natural processes" (Bryant & Barnett, 2018; Laestadius, 2015; Laestadius & Caldwell, 2015). Along similar lines, perceived unnaturalness of clean meat has been associated with lower acceptability of perceived risks of clean meat and reduced willingness to consume it (e.g., Siegrist & Sütterlin, 2017; Siegrist et al., 2018; Wilks & Phillips, 2017).

A related yet distinct psychological barrier to clean meat acceptance concerns safety. Indeed, the idea of growing meat in a laboratory with new technologies can elicit anxiety about potential negative health effects, although such concerns can be attributed to scientific uncertainty and lack of knowledge among consumers (e.g., Bryant & Dillard, 2019; Gómez-Luciano et al., 2019; Shaw & Mac Con Iomaire, 2019; Zhang et al., 2020). Nonetheless, some consumers perceive health and safety benefits of clean meat (e.g., Verbeke et al., 2015), particularly when provided with additional information about the safety of clean meat (e.g., Mancini & Antonioli, 2020; Rolland et al., 2020). Furthermore, Wilks and Phillips (2017) found that while participants perceived clean meat as less natural than traditional meat, they did not necessarily perceive it as less healthy; moreover, they recognised the lower zoonotic disease risk and ethical benefits of clean meat.

Taken together, although several studies have highlighted naturalness and safety concerns as psychological barriers to clean meat acceptance, other studies revealed mixed findings, or positive health-related attitudes towards clean meat. To gain more insight into these

potential psychological barriers, a more nuanced approach is needed. Specifically, whereas some people are reluctant to engage with clean meat due to its perceived unnaturalness, others consider naturalness unimportant for their food decisions. Along similar lines, whereas some experience high levels of discomfort and fear surrounding new food technologies, others are confident that new technologies are typically safe and scientifically sound. In other words, people widely differ in valuing the naturalness of food products (i.e., food naturalness importance, e.g., Román et al., 2017) and in the extent to which they fear novel food technologies (i.e., food technology neophobia, Cox & Evans, 2008). Although the predictive value of these two psychological individual difference variables has been confirmed for a range of food products (see Román et al., 2017; Siegrist & Hartmann, 2020), their roles in relation to the evaluation of clean meat relative to traditional meat remain unclear.

A survey by Michel and Siegrist (2019) found that consumers' perceived importance of food naturalness is associated with a lower perceived naturalness of clean meat and lower willingness to eat it. Furthermore, focusing on preferences for natural things in general (not food-specific), Wilks et al. (2019) found no association between naturalness bias and clean meat attitudes. However, neither of these studies compared consumers' acceptance of clean meat relative to traditional meat, and thus it remains unclear whether general preferences for food naturalness are associated with more negative evaluations of clean meat relative to traditional meat.

Wilks and colleagues (2019) also reported that fear of new foods (i.e., food neophobia) predicted lower willingness to eat clean meat. They argued that the fear of new products for people higher in food neophobia can lead to negative evaluations of clean meat regardless of actual safety risks and benefits. However, food neophobia expresses people's reactions to ethnic, foreign, and unknown foods rather than reflecting fear of new *technologies* for food production, which are likely more closely related to fear and opposition to clean meat. Indeed,

several past studies showed that food technology neophobia is reliably and robustly correlated with a reduced willingness to try foods produced by new technologies such as the use of genetic modification, food irradiation, or nanotechnology (e.g., Evans & Cox, 2006; Evans et al., 2010; Siegrist & Hartmann, 2020). To date, no published study has investigated the associations between food technology neophobia and attitudes towards clean meat. Moreover, the previously observed negative association between food naturalness importance and clean meat acceptance might be partly explained by the influence of higher food technology neophobia. The current research addresses this gap in the literature by investigating the roles of both food technology neophobia and food naturalness importance in relation to consumers' evaluations of clean meat relative to traditional meat.

5.1.3. The Present Research

In three experiments, we systematically investigated consumer perceptions of clean and traditional meat. Whereas most previous research relied on written text to probe attitudes towards clean meat, we asked participants to evaluate dishes, presented as images, in terms of appeal, expected smell and taste, and how likely they would try the dish. The dishes were either labelled as traditional meat or as clean meat. By counter-balancing the labels assigned to each dish across participants, we tested the pure effect of labelling a dish as "traditional meat" versus "clean meat", and thus controlled for what was actually presented in the food images. Moreover, we tested the moderating roles of food technology neophobia and food naturalness importance in a sample of omnivores.

We hypothesised that dishes labelled as traditional (*vs*. clean) meat would be evaluated more favourably (Hypothesis 1). Furthermore, we expected that the label effect would be moderated by food technology neophobia, with a stronger label effect expected among those higher (*vs*. lower) in food technology neophobia (Hypothesis 2). Our rationale was that those with higher levels of anxiety about novel food technologies may perceive clean meat as less

safe, and thus less appealing than traditional meat. Along similar lines, we expected that the label effect would be moderated by food naturalness importance, with a stronger label effect expected among those higher (*vs*. lower) on food naturalness importance (Hypothesis 3); our reasoning was that people who value food naturalness more strongly may perceive clean meat as more unnatural, and in turn be less favourable towards it.

Experiment 2 further extends the research scope by investigating the label effect, both in a sample of omnivores and a sample of veg*ns (i.e., vegetarians and vegans), and adds a third, plant-based meat condition. Experiment 3 then turns to the question of *why* clean meat may be evaluated differently than traditional meat, and particularly for omnivores higher on food technology neophobia or food naturalness importance. Specifically, we tested the mediating roles of participants' perceptions of safety and naturalness of the clean versus traditional meat dishes. In all studies, we included age, gender, political ideology, and meat liking as control variables to rule out any confounding effects of demographic and individual difference variables.

5.2. Experiment 1

5.2.1. Methods

Participants. Participants (N = 302) were recruited through the crowdsourcing platform Prolific and received financial compensation. Retaining only omnivores, 32 participants who identified as vegetarian, vegan, or pescatarian were excluded (final N = 270). The sample consisted of 54.9% men, 45.1% women and 0.7% who indicated "other" gender, with a mean age of 30.42 years (SD_{age} = 10.95).

Materials and Procedure. Participants were presented with the same six food images. Three images showed dishes made with traditional meat from farmed animals (i.e., a burger, meatballs, and meat-filled tacos), and three images showed similar dishes made from clean meat (The data and materials used in this chapter can be accessed via the Open Science Framework: https://osf.io/tdx4n/?view_only=7bd6c6764b54443881ca7ffb0eb6e0a3 and the full materials for this experiment can be found in Appendix D.). Critically, to test the effect of *clean meat* versus *traditional meat*, while controlling for image content, we manipulated the labels assigned to the dishes. For all participants three dishes were labelled as clean meat and three as traditional meat. These dish labels were counterbalanced across participants such that each dish was presented as clean meat to half of the participants, and as traditional meat to the other half.

After viewing each image, we asked participants to imagine they had the dish in front of them and to evaluate each dish in terms of appeal (1, *Extremely appealing; 7, Extremely repulsive*), smell (1, *Smells extremely good;* 7, *Smells extremely bad*), taste (1, *Tastes extremely good; 7, Tastes extremely bad*) and how likely they would be to eat the dish if offered at a buffet (1, *Extremely likely; 7, Extremely unlikely*).

Measures. Favourability of dishes was measured through appeal, taste, smell, and likeliness to eat the dish at a buffet. For each label condition, these four items were averaged into a single score, with higher scores indicating more favourable evaluations ($\alpha_{traditional}$ = .93; α_{clean} = .92).

Participants completed the 13-item Food Technology Neophobia Scale (FTN; Cox & Evans, 2008) on 7-point scales (*Strongly disagree*; *Strongly agree*; α = .84; *M* = 4.07, *SD* = 0.88). This scale measures consumer attitudes towards foods produced using novel technologies (e.g., "New food technologies are something I am uncertain about").

We measured food naturalness importance with the Natural Product Interest Scale (NPI; Roininen et al., 1999), which assesses attitudes towards unprocessed, natural, and organic foods. The scale consists of 6 items (α = .76; *M* = 4.29, *SD* = 1.12; e.g., "I do not eat processed foods, because I do not know what they contain") completed on 7-point scales *(Strongly disagree*; *Strongly agree*).

Participants indicated their political ideology on a 7-point scale (*Very liberal; Very conservative; M* = 3.19, *SD* = 1.41).

Meat liking was assessed with three items (Dhont & Hodson, 2014) asking whether they like the taste, look, and smell of meat (α = .85; *M* = 5.70; *SD* = 1.18) on 7-point scales (*Strongly disagree; Strongly agree*).

5.2.2. Results

First, we conducted a univariate ANOVA with dish label (clean *vs*. traditional meat) as the within-subjects factor. Confirming Hypothesis 1, dishes labelled as traditional meat (*M* = 5.42, *SD* = 0.96) were evaluated more favourably than dishes labelled as clean meat (*M* = 5.20, *SD* = 1.02), $F(1, 269) = 11.94$, $p = .001$, $\eta_p^2 = .043$.

Next, we tested Hypotheses 2 and 3, whereby food technology neophobia and naturalness importance potentially moderate the label-evaluation effect. We conducted an ANCOVA with label condition as the within-subjects factor, food technology neophobia and food naturalness importance as continuous predictors, as well as their interaction terms with label condition. Age, gender, political ideology, and meat liking were included as control variables (see Table S11 in Appendix E for results without controls). This analysis revealed a

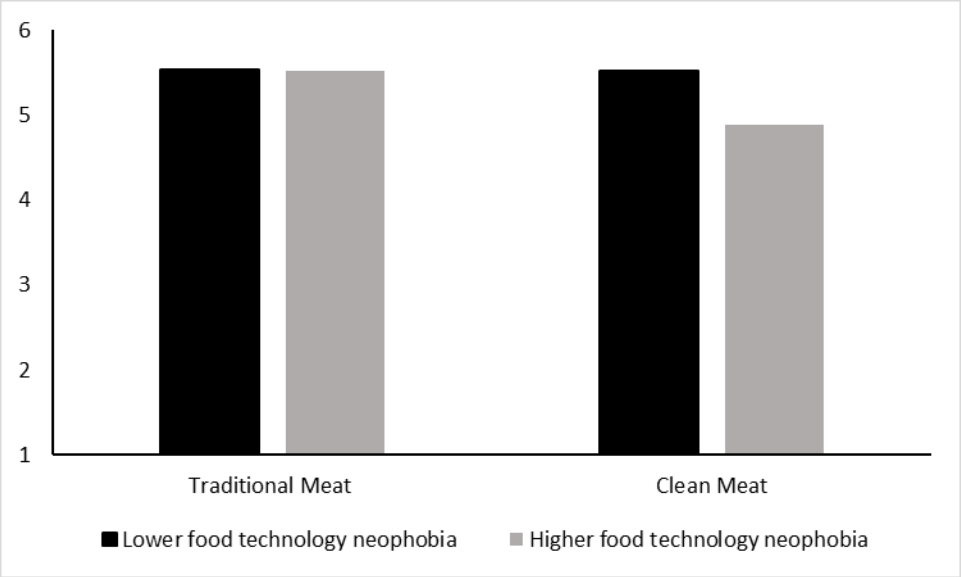
main effect of food technology neophobia, $F(1, 259) = 10.96$, $p = .001$, $\eta_p^2 = .04$ and, as expected, an interaction between food technology neophobia and label condition, $F(1, 259) = 10.38$, $p = .001$, $\eta_p^2 = .039$.[14]

To decompose and interpret the food technology neophobia x label condition interaction, we conducted moderation analysis for within-subjects designs using the macro MEMORE in SPSS (Montoya, 2019), allowing us to test and probe the label effect on dish evaluation at lower (-1 *SD*) and higher (+1 *SD*) levels of food technology neophobia (i.e., the moderator; see also figure 5.1.). Confirming Hypothesis 2, the results showed that only among those higher (but not lower) in food technology neophobia traditional (*vs*. clean) meat dishes received more favourable evaluations, $b = 0.42$, $SE = .09$, $t(268) = 4.67$, $p < .001$, 95% CI [0.24, 0.60] and $b = 0.03$, $SE = .09$, $t(268) = -.29$, $p = .77$, 95% CI [-0.15, 0.20], respectively.

With regard to naturalness importance, neither the main effect nor interaction between naturalness importance and label condition were significant, $F(1, 259) = 0.88$, $p = .348$ and $F(1, 259) = 1.58$, $p = .210$. Hence, we did not find support for Hypothesis 3.

[14] Meat liking interacted significantly with label, $F(1, 259) = 11.933$, $p = .001$, $\eta_p^2 = .044$. We also found a significant main effect of meat liking, $F(1, 259) = 22.71$, $p < .001$, $\eta_p^2 = .081$. No significant main or interaction effects of age, gender or political ideology emerged.

Figure 5.1. *Evaluations of clean and traditional meat dishes at lower (-1 SD) and higher (+1 SD) levels of food technology neophobia (Experiment 1).*



5.2.3. Discussion Experiment 1

In sum, Experiment 1 showed that omnivores exhibited a bias against clean meat dishes. Consistent with Hypothesis 1, dishes were evaluated as less favourably when labelled as clean (*vs*. traditional) meat. Importantly, this label effect was qualified by a significant moderation by food technology neophobia, corroborating Hypothesis 2: only participants higher, but not those lower, in food technology neophobia evaluated clean (*vs.* traditional) meat dishes less favourably. The results did not support Hypothesis 3: food naturalness importance did not moderate the evaluation of clean (*vs.* traditional) meat dishes.

5.3. Experiment 2

Experiment 2 examined evaluations of clean (*vs.* traditional) meat in a sample of both meat eaters and meat abstainers (i.e., vegetarians and vegans). Furthermore, we included a third label condition to compare evaluations of clean meat dishes with both traditional meat dishes and plant-based meat dishes. Whereas clean meat is physically analogous to traditional meat, plant-based substitutes are distinct, comprised of plant-based proteins (despite mimicking traditional meat products such as sausages and burgers). We expected that omnivores would prefer traditional meat over clean meat, and clean meat over plant-based meat (Hypothesis 4a), whereas veg*ns would prefer plant-based meat over clean meat, and clean meat over traditional meat (Hypothesis 4b).

We further investigated the moderating roles of food technology neophobia and food naturalness importance. Although plant-based products are not necessarily less processed than traditional meat products, consumers may perceive such products as healthier and more natural (Mäkiniemi & Vainio, 2014; Verain et al., 2015). Furthermore, those more interested in food naturalness may also be more inclined to purchase plant-based substitutes, which are oftentimes framed as more natural and sustainable (Tobler et al., 2011). As such, food naturalness importance may prove to be more relevant when comparing evaluations of clean with plant-based (rather than traditional) meat dishes.

5.3.1. Methods

Participants. Participants (N = 655) were recruited through opportunity sampling on social media. Retaining only data from omnivores and veg*ns, 29 participants who identified as pescatarian or "other" were excluded (final N = 626; 78.2% women, M_{age} = 36.41 years, SD_{age} = 16.41). Of this sample, 455 were omnivores (74.7% women; M_{age} = 37.47 years, SD_{age} = 17.07) and 171 were veg*n (87.8% women; M_{age} = 33.35 years; SD_{age} = 14.45).

Materials and Procedure. Participants completed the same task as in Experiment 1, but in addition to the six images from Experiment 1 (three traditional meat dishes and three clean

meat dishes), we included three more images showing similar dishes with plant-based meat (see Online Supplement). Three dishes were labelled as clean meat, three as traditional meat, and three as plant-based meat. Critically however, as in Experiment 1, in order to test the effect of dish labels (*clean* vs. *traditional* vs. *plant-based meat)* while controlling for image content, the label assigned to each dish was counterbalanced such that each dish was presented as clean meat to one third of the participants, as traditional meat to another third, and as plant-based meat to another third. After viewing each dish, participants completed the same four evaluative items as used in Experiment 1. For each label condition, the four items were averaged, with higher scores indicating more favourable evaluations of dishes labelled as traditional meat, clean meat, or plant-based meat.

Measures. Favourability of dishes was measured in the same way as in Experiment 1. For each label condition, the four items on appeal, smell, taste, and likelihood of eating at a buffet, were averaged into a single score, with higher scores indicating more favourable evaluations ($\alpha_{traditional}$ = .95; α_{clean} = .95; $\alpha_{plant\text{-}based}$ = .94).

Food technology neophobia **(**α = .83; *M* = 4.19, *SD* = 0.84) and food naturalness importance (α = .78, *M* = 4.49, *SD* = 1.25), were measured as in Experiment 1. We also assessed meat liking (α = .92, *M* = 4.61, *SD* = 1.97) and political ideology (*M* = 3.25, *SD* = 1.42) as in Experiment 1.

5.3.2. Results

First, we compared the evaluations of the dishes between the omnivores and veg*ns by conducting a mixed ANOVA with dish label (clean *vs*. traditional *vs*. plant-based) as the within-subjects factor and diet (omnivore *vs*. veg*n) as the between-subjects factor. The results (Figure 5.2) showed main effects of dish label and dietary category, $F(2, 623) = 296.97$, $p < .001$, $\eta_p^2 = .49$ and $F(1, 624) = 208.40$, $p < .001$, $\eta_p^2 = .25$, respectively. More importantly, these main effects were qualified by a significant interaction between label and diet, $F(2, 623)$

= 494.92, $p < .001$, $\eta_p^2 = .61$. As expected, compared to veg*ns, omnivores evaluated traditional meat and clean meat dishes more favourably, $F(1, 624) = 809.42$, $p < .001$, $\eta_p^2 = .57$, and $F(1, 624) = 194.21$, $p < .001$, $\eta_p^2 = .24$, respectively. Plant-based meat received more favourable evaluations from veg*ns than from omnivores, $F(1, 624) = 104.28$, $p < .001$, $\eta_p^2 = .14$. Having established these marked differences between dietary groups, we proceeded by testing the moderating role of food technology neophobia and food naturalness importance in both samples separately.

Figure 5.2. *Evaluations of clean and traditional meat dishes for omnivores and veg*ns (Experiment 2).*

Omnivore subsample

We first tested whether the omnivores evaluated the dishes differently depending on the label condition by conducting a univariate ANOVA with label as the within-participants factor. As expected, the effect of label was significant, $F(2, 453) = 29.18$, $p < .001$, $\eta_p^2 = .11$. Omnivores rated dishes labelled as traditional (*vs*. clean) meat more favourably, $F(1, 454) = 26.24$, $p < .001$, $\eta_p^2 = .06$, and rated images labelled as traditional (*vs*. plant-based) meat more favourably, $F(1, 454) = 55.82$, $p < .001$, $\eta_p^2 = .11$. Furthermore, omnivores also evaluated dishes labelled as clean (*vs*. plant-based) meat more favourably, $F(1, 454) = 8.67$, $p = .003$, $\eta_p^2 = .02$.

Next, we tested the moderating role of food technology neophobia and food naturalness importance, including age, gender, political ideology, and meat liking as control variables (see Table S11 in Appendix E for results without controls). This analysis showed a significant main effect of food technology neophobia, $F(1, 437) = 41.38$, $p < .001$, $\eta_p^2 = .09$ and a significant interaction between food technology neophobia and label condition, $F(2, 436) = 10.29$, $p < .001$, $\eta_p^2 = .05$. The main effect of food naturalness importance was also significant, $F(1, 437) = 4.89$, $p = .028$, $\eta_p^2 = .01$, as was the interaction between food naturalness importance and label condition, $F(2, 436) = 10.72$, $p < .001$, $\eta_p^2 = .05$.[15]

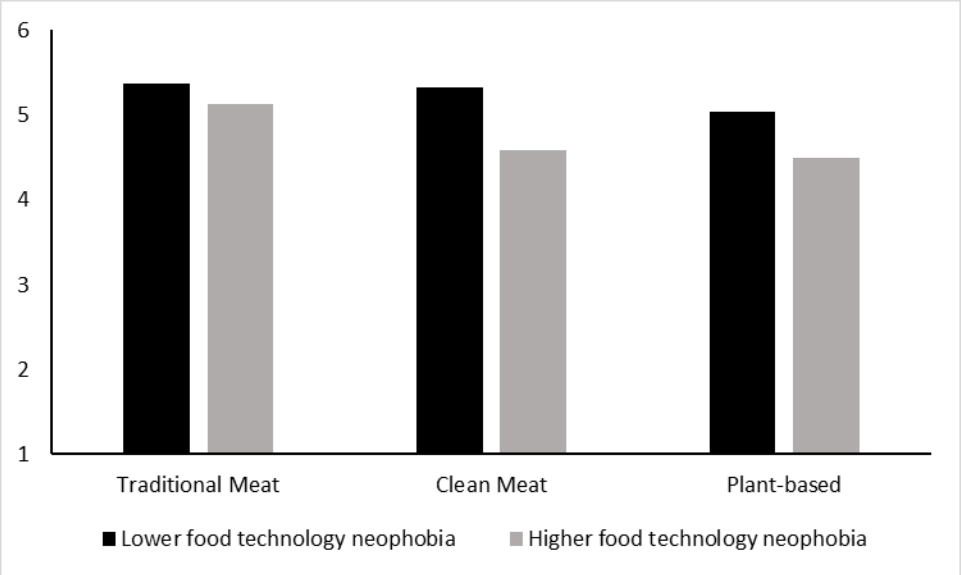
[15] A significant main effect of meat liking emerged, $F(1, 437) = 38.00$, $p < .001$, $\eta_p^2 = .08$. Meat liking significantly interacted with label, $F(2, 436) = 17.88$, $p < .001$, $\eta_p^2 = .08$. Higher meat liking was associated with stronger label effects for each comparison: traditional vs. clean meat label, $F(1, 437) = 6.36$, $p = .012$, $\eta_p^2 = .01$, traditional vs. plant-based meat label, $F(1, 437) = 35.77$, $p < .001$, $\eta_p^2 = .03$ and clean vs. plant-based meat label, $F(1, 437) = 12.08$, $p = .001$, $\eta_p^2 = .03$. There were also significant main effects for age, $F(1, 437) = 17.56$, $p < .001$, $\eta_p^2 = .039$; political ideology, $F(1, 437) = 5.04$, $p = .025$, $\eta_p^2 = .01$. No significant interactions with gender, age, or political ideology emerged.

To decompose these interaction patterns, we conducted moderation analysis for within-subjects designs (Montoya, 2019) and tested the effect of label condition on dish evaluation at lower (-1 *SD*) and higher (+1 *SD*) levels of food technology neophobia. The results are reported in Table 5.1. and presented in Figure 5.3., Panel A. Replicating Experiment 1, only omnivores higher (but not lower) on food technology neophobia evaluated clean (*vs*. traditional) meat dishes less favourably. Furthermore, although both those higher and lower on food technology neophobia evaluated traditional (*vs*. plant-based) meat dishes more favourably, this label effect was significantly stronger for those higher on food technology neophobia. Finally, food technology neophobia did not significantly moderate the difference in evaluations between clean meat and plant-based dishes. However, the simple slope analyses indicated that only omnivores lower, but not those higher on food technology neophobia, evaluated clean meat dishes more favourable than the plant-based meat dishes (see Figure 5.3. Panel A and Table 5.1.).

With respect to food naturalness importance, we found no moderation effect when comparing traditional and clean meat dishes, consistent with Experiment 1. However, food naturalness importance significantly moderated the label effect when comparing clean and traditional with plant-based dishes (see Figure 5.3., Panel B and Table 5.1.). Only participants lower (but not higher) in food naturalness importance preferred dishes labelled as clean and traditional meat over dishes labelled as plant-based meat.

Figure 5.3. *Evaluations of clean and traditional meat dishes at lower (-1 SD) and higher (+1 SD) levels of food technology neophobia (Panel A) and food naturalness importance (Panel B) (Experiment 2).*

Panel A



Panel B

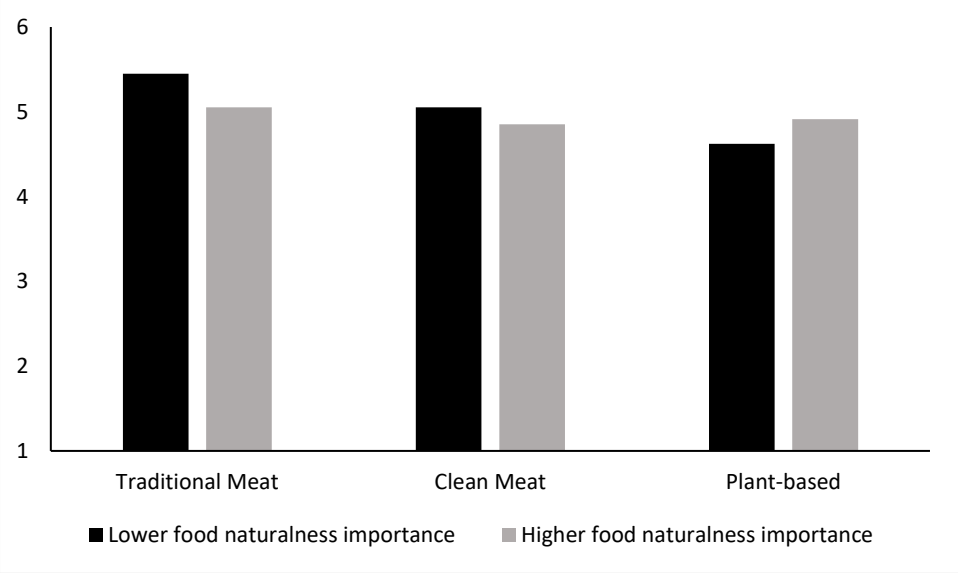


Table 5.1. Effect of label condition on dish evaluation at lower (-1 *SD*) and higher (+1 *SD*) levels of food technology neophobia and food naturalness importance and their respective interactions (among omnivores, Experiment 2).

	Lower food technology neophobia					Higher food technology neophobia					Label X food technology neophobia interaction				
	b	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*
Traditional (*vs*. clean)	0.06	.08	.68	.497	[-0.10, 0.22]	0.54	.08	6.70	<.001	[0.38, 0.70]	0.32	.08	4.25	<.001	[0.17, 0.47]
Traditional (*vs*. plant-based)	0.34	.09	3.77	<.001	[0.16, 0.52]	0.62	.09	6.84	<.001	[0.44, 0.80]	0.18	.08	2.17	.03	[0.02, 0.35]
Clean (*vs*. plant-based)	0.29	.09	3.28	.001	[0.12, 0.46]	0.08	.09	.89	.375	[-0.09, 0.25]	-0.14	.08	-1.69	.091	[-0.30, 0.02]
	Lower food naturalness importance					Higher food naturalness importance					Label X food naturalness interaction				
	b	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*
Traditional (*vs*. clean)	0.40	.08	4.79	<.001	[0.23, 0.56]	0.20	.08	2.47	.014	[0.04, 0.37]	-0.08	.05	-1.64	.10	[-0.17, 0.02]
Traditional (*vs*. plant-based)	0.82	.09	9.31	<.001	[0.65, 0.10]	0.14	.09	1.58	.114	[-0.03, 0.31]	-0.28	.05	-5.46	<.001	[-0.38, -0.18]
Clean (*vs*. plant-based)	0.43	.09	4.97	<.001	[0.26, 0.60]	-0.06	.09	-.74	.46	[-0.23, 0.10]	-0.20	.05	-4.03	<.001	[-0.30, 0.10]

Veg*n subsample

We followed the same analytical procedures for the veg*n subsample. Specifically, veg*ns also evaluated the dishes significantly differently depending on the label, $F(2, 169) = 431.19$, $p < .001$, $\eta_p^2 = .84$. As expected, veg*ns evaluated clean (*vs*. traditional) meat dishes more favourably, $F(1, 170) = 94.11$, $p < .011$, $\eta_p^2 = .34$. They also evaluated plant-based dishes more favourably than traditional and clean meat dishes, $F(1, 170) = 866.93$, $p < .001$, $\eta_p^2 = .84$ and $F(1, 170) = 389.17$, $p < .001$, $\eta_p^2 = .70$, respectively.

We next tested the moderating role of food technology neophobia and naturalness importance, including the control variables age, gender, political ideology, and meat liking (see Table S11 in Appendix E for results without controls). We found a significant main effect of food technology neophobia, $F(1, 156) = 17.18$, $p < .001$, $\eta_p^2 = .10$, plus a significant interaction between food technology neophobia and label condition, $F(2, 155) = 8.34$, $p < .001$, $\eta_p^2 = .10$.[16] Decomposing the interaction pattern to test the label effect at lower (-1 *SD*) and higher (+1 *SD*) levels of food technology (Table 5.2. and Figure 5.4.) showed that veg*ns lower on food technology neophobia showed more favourable evaluations for clean (*vs*. traditional) meat, with this effect significantly weaker among veg*ns higher on food technology neophobia. Furthermore, although veg*ns at both higher and lower levels of food technology neophobia evaluated plant-based (*vs*. clean) dishes more favourably, this label effect was significantly stronger among those higher (*vs*. lower) on food technology neophobia.

[16] Furthermore, an interaction between meat liking and label condition emerged, $F(2, 155) = 17.12$, $p = .005$, $\eta_p^2 = .18$, as well as an interaction between political ideology and label condition, $F(2, 155) = 5.53$, $p = .005$, $\eta_p^2 = .07$. Higher meat liking was associated with larger label effects for traditional vs. plant-based meat, $F(1, 156) = 34.07$, $p < .001$, $\eta_p^2 = .18$ and for plant-based vs. clean meat, $F(1, 156) = 17.83$, $p < .001$, $\eta_p^2 = .10$. More conservative political ideology was also associated with larger label effects for traditional vs. plant-based meat $F(1. 156) = 9.97$, $p = .002$, $\eta_p^2 = .06$ and for plant-based vs. clean meat, $F(1, 156) = 8.16$, $p = .005$, $\eta_p^2 = .05$. Furthermore, the main effects of age and meat liking were significant, $F(1, 156) = 5.46$, $p = .021$, $\eta_p^2 = .03$, and $F(1, 156) = 50.27$, $p < .001$, $\eta_p^2 = .24$, respectively.

The main effect of food naturalness importance and its interaction with label condition were not significant, $F(1, 156) = 0.66$, $p = .418$ and $F(2, 155) = 0.62$, $p = .542$.

Figure 5.4. *Evaluations of clean and traditional meat dishes for veg*ns at lower (-1 SD) and higher (+1 SD) levels of food technology neophobia (Experiment 2).*

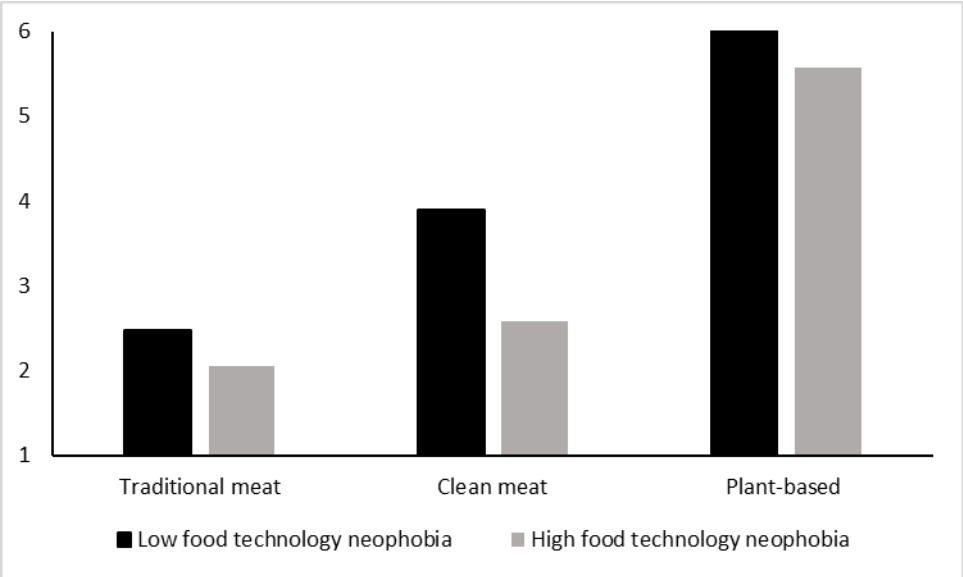


Table 5.2. Effect of label condition on dish evaluation at lower (-1 *SD*) and higher (+1 *SD*) levels of food technology neophobia and food naturalness importance and their respective interactions with label condition (veg*n subsample, Experiment 2).

	Lower food technology neophobia					Higher food technology neophobia					Label X food technology neophobia interaction				
	b	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*	*b*	*SE*	*t*	*p*	*95% CI*
Traditional (*vs*. clean)	-1.42	.13	-10.65	<.001	[-1.68, -1.16]	-0.52	.13	-3.90	<.001	[-0.78, -0.26]	0.46	.10	4.77	<.001	[0.27, 0.65]
Traditional (*vs*. plant-based)	-3.59	.17	-20.93	<.001	[-3.93, -3.25]	-3.52	.17	-20.53	<.001	[-3.86, -3.18]	0.03	.12	.28	.779	[-0.21, 0.28]
Clean (*vs*. plant-based)	-2.17	.18	-12.01	<.001	[-2.53, -1.81]	-3.00	.18	-16.61	<.001	[-3.36, -2.65]	-0.42	.13	-3.25	.001	[-0.68, 0.17]

5.3.3. Discussion Experiment 2

Replicating Experiment 1, omnivores evaluated dishes labelled as traditional (*vs.* clean) meat more favourably (Hypothesis 1), yet this was only the case for those higher (not lower) in food technology neophobia (Hypothesis 2). Again, we found no support for the moderating role of naturalness importance in the evaluation of traditional (*vs.* clean) meat dishes. However, food naturalness importance did play a role when considering plant-based dishes. Specifically, whereas those lower on food naturalness evaluated dishes labelled as traditional and clean meat more favourably than plant-based dishes, no such label effects occurred among those higher on food naturalness importance.

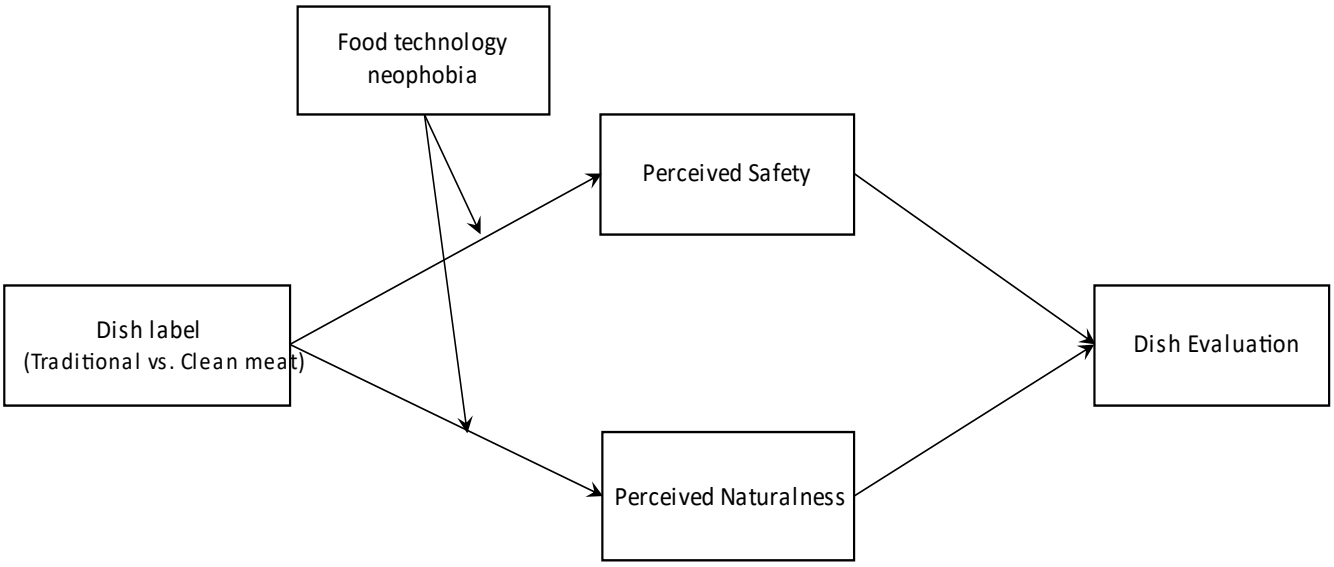
Furthermore, confirming Hypothesis 4a, omnivores evaluated dishes labelled as traditional meat more favourably than veg*ns, and veg*ns evaluated dishes labelled as plant-based meat more favourably than omnivores. Within the veg*n sample, plant-based meat was favoured over clean meat, which in turn was favoured over traditional meat, confirming Hypothesis 4b. Furthermore, food technology neophobia (but not food naturalness importance) moderated the label effect of clean meat relative to both traditional and plant-based meat with more negative evaluations of clean meat dishes among those higher (*vs.* lower) on food technology neophobia (see Figure 5.4.).

5.4. Experiment 3

In Experiment 3, we asked *why* omnivores higher on food technology neophobia evaluate clean meat differently than traditional meat. Specifically, we measured participants' perceptions of safety and naturalness of the clean and traditional meat dishes and tested perceived safety and naturalness as mediators of the interaction effect between label (clean *vs.* traditional meat) and food technology neophobia (higher *vs.* lower) on the evaluations of the dishes (see Figure 5.5 for conceptual model). Although we measured food naturalness importance in this experiment, we did not expect that food naturalness importance would play a substantial moderating role based on Experiments 1 and 2.

Figure 5.5.

Conceptual model illustrating the mediated moderation model.



Conceptual model

5.4.1. Methods

Participants. Participants (N = 312) were recruited through the crowdsourcing platform Prolific and received financial compensation. Retaining only omnivores, 39 self-identifying vegetarians, vegans and pescatarians were excluded (final N = 273). The sample consisted of 56.1% men, with a mean age of 28.19 years (SD_{age} = 9.36).

Materials and Procedure. The design and procedure were identical to Experiment 1. However, in addition to evaluating clean and traditional meat dishes, participants also rated the naturalness and safety of the dishes on a 7-point scale, ranging from *Looks extremely unnatural* to *Looks extremely natural* and ranging from *Seems extremely unsafe* to *Seems extremely safe,* respectively.

Measures. Dish favourability was measured in the same way as in Experiment 1, $\alpha_{traditional}$ = .90, α_{clean} = .91. Food technology neophobia **(**α = .83; M = 3.99, SD = 0.89) and food naturalness importance (α = .70, M = 4.20, SD = 1.11) were measured as in Experiment 1. We also assessed meat liking (α = .82, M = 6.02, SD = 1.00) and political ideology (M = 3.13, SD = 1.41) as in Experiment 1.

5.4.2. Results

First, we tested whether participants evaluated the dishes differently depending on the label condition, conducting a univariate ANOVA with label as the within-participants factor. Replicating previous experiments, the label effect was significant. Dishes labelled as traditional (*vs*. clean) meat were evaluated more favourably (see Table 5.3.).

Next, we conducted an ANCOVA with label condition as the within-subjects factor, food technology neophobia and food naturalness importance as continuous predictors, as well as their interaction terms with label condition. We included age, gender, political ideology, and meat liking as control variables (see Table S11 in Appendix E for results without controls). This analysis revealed a main effect of food technology neophobia, $F(1, 264) = 6.68$, p = .010,

η_p^2 = .025, and an interaction between food technology neophobia and label condition, F(1, 264) = 6.65, p = .010, η_p^2 = .025. Decomposing the moderation effect of food technology neophobia confirmed Hypothesis 2: only those higher (+1SD), but not those lower (-1SD), on food technology neophobia evaluated clean (*vs*. traditional) meat less favourably, b = 0.40, SE = .08, t(271) = 5.16, p < .001, 95% CI [0.24, 0.55] and b = 0.07, SE = .08, t(271) = .93, p = .35, 95% CI [-0.08, 0.22], respectively.

In line with the previous two experiments, the main effect of food naturalness importance and its interaction with label condition were not significant, F(1, 264) = 0.01, p = .932 and F(1, 264) = 0.89, p = .346, respectively. [17]

Table 5.3. Dish evaluations, perceived safety, and perceived naturalness ratings for each type of meat and results of the ANOVAs testing for differences between conditions (Experiment 3).

	Traditional meat	Clean meat	Difference
	M (*SD*)	*M*(*SD*)	*F*(1,272)
Dish evaluation	5.50 (0.87)	5.26 (0.91)	F =18.06, p < .001, η_p^2 = .062
Perceived safety	5.37 (1.06)	5.17 (1.07)	F = 10.54, p = .001, η_p^2 = .037
Perceived naturalness	4.80 (1.14)	4.65 (1.14)	F = 4.82, p = .029, η_p^2 =.017

[17] We also found a significant main effect of meat liking, F(1, 264) = 35.78, p < .001, η_p^2 = .12, and a main effect of age, F(1, 264) = 4.36, p = .038, η_p^2 = .016.

Perceived Safety and Naturalness

We conducted ANOVAs to examine whether the dishes were evaluated differently in terms of perceived safety and perceived naturalness. Traditional meat was perceived as safer and more natural than clean meat (see Table 5.3.).

Next, we tested whether the differential perceptions of safety and naturalness for traditional versus clean explain (i.e., mediate) the effect of dish label on dish evaluation for those higher but not for those lower on food technology neophobia. Specifically, we tested a mediated moderation model for within-subject designs in Mplus (Version 8; Muthén & Muthén, 1998–2017) following the analytic procedures described by Montoya (2018). In other words, we tested the effect of label condition (traditional *vs.* clean meat) on the mediators (i.e., perceived safety and naturalness), which in turn were associated with the outcome variable (i.e., dish evaluations). Food technology neophobia was included as a moderator of the label effect on both mediators and the outcome variable. This allowed us to test for the conditional indirect effect of label condition at higher and lower levels of food technology neophobia on dish evaluations via perceived safety and naturalness. Age, gender, political ideology, and meat liking were included as control variables.

This model test confirmed that clean (*vs.* traditional) meat was evaluated as significantly less safe and less natural, $b = 0.21$, $SE = .06$, $p = .001$ and $b = 0.15$, $SE = .07$, $p = .026$, respectively. With respect to dish evaluations, the results confirmed that clean (*vs.* traditional) meat was evaluated as significantly less favourably, $b = 0.13$, $SE = .04$, $p = .004$. Furthermore, both mediators (i.e., differential safety and naturalness perceptions) were significantly associated with dish evaluations, $b = 0.41$, $SE = .05$, $p < .001$ and $b = 0.16$, $SE = .05$, $p = .001$, respectively.

Critically, however, food technology neophobia significantly moderated the label effect on perceived safety, $b = 0.17$, $SE = .07$, $p = .025$, but not on perceived naturalness, $b = 0.02$,

SE = .08, *p* = .853. Specifically, those higher in food technology neophobia perceived clean meat as less safe than traditional meat, *b* = 0.36, *SE* = .09, *p* = .001, whereas no such label effect on perceived safety was found for those lower in food technology neophobia, *b* = 0.06, *SE* = .09, *p* = .527. The label effect on perceived naturalness was non-significant for those both higher and lower in food technology neophobia *b* = 0.16, *SE* = .10, *p* = .098 and *b* = 0.13, *SE* = .10, *p* = .166, respectively.

Consequentially, the findings revealed a significant mediated moderation effect on dish evaluations via perceived safety, *b* = 0.07, *SE* = .03, *p* = .031, but not via perceived naturalness, *b* = 0.002, *SE* = .01, *p* = .853. Estimating the conditional indirect effect of label condition on dish evaluation via perceived safety confirmed that only those higher on food technology neophobia evaluated clean (*vs*. traditional) meat dishes as less favourably, through lower safety perceptions of clean (*vs*. traditional) meat, indirect effect = 0.15, *SE* = .04, *p* < .001. No such indirect effect was found for those lower in food technology neophobia, indirect effect = 0.02, *SE* = .04, *p* = .528.

5.4.3. Discussion Experiment 3.

Experiment 3 showed that those higher (but not those lower) on food technology neophobia rated clean meat as less safe than traditional meat, which further explained (mediated) in part why they evaluated clean meat dishes as less favourable. Furthermore, clean meat dishes were also rated as slightly less natural than traditional meat dishes, yet the effects on perceived safety were more pronounced, and naturalness concerns did not account for why those higher on food technology neophobia evaluated clean meat dishes more negatively.

5.5. General Discussion Chapter 5

Across three studies we examined people's evaluations of clean meat dishes as compared to traditional meat dishes. As expected, all three studies demonstrated that on average, omnivores preferred dishes labelled as traditional (*vs*. clean) meat over dishes despite controlling for the objective attractiveness and appeal of the presented dishes by using identical photos across conditions (i.e., counterbalancing the labels). Critically however, this label effect was further qualified by participants' levels of food technology neophobia (Experiments 1-3). Only participants higher, but not those lower, in food technology neophobia felt less favourable towards clean meat as compared to traditional meat. Further in line with this finding, safety concerns, but not naturalness concerns, explained (i.e., mediated) why those who express greater resistance against new food technologies are also less willing to try clean meat and exhibit stronger doubts and scepticism about its taste and smell (Experiment 3).

Omnivores also preferred traditional meat over plant-based meat (Experiment 2), yet again, this effect was moderated by food technology neophobia such that omnivores higher on food technology neophobia seemed particularly sceptical about the taste and smell of plant-based meat alternatives and were less willing to try such dishes. Moreover, food technology neophobia was also implicated in the evaluation of clean meat among veg*ns (Experiment 2). Indeed, although a strong overall preference for plant-based meat over clean meat was observed among veg*ns, veg*ns higher (*vs.* lower) on food technology neophobia were much less accepting of clean meat.

We had also reasoned that omnivores who are more concerned about food naturalness would be more negative about clean meat than about traditional meat, yet we did not obtain support for this idea. Hence, the role of food naturalness importance is less clear and only played a role when comparing clean meat with plant-based meat among omnivores such that those lower, but not those higher, on food naturalness importance rated traditional and clean meat more favourably than plant-based meat.

Taken together, the findings highlight that both for omnivores and veg*ns, concerns about new food technologies rather than general preferences for natural food products are implicated in their evaluations of clean meat. Importantly, by using the same sets of photos of familiar dishes in all conditions, our experimental design is unique compared to past studies on this topic, which typically only presented written descriptions of clean meat. Indeed, our design allowed for a direct test of labelling dishes as clean meat compared to traditional meat by keeping the visual appearance of the dishes constant between conditions. The use of images also avoids the possible problem that participants can only think of clean meat in abstract terms when reading about clean meat, while they can easily visualise traditional meat dishes in concrete terms without photos. By avoiding such confounds, our studies provide convincing evidence that labelling dishes as clean meat significantly affects people's evaluations of the dish, at least among those higher on food technology neophobia.

5.5.1. Food Technology Neophobia and Naturalness

Our studies are the first to demonstrate the robust predictive role of food technology neophobia in the context of clean meat acceptance. Indeed, food technology neophobia has largely been overlooked in previous work on clean meat yet has been shown to be an important predictor for negative attitudes towards foods produced using novel technologies, such as genetic modification, pasteurisation, and nanotechnology, and for foods enriched with bioactive proteins (e.g., Kim et al., 2014; Matin et al., 2012; Vidigal et al., 2015). Our experiments extend previous findings by showing that attitudes towards clean meat can reliably be predicted by concerns about novel food technologies. Furthermore, our findings suggest that fears of novel food technologies can elicit anxiety about the safety of clean meat, including concerns about possible negative health effects, and poor nutritional quality - concerns more strongly attributed to a lack of knowledge rather than unfamiliarity (e.g., Bryant & Dillard, 2019; Gómez-Luciano et al., 2019; Shaw & Mac Con Iomaire, 2019; Zhang et al., 2020).

The findings also remind us of the effect of a related yet distinct concept. Specifically, Wilks and colleagues (2019) reported that fear of novel foods (i.e., food neophobia) predicted lower willingness to try clean meat. Although food neophobia is indeed relevant in the study of clean meat as a novel food, food technology neophobia can be considered a more proximal construct, referring to the essence of clean meat, not just as a novel food item, but as a food item produced using novel technologies (e.g., Cox & Evans, 2008). This distinction is important because different types of concerns may underpin fear of novel food and fear of food produced with novel technologies and thus, likely require different strategies for consumer acceptance of clean meat. However, as we did not measure food neophobia, future experiments could include this variable alongside food technology neophobia, in order to test and distinguish the unique predictive roles of both variables.

Previous work highlighted that naturalness concerns pose a substantial barrier to the acceptance of clean meat (e.g., Siegrist et al., 2018; Siegrist & Sütterlin, 2017), with those who strongly value food naturalness being less willing to eat it (Michel & Siegrist, 2019). However, our studies did not reveal unique effects of naturalness importance when comparing ratings of traditional and clean meat. A possible explanation for this discrepancy could be that previous research designs did not allow for direct comparisons between clean and traditional meat, making it difficult to identify the unique psychological barriers to clean meat acceptance. Moreover, although higher perceived naturalness ratings were significantly related to more positive evaluations of the presented dishes, the difference in naturalness perceptions between the clean relative to the traditional meat dishes was rather small, indicating that naturalness concerns are implicated in the evaluations of both types of meat.

5.5.2. Limitations & Future Directions

Our findings identified safety concerns as a key barrier to clean meat acceptance for those high on food technology neophobia. However, our research design does not allow for

causal interpretations of the association between perceived safety and dish evaluations. Future research could manipulate safety perceptions to test if framing clean meat as safer would erase the differences in evaluations between clean and traditional meat for those high on food technology neophobia.

Although our focus was on food technology neophobia and naturalness importance, we also found that participants who like meat more favoured traditional over clean meat dishes. Future studies could examine whether framing clean meat as more similar to traditional meat in terms of smell, taste, and texture, would erase those differences among those higher on meat liking. Similarly, we found some evidence for the role of political ideology, with more conservative participants favouring traditional meat, although this finding was inconsistent across experiments. Future studies could examine whether certain ideologies may be more closely related to food technology neophobia and clean meat acceptance.

5.5.3. Conclusion

Our experiments provide new insights into consumer perceptions of clean meat by revealing that fears of novel food technologies may pose a key psychological barrier to clean meat acceptance. Understandably, many people are wary about foods produced by new technologies they know little about. Strategies that focus on reducing anxiety around the use of new technologies and increasing its perceived safety may go a long way in effectively increasing clean meat acceptance.

Chapter 6: General Discussion

This thesis aimed to contribute to the growing body of literature on human-animal intergroup relations, presenting three research lines investigating the ties between ideology and motivated cognitions about animals, as well as the factors that stand in the way of clean meat acceptance. This thesis firstly provided evidence that human supremacy beliefs act as a hierarchy-enhancing motive in human-animal intergroup relations, supporting the selective oppression of some animals and perpetuating the moral divide between animals of different social categories. Secondly, this thesis extended the literature on the denial of mind of animals, demonstrating that ideologically motivated individuals misremember sentience information about food animals. Lastly, this thesis presented evidence on the factors that influence acceptance of clean meat, highlighting the importance of food technology neophobia and perceptions of safety.

6.1. Summary of findings

Previous research has shown that although people typically claim to care for animals overall, this differs greatly between different species, linked directly to the animal's status in society (Dhont et al., 2020; Herzog, 2011; Joy, 2010; Leite et al., 2019; Plous, 2003). Chapter 3 thus examined this moral divide between animals of different social categories and the role of human supremacy beliefs in predicting this. Extending the work done by Leite and colleagues (2019), we expected that participants higher in human supremacy beliefs would have lower levels of moral concern for animals overall. Moreover, we expected an interaction effect between animal category and human supremacy beliefs, such that those higher (vs. lower) in human supremacy beliefs would perceive a greater moral divide between low- and high-status animals. Specifically, the moral divide was expected to be stronger in participants with higher human supremacy beliefs.

The results of Chapter 3 confirmed that people care significantly more for high-status animals like companion animals and appealing wild animals than for low-status animals, such as food animals and unappealing wild animals. Importantly, and in line with expectations, this difference in moral concern between the high- and low-status categories was significantly greater for participants with higher human supremacy beliefs, as opposed to those with lower human supremacy beliefs. Specifically, people who held stronger beliefs in humans' supremacy over animals also perceived a greater moral divide between high- and low-status animals. Importantly, these findings held up after controlling for age, gender, diet and SDO, indicating that human supremacy beliefs contribute to an increased perceived moral divide between animals above and beyond the influence of these other variables.

While omnivores have been shown to employ a wide range of justification strategies to avoid meat-related cognitive dissonance (e.g., Rothgerber, 2020a), Chapter 4 focused specifically on the denial of animal mind. Using a newly developed memory paradigm, we tested whether people higher on dominance-based ideologies (i.e., RWA and SDO) would make more memory errors than those lower in those ideologies when asked to remember recently learned information about a traditional food animal's intelligence and sentience. Confirming these expectations, higher levels of dominance-based ideologies, both RWA and SDO, were associated with more memory errors in both types of recall (i.e., free, and cued recall) tasks. However, follow-up analyses in Study 3 revealed that when entered into the model together, RWA was the main predictor for targeted memory loss across both types of recall task, rather than SDO, which was only marginally significant. This was an interesting and somewhat surprising finding, since SDO tends to be more closely related to speciesism and desires for group-based dominance than RWA.

In the learning materials for Study 4 we distinguished between sentience and use-information. This distinction was crucial as it allowed us to disentangle the effects of the

motivated memory mechanisms between sentience information (information relating to the animals' intelligence) and use-information (information relating to different uses of the animal in scientific and culinary settings). In line with the third study, both RWA and SDO significantly predicted targeted memory errors separately. However, and importantly, RWA was a significant predictor for targeted memory errors relating to sentience information only, but not for memory errors relating to use-information. SDO predicted targeted memory errors across both types of information, with no distinction between sentience- and use-information. This distinction between RWA and SDO is important, as both constructs are implicated in attitudes towards animals, although in different capacities as is reflected here in the results of Study 4.

The final empirical chapter of this thesis, Chapter 5, turned its focus away from attitudes towards animals and instead onto attitudes towards animal products. Clean meat was discussed as a potential solution to the ethical, environmental, and public health issued currently faced by the traditional animal agriculture industry (see for example Graham et al., 2008; Gerber et al., 2013; Dhont & Hodson, 2020). Clean meat presents an opportunity to move towards more sustainable food production, cutting out risks of zoonotic diseases, and most importantly perhaps could end the large-scale exploitation of animals for human consumption. Shifting the focus from the previous chapter, this chapter examined not how we think about animals, but the factors that can help explain attitudes towards meat substitutes like clean meat. Chapter 5 thus aimed to add to the growing body of literature on clean meat acceptance, which will be crucial in developing the most effective messaging and marketing strategies.

Across three experiments we investigated attitudes towards clean meat as compared to traditional meat, by labelling dishes as either clean or traditional meat. We also investigated the individual difference variables that may affect these attitudes. We expected the label effect to be moderated by food technology neophobia and food naturalness importance, and for these

effects to be further mediated by perceptions of safety and naturalness. We expected omnivores to prefer dishes labelled as traditional meat over dishes labelled as clean meat, and for this label effect to be moderated by differences in food technology neophobia, with a stronger label effect expected for those higher (vs. lower) in food technology neophobia. Along similar lines, we expected the label effect to be moderated by differences in food naturalness importance, with a stronger label effect expected for those higher (vs. lower) in food naturalness importance. In Experiment 2, having included plant-based meat dishes, we also expected omnivores to favour dishes labelled as traditional meat over those labelled as clean meat over those labelled as plant-based meat, and for vegetarians and vegans (i.e., veg*ns) to favour dishes labelled as plant-based meat over dishes labelled as clean meat over those labelled as traditional meat.

As expected, all three experiments demonstrated that omnivores did indeed prefer dishes labelled as traditional meat over dishes labelled as clean meat, despite carefully controlling for the objective attractiveness of the dishes by counterbalancing the dish labels across images and also across participants. Importantly, this demonstrated that simply labelling an image as clean meat can lead to less favourable evaluations, irrespective of the objective appeal of the dish presented. Further in line with expectations, food technology neophobia moderated this label effect such that only participants higher, but not those lower, in food technology neophobia viewed dishes labelled as clean meat as significantly less appealing than dishes labelled as traditional meat across experiments. Moreover, Experiment 2 also revealed that veg*ns evaluated dishes labelled as plant-based meat more favourably than dishes labelled as clean meat, and the latter more favourably than dishes labelled as traditional meat, and as for omnivores, this label effect was qualified by levels of food technology neophobia, such that veg*ns higher, but not those lower, in food technology neophobia evaluated clean meat more negatively. Experiment 3 revealed that omnivores higher (vs. lower) in food technology

neophobia also perceived clean (vs. traditional) meat as less safe, further explaining why participants higher on food technology neophobia viewed clean meat as less appealing.

Although we had reasoned that food naturalness importance would also moderate the label effect, we found little evidence for this across all three experiments. Only in experiment 2 did omnivores lower (vs. higher) in food naturalness importance rate traditional and clean meat as more favourable than plant-based meat. Furthermore, we found little evidence to support the notion that perceptions of naturalness mediated the label effect. While higher naturalness ratings were indeed linked to greater appeal of all dishes, the difference in naturalness perceptions between clean and traditional meat was negligible, indicating that naturalness concerns may be implicated in attitudes towards both types of meat, rather than for clean meat specifically. It is possible that those who value their food's naturalness more strongly feel less positively about meat in general, laboratory- or animal-grown.

6.2. Theoretical Implications

Evidently, ideology and individual differences are heavily implicated in peoples' thinking about animals and meat substitutes. In this following section, the theoretical implications of the findings presented in this thesis are discussed further.

1) Human supremacy beliefs predict not only moral concern for animals overall, but also a greater perceived moral divide between low- and high-status animals, above and beyond the influence of SDO.

The findings of Chapter 3 confirm that while SDO is implicated in human-animal intergroup relations (e.g., Dhont & Hodson, 2014), human supremacy beliefs may be a more proximal variable in the context of investigations into moral concern for animals. Our findings provide further support for the notion that human supremacy beliefs act as a hierarchy-enhancing motive, furthering selective oppression and supporting the distinction between high and low-status animal outgroups, similar to how SDO is especially implicated in attitudes

towards low-status human outgroups (e.g., Jackson, 2019; Dhont et al., 2014; Salmen & Dhont, 2020). Essentially, participants who believed in human supremacy over animals more strongly did not just report less moral concern for animals overall, but also perceived a greater moral divide between animals belonging to high and low-status groups.

There are several potential explanations for why higher human supremacy beliefs were associated with a greater perceived moral divide between high- and low-status animals. Firstly, individuals motivated by human supremacy beliefs may be more prone to perceiving the desirable characteristics of high-status animals (like cuteness, perceived similarity to humans, and intelligence) more strongly in line with such animals' higher hierarchical position. Previous research suggests that factors like perceived cuteness can indeed impact the perceived edibility of an animal and elevate its moral standing (e.g., Bastian et al., 2012; Piazza et al., 2018). Along similar lines, participants who more strongly believe in human supremacy over animals may also perceive the negative or undesirable features of low-status animals more strongly. Perceptions of danger and disease have been associated with decreased moral standing, especially for unappealing low-status animals like snakes or snails (e.g., Knight, 2008; Piazza et al., 2014; Possidónio et al., 2019). Such perceptions may also serve to justify low-status animals' position at the bottom of the hierarchy. Moreover, high-status animals such as companion animals (e.g., dogs, cats) and appealing wild animals (e.g., dolphins, chimpanzees) are usually perceived as highly sentient and intelligent (e.g., (Possidónio et al., 2019), and as a result of this perceived developed mind are also more likely to be seen as more similar to humans and as more deserving of moral concern (Bastian et al., 2012). Low-status animals like food animals however tend to be perceived as significantly less sentient and intelligent. When considering food animals specifically, this dementalisation is thought to be one of the ways in which omnivores justify their meat consumption and resolve meat-related cognitive dissonance (e.g., Rothgerber, 2020a), as well as perpetuating food animals' low hierarchical status. People

scoring higher in human supremacy beliefs may therefore be more motivated to upkeep existing animal hierarchies, which is examined in depth in the moral divide as described in Chapter 3.

2) Right wing authoritarianism significantly predicts targeted memory errors for information on food animals' sentience, but not for information on their uses to humans, indicating that targeted memory errors occur only for information that is threatening to the societal status quo of carnism, rather than any information on food animals.

As briefly touched upon in the previous section, people employ many strategies to justify their lack of moral concern for some animals, but not others. This thesis focused in particular on the dementalisation of food animals, or the denial of mind of such animals. Denial of mind occurs when information on an animal's intelligence, sentience, as well as their ability to feel complex emotions is disregarded when recognising these factors would amplify meat-related cognitive dissonance (e.g., Bilewicz et al., 2011; Bratanova et al., 2011; Loughnan et al., 2010). If an animal is seen as unable to think and feel, its exploitation for human gain is more easily justified than if its sentience were accurately considered: pigs for example exhibit high levels of sentience and intelligence which are routinely disregarded by omnivores (see Mendl et al., 2010 for an overview of research into pig cognition). This dementalisation thus helps to justify the continued exploitation and consumption of such low-status animals (e.g., Bastian et al., 2012; Hodson et al., 2014; Piazza et al., 2014). While previous research has suggested that sentience information on food animals is largely disregarded by omnivores when making moral judgements (e.g., Bastian et al., 2012; Bratanova et al., 2011), Chapter 4 extended this body of research by demonstrating that this process occurs even during a memory exercise where moral concern or the animal's edibility was not a salient factor. Even when the animals' moral standing was not highlighted, individuals who more strongly endorsed dominance-based ideologies (i.e., RWA and SDO) made more memory errors for information

on food animals' sentience. Crucially however, RWA predicted targeted memory errors for sentience information only, while SDO predicted impaired memory for all information (i.e., sentience and use information). SDO is more generally related to speciesism and moral exclusion of animals regardless of status, which could help explain the finding that SDO predicted memory errors across the board, for both sentience and use-information. In sum, RWA appears more relevant in the context of meat consumption and attitudes towards animals that traditionally hold a status as food and as a result show greater the disregard of sentience information for such animals (e.g., Dhont & Hodson, 2014).

3) A major barrier to clean meat acceptance is food technology neophobia, but not food naturalness importance. Perceptions of safety, but not naturalness, mediated the effects of food technology neophobia on perceptions of clean meat as compared to traditional meat.

The results from all three experiments presented in Chapter 5 provide convincing evidence that concerns about new food technologies, rather than preferences for naturalness in foods, are more heavily implicated in evaluations of clean meat as compared to traditional meat. Chapter 5 demonstrated that simply labelling an image as clean meat had significant effects on how it was perceived by participants. Importantly, no study to date had used images to probe attitudes, and very few studies had directly compared attitudes towards clean and traditional meat to one another. Crucially, Chapter 5 demonstrated that food technology neophobia, or the extent to which people are wary of new food technologies, significantly and negatively impacted attitudes towards clean meat. This effect was further mediated by participants' perceptions of clean meat being less safe. These experiments demonstrate the importance of food technology neophobia in the context of clean meat acceptance research. Previous work on the topic had largely overlooked this measure, despite its documented role in consumer acceptance of foods produced using novel technologies like genetic modification,

nanotechnology, and pasteurisation (e.g., Kim et al., 2014; Matin et al., 2012; Vidigal et al., 2015). While previous research also found clean meat to be perceived as unnatural (e.g., Siegrist & Sütterlin, 2017), Chapter 4 demonstrated that when comparing both traditional and clean meat, individuals who valued their foods' naturalness more (vs. less) rated both types of meat similarly low. This may indicate that those who value their foods' naturalness more might not only opposed to clean meat, but also to other types of meat. Ultimately, we found food technology neophobia to moderate reactions towards clean meat as compared to traditional meat, and this effect was mediated by perceptions of safety.

6.3. Limitations and Future Directions

6.3.1. Chapter 3. There are, however, some important limitations to the present research. The current findings show that human supremacy beliefs are implicated in human-animal intergroup relations and are a critical variable in studying the moral divide between high- and low-status animals. However, due to the cross-sectional design employed in the two studies reported in Chapter 3, the causal direction of the relationships observed cannot be discussed with certainty. Future research could investigate this further in applying longitudinal designs to the current framework. Moreover, a range of research has shown that low-status and unappealing animals such as snakes or rats are seen as disgusting or dangerous, and in turn are afforded much less moral concern (Knight, 2008; Piazza et al., 2014; Possidónio et al., 2019). People higher in human supremacy beliefs may be more likely to perceive such negative characteristics more strongly, and in turn feel less inclined to include animals seen as dangerous, repulsive, or harmful in their moral circle. It would be interesting to see future research investigate whether people scoring higher in human supremacy beliefs really do perceive such negative characteristics more strongly, or perhaps are more likely to dementalise low-status animals as compared to high-status animals.

Additionally, it would certainly be useful for future projects into this research line to include a measure of speciesism since human supremacy beliefs and speciesism are inherently connected as constructs. By measuring and controlling for speciesism, future projects could bring forth convincing evidence for the unique role of human supremacy beliefs in the moral divide.

On the other hand, Chapter 3 also presents a strength in that moral concern ratings were given only for the written animal-name (e.g., ‘’cow’’ or ‘’sheep’’), with no visual or descriptive stimuli that may affect perceptions. While there is certainly an advantage in removing any confounding factors and tapping in only on the participants’ own perceptions of the animal, it would be interesting for future research to examine whether the inclusion of images or descriptions may affect results. There is some evidence that the perceived cuteness of an animal, especially a baby animal, can significantly affect its moral standing and perceived edibility (Piazza et al., 2018), and previous work has shown that by describing animals as more human-like, their moral status can be elevated (e.g., Bastian et al., 2012).

Furthermore, the animal categories consisted of uneven numbers of exemplars. It is possible that such uneven distributions may have distorted the average moral concern scores for the animal categories with relatively low exemplars (i.e., only three items for companion animals). The animals and categories were chosen for their applicability to majority of people in the UK context, and certain animals were not included in order to avoid category ambiguity, as animals such as rabbits may be seen by some as companion animals and by others as food animals. Additionally, the animals included in the unappealing wild category were mostly not mammals. It is likely that phylogenetic differences play a role in moral concern judgements, and thus future studies could probe the observed effects by including only mammals or investigating further whether these phylogenetic differences do indeed drive the effects as observed in the current studies. In future studies, this concern could be addressed by more

evenly distributing the number of animals per category and using a standardised set of items, such as the materials developed and tested by Possidónio and colleagues (2019). This recent work presents a comprehensive open-source image database of 12 biological animal categories and 11 psychological evaluation dimensions. Possidónio and colleagues (2019) found that moral judgments about animals in this database were largely affected by cuteness, edibility, capacity to feel, and familiarity. These factors taken together should allow future researchers to tap into different aspects of perceptions of animals belonging to differing socio-cultural statuses, using standardised images and evaluation dimensions, to further our understanding of how animal characteristics can affect moral judgements alongside a wide range of socio-ideological factors.

6.3.2. Chapter 4. Chapter 4 also presents some important limitations. For example, we only included a typical food animal, pigs, into the research. While the results certainly support the notion that memory for sentience information for pigs is impacted in individuals who are ideologically motivated, there was no comparison with other classes of animals, or even with other food animals. Future research could firstly replicate the work presented in this thesis and extend it by comparing different types of food animals, in order to establish whether the motivated memory mechanisms observed in the studies of Chapter 4 replicate across other low-status food animals in a similar manner. We would expect the results to look similarly when comparing for example pigs and cows. Additionally, it would be highly interesting to replicate the studies including both high- and low-status animals, for example by comparing dogs and pigs. Dogs and pigs are known to possess similar levels of intelligence, yet dogs are usually seen as a high-status companion animal, while pigs are seen as a low-status food animal. Moreover, both animals have "uses". In the learning materials of Chapter 4, pigs were presented as useful to humans through their abilities of truffle hunting and training to performs tricks for human entertainment. Similarly, dogs could be presented to have comparable uses,

for example as truffle hunters, rescue dogs, and as being capable of learning tricks and commands. Due to their similarities in intelligence and uses for humans, the learning materials for both could be very similar or even the same, allowing for a robust investigation into this comparison based solely on the socio-culturally constructed status of the animal in question while controlling for the objective information presented to participants.

Individuals higher on RWA can be expected to make more targeted memory errors only for information on animals that could be viewed as threatening to the carnist status quo, and traditions of meat consumption, like sentience information for pigs. One could therefore expect that individuals higher on RWA may exhibit more memory errors in relation to sentience information for low-status animals (like food animals and unappealing wild animals), than they would for high-status animals (like companion animals and appealing wild animals). Moreover, one might also postulate that individuals higher on SDO might make more memory errors across the board for all types of animals, since SDO is related to speciesism more generally than RWA is, and to the oppression of low-status groups, both human and non-human (e.g., Dhont et al., 2016; Jackson, 2019). Essentially, participants higher in SDO and speciesism beliefs may be less motivated to remember any information about animals, regardless of whether this information is threatening (sentience) or not (use-information), but rather as a result of their more generalised desire for group-based dominance of humans over animals.

Follow-up studies in this line of research would also benefit from the inclusion of measures of human supremacy beliefs and speciesism. Both RWA and SDO are known to be closely related to both human supremacy beliefs and speciesism, as the latter two are to one another. It is possible that individuals who are more speciesist, and score higher on SDO, would make more memory errors across the board. Conversely, individuals with higher human supremacy beliefs and greater endorsement of RWA may be more motivated to commit

memory errors specifically relating to sentience information of food animals or other low-status animals.

Lastly, while animals do not always belong to the same socio-cultural categories across geographical contexts (think for example whales as a high-status animal in Europe compared to the same animal as a food animal in Norway (e.g., Murata, 2007). One could expect that information about whales may be better remembered by those in locations where whales hold a high status, as compared to locations like Norway, where results may be more similar to those reported in Chapter 4 for sentience information on pigs. It would be highly interesting to conduct similar experiments in different socio-cultural contexts to test these mechanisms further.

6.3.3. Chapter 5. Moving away from attitudes towards animals, Chapter 5 examined instead perceptions of clean meat relative to traditional meat. Understandably, consumers are wary about new food products and food products made using novel technologies. We found that those higher in food technology neophobia perceived clean meat as less safe, which can likely be attributed to a lack of knowledge and scientific uncertainty regarding the product and technologies involved. Such an issue may be easily addressed through information campaigns and education on the topic, although future research could examine this in more depth to identify the correct messaging strategies. However, the design of Chapter 5 did not allow for causal interpretations of the association between perceived safety and dish evaluations, so further research is needed to establish the direction of associations. Moreover, the experiments presented in Chapter 5 only gave participants very brief, objective definitions of the type of meat dish they were seeing. Future research could extend our findings by experimentally manipulating perceptions of safety, for example by providing participants with more or less information about the production processes of clean meat, or by manipulating how safe or unsafe the product is presented as. Moreover, future studies in this research line ought to

measure and control for food neophobia, in order to further our understanding of the unique role of food technology neophobia in clean meat acceptance.

Moreover, we found, for the first time, that individuals who were more concerned about the naturalness of their food perceived not only clean meat as less appealing and less natural, but that this was also the case for traditional meat. Where previous research had pointed to naturalness concerns as a barrier to clean meat acceptance (e.g., Siegrist et al., 2018; Siegrist & Sütterlin, 2017), the experiments presented in Chapter 5 demonstrated that such concerns may apply more broadly to all types of meat. By comparing attitudes between clean and traditional meat, future research may be better able to identify the factors specific to clean meat acceptance that will be crucial to its acceptance in the future.

6.4. Practical Implications

All three research lines present important practical implications, especially when taken together. Firstly, Chapter 3 reports that those with higher human supremacy beliefs perceived a greater moral divide between animals of high and low status. Secondly, in Chapter 4, we found that individuals who were ideologically motivated also made more memory errors when remembering recently learned sentience information about food animals. Chapter 5 focused instead on perceptions of meat substitutes, namely on the acceptance of clean meat products. While the individual difference variables (i.e., human supremacy beliefs, RWA, and SDO) that are implicated in moral concern for animals and memory for information about animal sentience might be very difficult to change or manipulate (see for example, Dhont et al., 2013), clean meat presents a unique opportunity that could allow for traditions of meat consumption to be upheld while simultaneously eliminating the aspects of animal and environmental exploitation. Attempting to appeal to people's moral judgments about animals or educating them on animal sentience may not be an effective strategy to sway large portions of the population to an animal-free lifestyle, but clean meat could present just this opportunity.

While clean meat is not yet widely available to consumers, first steps towards a market availability are being made. Singapore's food agency has recently become the first in the world to give its commercial approval to chicken bites produced by the US company Eat Just, and the Israeli company Supermeat has opened the first restaurant focused on clean meat sampling (Carrington, 2020). Moreover, companies like Perfect Day foods are producing clean dairy, which rests on similar principles as clean meat, producing "real" milk, which is structurally identical to cow's milk, but produced entirely in a laboratory and can even be produced without lactose, appealing also to the market of lactose-intolerant individuals (Perfect Day Foods, 2021). Products made from this clean milk, like ice cream, and cheese, are beginning to hit the market this year, with the company Brave Robot already retailing animal-free dairy ice cream int the United States (Brave Robot, 2020). The future of laboratory-grown foods is no longer a distant science fiction dream, with experts predicting that by 2040, nearly 60% of the world's meat will either be clean meat, or other forms of plant-based meat substitutes (Carrington, 2019). Thus, research presented like that in Chapter 5 can be crucial in developing the most effective and impactful messaging strategies to ameliorate perceptions and attitudes towards clean meat and related products.

6.5. Conclusions

Taken together, the research presented in this thesis adds to the growing body of literature on human-animal intergroup relations and highlights further the role of ideology in how we think about animals of different socio-cultural statuses. Innovations like clean meat and dairy indeed do have the power to disrupt the global food production markets at a large scale, and if their messaging strategies are right, may be able to sway large amounts of the population towards animal-free foods with minimal changes in dietary behaviour or purchasing price, who otherwise would be resistant to such changes based on individual differences in ideology. As stated by SCO of Perfect Day Foods:

> "We're manufacturing at a large scale. You want to be truly disruptive, you don't want to be some boutique thing that's just disruptive in [one] geography. You want to do this on a global scale." (in Southey, 2021)

As such products grow in availability and prices drop, the factors that stand in the way of their acceptance are crucial to understand. Ultimately, innovations like clean meat can bring us closer to the dream of a cruelty-free world – and although the liberation of food animals will not achieve this on its own, it may well be a very important step in that direction.

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Appendix A - Chapter 3

Materials for Study 1

Human supremacy beliefs (Dhont, & Hodson, 2014).

Please indicate the extent to which you agree or disagree with the following statements using the scale presented.

1. The life of an animal is just not of equal value as the life of a human being.
2. Animals are inferior to humans.
3. There is nothing unusual in the fact that humans dominate other animal species.
4. We should strive for more equality between humans and animals.
5. In an ideal world, humans and animals would be treated on an equal basis.
6. It is important that we treat other animal species more equally.

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Moral Concern for Animals (Leite, Dhont, & Hodson, 2019)

When we think about animals in the world, we might feel a moral obligation to show concern for the welfare and interests of some of those animals. Below is a list of animals. Please indicate to what extent you feel morally obligated to show concern for each of these animals:

[Companion animals]
- Dog
- Cat
- Horse

[Food animals]
- Chicken
- Sheep
- Turkey
- Cow
- Pig
- Duck

[Appealing wild animals]
- Chimp
- Dolphin
- Kangaroo
- Bear
- Lion

Note. Scale points ranged from 1 (Not at all) to 7 (Very much so).
Items presented in randomized order to participants. Categories in [brackets] not shown to participants.

Materials for Study 2

SDO (Ho, Sidanius, Kteily, Sheehy-Skeffington, Pratto, Henkel,... & Stewart, 2015).
Please indicate the extent to which you agree or disagree with the following statements using the scale presented.

1. An ideal society requires some groups to be on top and others to be on the bottom.
2. Some groups of people are simply inferior to other groups.
3. No one group should dominate in society.
4. Groups at the bottom are just as deserving as groups at the top.
5. Group equality should not be our primary goal.
6. It is unjust to try to make groups equal.
7. We should do what we can to equalize conditions for different groups.
8. We should work to give all groups an equal chance to succeed.

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Human supremacy beliefs (Dhont, & Hodson, 2014).
Please indicate the extent to which you agree or disagree with the following statements using the scale presented.

1. The life of an animal is just not of equal value as the life of a human being.
2. Animals are inferior to humans.
3. There is nothing unusual in the fact that humans dominate other animal species.
4. We should strive for more equality between humans and animals.
5. In an ideal world, humans and animals would be treated on an equal basis.
6. It is important that we treat other animal species more equally.

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Moral Concern for Animals (Leite, Dhont, & Hodson, 2019)
When we think about animals in the world, we might feel a moral obligation to show concern for the welfare and interests of some of those animals. Below is a list of animals. Please indicate to what extent you feel morally obligated to show concern for each of these animals:
[Companion animals]

Dog
Cat
Horse

[Food animals]

Chicken
Rabbit
Sheep
Turkey
Cow
Pig
Duck
Goat

[Appealing wild animals]

Chimp
Dolphin
Kangaroo
Bear

[Unappealing wild animals]

Bat
Snake
Snail
Frog

Note. Scale points ranged from 1 (Not at all) to 7 (Very much so). Items presented in randomized order to participants.

Appendix B – Chapter 4

Materials for Study 3

We would like you to take some time to read the text below. It focuses on information regarding the emotional and cognitive abilities of pigs, as shown by recent scientific research findings. Please bear in mind you may be asked to recall some of the information presented later in the study.

Pigs are seen as moderately intelligent animals, with 415,000,000 neurons in their brain, which weighs around 170 grams. The white to grey matter ratio of pigs is (white/grey = 1.3). Research shows that pigs possess cognitive abilities very similar to those of human children. Their memory is advanced, which can be noticed by their expressions of joy in playing memory games. However, pigs can only remember individuals, objects and commands they have learned up to 11 weeks prior without continued training. It takes on average 23 tries for pigs to learn a new command, and they respond to learned commands around 47% of the time.

Related to their memory abilities, pigs possess excellent spatial abilities, which shows in their capability to quickly master mazes. It usually takes 6 tries for pigs to successfully master a maze, which is remembered up to 38 hours after training. In the wild, this would help them remember beneficial foraging spots, and create optimism in knowing where food is located. When foraging in the wild, pigs display some exploitative and deceitful tendencies. Naïve pigs will follow pigs that know the location of food sources, yet the latter typically returns to the known food source if the naïve pig is out of sight or walking in an opposite direction. This indicates that pigs are also logical in some way and can piece together information about their environment. This shows in their solving of simple logic puzzles, developed for human infants. The average time taken is 260 seconds, and pigs show pride when solving puzzles. Pigs' IQ is estimated at 79, while the average for humans is around 100.

Pigs are also thought to have a sense of time, and in captivity will choose to stay in environments they know will provide food or comfort for longer periods of time. They often get angry or sad when food is not provided, and surprised when food arrives early.

Pigs' brain to body ratio is relatively small, with an Encephalization Quotient (EQ) of only 0.53 (an EQ of greater than 1 indicates a large brain to body ratio). In comparison, that of humans is typically greater than 7. Pigs enjoy playing with simple objects, such as sticks and balls. They oftentimes play in groups and express sympathy and affection with others. They also experience joy when chasing other individuals and play fighting. Although this may be a simple form of inducing feelings of fun, pigs do not have a sense of humour.

Also included in the range of emotions pigs experience are disgust, relief, sadness and longing. Aside from simple noises, pigs cannot produce sounds to communicate their emotions. Loud or unexpected noises may startle and induce nervousness in pigs.

Multiple Choice Questions:

1. How many tries does it take for pigs to successfully master a maze?
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - 8
2. How long does it take pigs to complete simple logic puzzles (designed for human infants)?

- 170 seconds
- 200 seconds
- 230 seconds
- 260 seconds
- 290 seconds
- 310 seconds
- 330 seconds

3. What is an average Pigs' IQ?
    - 51
    - 58
    - 65
    - 72
    - 79
    - 86
    - 100
4. How frequently do pigs respond to learned commands?
    - 26% of the time
    - 38% of the time
    - 47% of the time
    - 53% of the time
    - 68% of the time
    - 74% of the time
    - 86% of the time
5. How many tries does it take for pigs to learn new commands?
    - 19
    - 20
    - 21
    - 23
    - 27
    - 29
    - 33
6. How many neurons can be found in pigs' brains?
    - 345,000,000
    - 375,000,000
    - 415,000,000
    - 435,000,000
    - 455,000,000
    - 475,000,000
    - 505,000,000
7. What is the encephalisation quotient (brain to body ratio) of pigs?
    - 0.15
    - 0.23
    - 0.29
    - 0.38
    - 0.45
    - 0.53
    - 0.58
8. How heavy is the average pig brain?
    - 150g
    - 160g
    - 170g
    - 180g

- 190g
- 200g
- 210g

9. What is the white matter to grey matter ratio of pig brains?
    - 0.9
    - 1.3
    - 1.6
    - 1.9
    - 2.1
    - 2.4
    - 2.7
10. How far back can pigs remember individuals and training commands, without continuing training?
    - 3 weeks
    - 5 weeks
    - 6 weeks
    - 9 weeks
    - 11 weeks
    - 15 weeks
    - 19 weeks

List of emotions:

[Emotions mentioned in the text]

[Primary]

- Joy
- Anger
- Sadness
- Fear

[Secondary]

- Relief
- Disgust
- Sympathy
- Longing
- Affection
- Pride
- Optimism
- Nervousness
- Surprise

[Emotions not mentioned in text]

[Secondary]

- Love
- Contentment
- Envy
- Disappointment
- Shame
- Lust
- Irritation
- Annoyance
- Bored

Note. Items, response options, and emotions in the list were presented in randomised order to participants. Categories in [brackets] not shown to participants.

Big Five Inventory (John & Srivastava, 1999), shortened version:
Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Using the scale provided, indicate for each statement to what extent you agree or disagree that this applies to you:

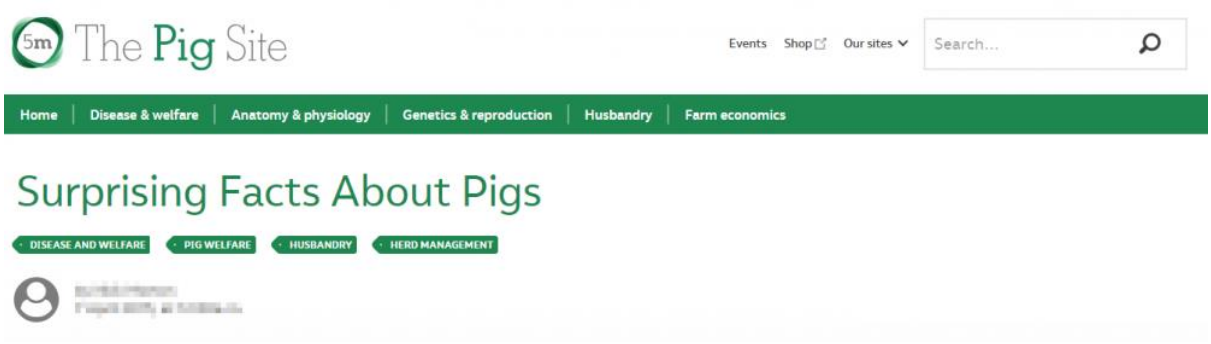
1. I see myself as someone who is talkative
2. I see myself as someone who does a thorough job
3. I see myself as someone who is depressed, blue
4. I see myself as someone who is original, comes up with new ideas
5. I see myself as someone who is helpful and unselfish with others
6. I see myself as someone who is curious about many different things
7. I see myself as someone who is full of energy
8. I see myself as someone who is a reliable worker
9. I see myself as someone who can be tense
10. I see myself as someone who is ingenious, a deep thinker
11. I see myself as someone who generates a lot of enthusiasm
12. I see myself as someone who has a forgiving nature
13. I see myself as someone who worries a lot
14. I see myself as someone who has an active imagination
15. I see myself as someone who is generally trusting
16. I see myself as someone who is inventive
17. I see myself as someone who has an assertive personality
18. I see myself as someone who perseveres until the task is finished
19. I see myself as someone who can be moody
20. I see myself as someone who is considerate and kind to almost everyone
21. I see myself as someone who does things efficiently
22. I see myself as someone who is outgoing, sociable
23. I see myself as someone who makes plans and follows through with them
24. I see myself as someone who gets nervous easily
25. I see myself as someone who likes to cooperate with others

Scale points:
1. Disagree Strongly
2. Disagree a Little
3. Neither Agree nor Disagree
4. Agree a Little
5. Agree Strongly

Materials for Study 4

The study is divided into multiple parts. In the first part, you will be presented with a number of facts about animals. In the second part, you will be asked about your personality. In the third part, you will be asked about your impressions of the initial facts. In the final part, you will be asked about your world views and personal background.

In the first part of the study we would like you to read a short article about pigs. We are interested in your perceptions of this information, and will ask you about it at a later point. We ask therefore that you read the article carefully. Please note, the next page is on a 3 minute timer. You will only be able to proceed when this timer is up.



Pigs have many uses. They provide important ingredients for cosmetics and other products. For example, pigs' skin is particularly useful. It is used to produce 23% of gelatine-related products, including sweets and ice creams. Pigs also contribute to the clothing market, with 7% of the consumer leather provided by pigs.

Pigs are also used in medicine. Their heart and blood are particularly valuable. Pigs provide heart valve transplants to 12,000 UK citizen every year. Likewise, extracting insulin from pigs can help treat diabetes, and proves successful in 78% of cases.

Pigs directly contribute to business and entertainment. In certain countries a truffle pig can expect to find 400g of truffles a day, netting the owner between £500-2000 depending on the quality of the truffles. Pigs are also used in the entertainment industry. For example, in 2009, 12 piglets took part in the Pig Olympics, drawing in crowds of up to 6,000. Lastly, 48 piglets were used in the filming of the 1995 movie Babe.

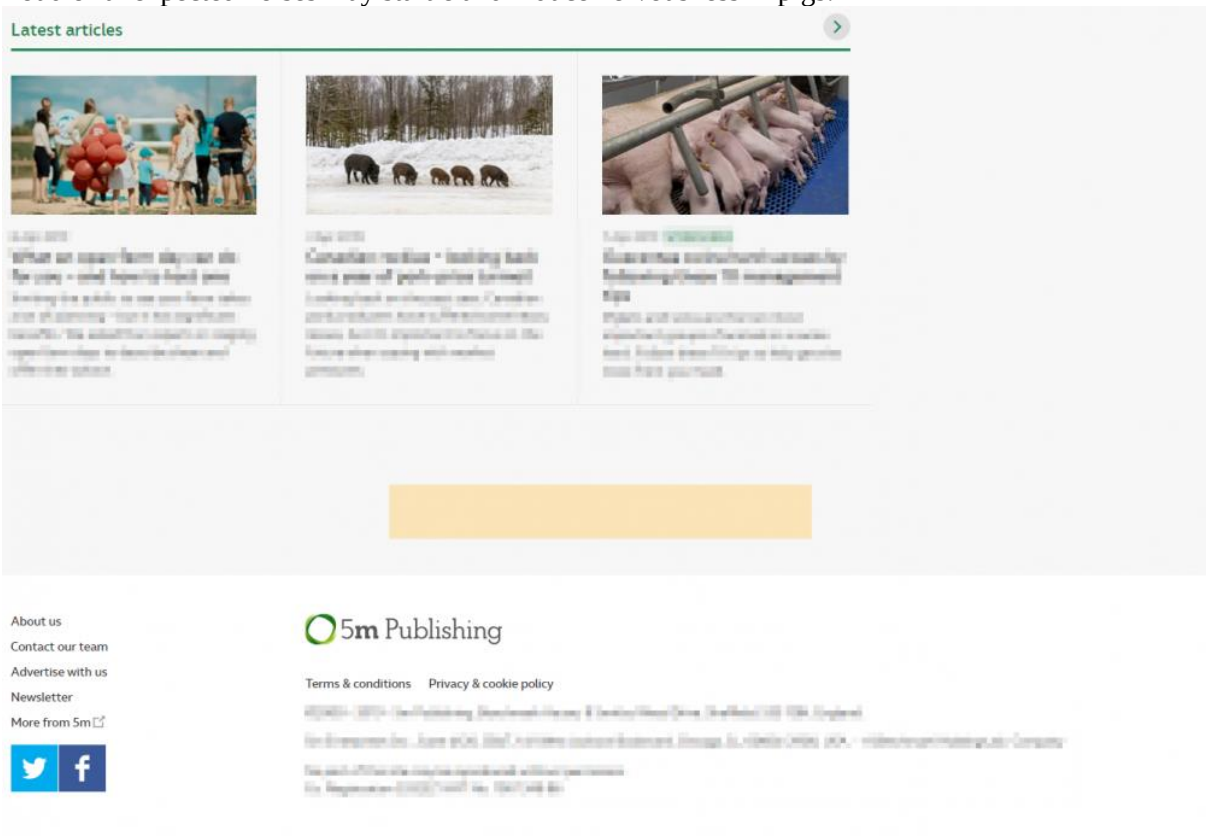
Perhaps the most significant use for pigs is for meat. In the EU, pigs produce 22 million tonnes of meat each year. Pork is a source of protein, containing 31.6g of protein per 100g. Pork is also purchased for its gustatory qualities. For example, cuts such as the tenderloin and sirloin are particularly desirable. The most expensive cut of ham commercially available retails at £268 per lbs.

Also included in the range of meat pigs provide are top-side, ribeye, round, filet and tri-tip. Particularly popular, and good for barbequing, are pork ribs.
Pigs are seen as intelligent animals. The average pig has 415,000,000 neurons in their brain, which weighs around 170 grams. The white to grey matter ratio of pigs is (white/grey) 1.3. Research shows that pigs possess sophisticated cognitive abilities. Their memory is advanced, which can be noticed by their expressions of joy in playing memory games. It takes on average 23 tries for pigs to learn a new command, and they respond to learned commands around 47% of the time. Pigs can remember commands, objects and individuals for 11 weeks without continued training.

Pigs possess excellent spatial abilities, which shows in their capability to quickly master mazes. It usually takes 6 tries for pigs to successfully master a maze, which is remembered up to 38 hours after training. In the wild, this would help them remember beneficial foraging spots, and create optimism in knowing where food is located. Pigs are also logical in some way and can piece together information about their environment. This shows in their solving of simple logic puzzles developed for human infants. The average time taken is 260 seconds, and pigs show pride after solving puzzles. Pigs' IQ is estimated at 79, while the average for humans is around 100.

Pigs' brain to body ratio is relatively large, with an Encephalization Quotient (EQ) of 0.53. Pigs enjoy playing with simple objects, such as sticks and balls. They oftentimes play in groups and express sympathy and affection with others.

Also included in the range of emotions pigs experience are disgust, relief, surprise, sadness and longing. Loud or unexpected noises may startle and induce nervousness in pigs.



Multiple Choice Questions:

1. What is the white matter to grey matter ratio of pigs?
    - 1.0
    - 1.3
    - 1.6
    - 1.9
    - 2.2
    - 2.5
    - 2.8
2. How heavy is the average pig brain?
    - 150g
    - 160g
    - 170g
    - 180g
    - 190g
    - 200g
    - 210g
3. How frequently do pigs respond to learned commands?
    - 29% of the time
    - 38% of the time
    - 47% of the time
    - 56% of the time
    - 65% of the time
    - 74% of the time
    - 83% of the time
4. How many neurons can be found in pigs' brains?
    - 375,000,000
    - 395,000,000
    - 415,000,000
    - 435,000,000
    - 455,000,000
    - 475,000,000
    - 495,000,000
5. How long does it take pigs to complete simple logic puzzles (designed for human infants)?
    - 170 seconds
    - 200 seconds
    - 230 seconds
    - 260 seconds
    - 290 seconds
    - 320 seconds
    - 350 seconds
6. How many tries does it take for pigs to learn new commands?
    - 17
    - 19
    - 21
    - 23
    - 25
    - 27
    - 29
7. How many tries does it take for pigs to successfully master a maze?
    - 2

- 3
- 4
- 5
- 6
- 7
- 8

8. What is the average IQ of a pig?
    - 51
    - 58
    - 65
    - 72
    - 79
    - 86
    - 95
9. How far back can pigs remember individuals and training commands, without continued training?
    - 3 weeks
    - 5 weeks
    - 7 weeks
    - 9 weeks
    - 11 weeks
    - 13 weeks
    - 15 weeks
10. What is the Encephalisation Quotient (EQ, brain to body ratio) of pigs?
    - 0.28
    - 0.33
    - 0.38
    - 0.43
    - 0.48
    - 0.53
    - 0.58
11. In the text you read, which of these emotions were attributed to pigs?
    - Joy
    - Anger
    - Sadness
    - Fear
    - Relief
    - Disgust
    - Sympathy
    - Longing
    - Affection
    - Pride
    - Optimism
    - Nervousness
    - Surprise
    - Love
    - Contentment
    - Envy
    - Disappointment
    - Shame
    - Lust
    - Irritation

- Annoyance
- Bored

12. What % of gelatine-related products (including sweets and ice creams) do pigs contribute to?
    - 21%
    - 23%
    - 25%
    - 27%
    - 29%
    - 31%
    - 33%
13. What % of leather for clothing is produced from pigs?
    - 3%
    - 5%
    - 7%
    - 9%
    - 11%
    - 13%
    - 15%
14. How many heart valve transplants in the UK do pigs provide a year?
    - 8,000
    - 10,000
    - 12,000
    - 14,000
    - 16,000
    - 18,000
    - 20,000
15. What quantity of truffles can a pig expect to find a day?
    - 200g
    - 300g
    - 400g
    - 500g
    - 600g
    - 700g
    - 800g

How successful is insulin (derived from pigs) in treating diabetes?

- 63%
- 68%
- 73%
- 78%
- 83%
- 88%
- 93%

16. How many piglets participated in the Pig Olympics in 2009?
    - 6
    - 8
    - 10
    - 12
    - 14
    - 16
    - 18
17. How many pigs were used in the filming of Babe?
    - 8

- 18
- 28
- 38
- 48
- 58
- 68

18. How many tonnes of meat per year do pigs produce in the EU?
    - 14 million
    - 16 million
    - 18 million
    - 20 million
    - 22 million
    - 24 million
    - 26 million
19. How many grams of protein (per 100g) does pork contain?
    - 23.6g
    - 25.6g
    - 27.6g
    - 29.6g
    - 31.6g
    - 33.6g
    - 35.6g
20. What does the most expensive cut of ham retail for?
    - £118 per lbs
    - £148 per lbs
    - £178 per lbs
    - £208 per lbs
    - £238 per lbs
    - £268 per lbs
    - £298 per lbs
21. In the text you read, which parts of a pig were mentioned?
    - Skin
    - Heart
    - Blood
    - Tenderloin
    - Sirloin
    - Top-side
    - Ribeye
    - Round
    - Tri-tip
    - Filet
    - Ribs
    - Ear
    - Liver
    - Lungs
    - Skirt
    - Flank
    - Brisket
    - T-Bone
    - Belly
    - Porterhouse
    - Chop

- Knuckle

Note. Items and response options were presented in randomised order to participants.

Appendix C – Supplement for Studies 3 and 4

Study 3: Confirmatory Analyses

Table S1.

Multi-level model predicting variations in memory performance across memory tasks (recall, recognition) with Right-Wing Authoritarianism (RWA).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.05	-0.10	0.10	252.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	252.00	0.00
Right-Wing Authoritarianism (RWA)	**-0.24*** **	**0.05**	**-0.34**	**-0.14**	**252.00**	**-4.53**
Memory Task × RWA	0.04	0.03	-0.02	0.10	252.00	1.17
Variance Components						
Residual	0.47***	0.04	0.39	0.55	-	-
Random Coefficient Variance						
Participant	0.48***	0.07	0.36	0.63	-	-
Fit Statistics						
ML deviance (number of parameters)	1351.71(6)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr, Levy, Scheepers & Tily, 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron, Hogarty, Dedrick, Hess, Niles, & Kromrey, 2008; Nezlek, 2012).

Table S2.

Multi-level model predicting variations in memory performance across memory tasks (recall, recognition) with Social Dominance Orientation (SDO).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.05	-0.11	0.11	252.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	252.00	0.00

Social Dominance Orientation (SDO)	**-0.12***	**0.05**	**-0.23**	**-0.01**	**252.00**	**-2.18**
Memory Task × SDO	0.03	0.03	-0.03	0.09	252.00	0.92
Variance Components						
Residual	0.47***	0.04	0.39	0.56	-	-
Random Coefficient Variance						
Participant	0.52***	0.07	0.40	0.68	-	-
Fit Statistics						
ML deviance (number of parameters)	1367.22(6)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Social Dominance Orientation (SDO) denotes the relationship between SDO and memory performance. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Study 3: Additional Analyses

Table S3.

Multi-level model predicting variations in memory performance across memory tasks (recall, recognition) with Right-Wing Authoritarianism (RWA) and Social Dominance Orientation (SDO).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.05	-0.10	0.10	251.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	251.00	0.00
Right-Wing Authoritarianism (RWA)	**-0.23*** **	**0.06**	**-0.34**	**-0.11**	**251.00**	**-3.96**
Social Dominance Orientation (SDO)	-0.03	0.06	-0.14	0.08	251.00	-0.53
Memory Task × RWA	0.03	0.03	-0.04	0.09	251.00	0.88
Memory Task × SDO	0.02	0.03	-0.05	0.08	251.00	0.50
Variance Components						
Residual	0.47***	0.04	0.39	0.56	-	-
Random Coefficient Variance						
Participant	0.52***	0.07	0.40	0.68	-	-
Fit Statistics						
ML deviance (number of parameters)	1360.04(8)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance whilst controlling for Social Dominance Orientation (SDO). We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Study 4: Confirmatory Analyses

Table S4.

Multi-level model predicting variations in memory performance across memory tasks (recall, recognition) and information types (sentience, use) with Right-Wing Authoritarianism (RWA).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.04	-0.09	0.09	253.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	253.00	0.00
Information Type (-1=sentience, 1=use)	0.11***	0.03	0.06	0.16	253.00	4.06
Right-Wing Authoritarianism (RWA)	**-0.13****	**0.04**	**-0.22**	**-0.04**	**253.00**	**-2.98**
Memory Task × Information Type	0.02	0.02	-0.02	0.05	253.00	0.81
Memory Task × RWA	0.05†	0.03	-0.00	0.11	253.00	1.84
Information Type × RWA	**0.06***	**0.03**	**0.01**	**0.11**	**253.00**	**2.23**
Memory Task × Information Type × RWA	0.02	0.02	-0.01	0.06	253.00	1.33
Variance Components						
Residual	0.36***	0.03	0.30	0.42	-	-
Random Coefficient Variance						
Participant	0.39***	0.04	0.32	0.49	-	-
Memory Task	0.13***	0.02	0.09	0.17	-	-
Information Type	0.09***	0.02	0.06	0.14	-	-
Fit Statistics						
ML deviance (number of parameters)	2714.73(12)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance. The coefficient for Information type × RWA denotes variations in the relationship between RWA and memory performance for information related to sentience versus use. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall

and recognition scores together with RWA were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Table S5.
Multi-level model predicting variations in memory performance, across memory tasks (recall, recognition) and information types (sentience, use) with Right-Wing Authoritarianism (RWA). Sentience information provides the reference category.

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	-0.11*	0.05	-0.20	-0.01	328.19	-2.28
Memory Task (-1=recall, 1=recognition)	-0.02	0.04	-0.09	0.05	451.27	-0.43
Information Type (0=sentience, 1=use)	0.22***	0.05	0.12	0.31	328.19	4.40
Right-Wing Authoritarianism (RWA)	**-0.19*** **	**0.05**	**-0.28**	**-0.10**	**328.19**	**-3.98**
Memory Task × Information Type	0.03	0.04	-0.05	0.11	240.13	0.74
Memory Task × RWA	0.03	0.04	-0.04	0.10	451.27	0.81
Information Type × RWA	**0.12***	**0.05**	**0.02**	**0.22**	**328.19**	**2.42**
Memory Task × Information Type × RWA	0.05	0.04	-0.03	0.13	240.13	1.20
Variance Components						
Residual	0.43***	0.04	0.36	0.52	-	-
Random Coefficient Variance						
Participant	0.36***	0.05	0.28	0.47	-	-
Memory Task	0.11***	0.02	0.07	0.16	-	-
Information Type	0.19***	0.06	0.10	0.35	-	-
Fit Statistics						
ML deviance (number of parameters)	2728.60(12)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance for sentience information. The coefficient for Information type × RWA denotes variations in the relationship between RWA and memory performance for information related to sentience versus use. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA were standardised prior analysis

so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Table S6.
Multi-level model predicting variations in memory performance, across memory tasks (recall, recognition) and information types (sentience, use) with Right-Wing Authoritarianism (RWA). Use information provides the reference category.

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.11*	0.05	0.02	0.20	320.70	2.30
Memory Task (-1=recall, 1=recognition)	0.02	0.04	-0.05	0.08	450.00	0.43
Information Type (0=use, 1=sentience)	-0.22***	0.05	-0.32	-0.12	320.70	-4.34
Right-Wing Authoritarianism (RWA)	**-0.07**	**0.05**	**-0.16**	**0.02**	**320.70**	**-1.48**
Memory Task × Information Type	-0.03	0.04	-0.11	0.05	248.81	-0.75
Memory Task × RWA	0.08*	0.04	0.01	0.15	450.00	2.21
Information Type × RWA	**-0.12***	**0.05**	**-0.22**	**-0.02**	**320.70**	**-2.39**
Memory Task × Information Type × RWA	-0.05	0.04	-0.13	0.03	248.81	-1.23
Variance Components						
Residual	0.42***	0.04	0.35	0.50	-	-
Random Coefficient Variance						
Participant	0.36***	0.05	0.28	0.46	-	-
Memory Task	0.11***	0.02	0.08	0.16	-	-
Information Type	0.22***	0.06	0.13	0.37	-	-
Fit Statistics						
ML deviance (number of parameters)	2722.99(12)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance for use information. The coefficient for Information type × RWA denotes variations in the relationship between RWA and memory performance for information related to use versus sentience. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Table S7.

Multi-level model predicting variations in memory performance across memory tasks (recall, recognition) and information types (sentience, use) with Social Dominance Orientation (SDO).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.04	-0.09	0.09	253.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	253.00	0.00
Information Type (-1=sentience, 1=use)	0.11***	0.03	0.06	0.16	253.00	4.02
Social Dominance Orientation (SDO)	**-0.09***	**0.04**	**-0.18**	**0.00**	**253.00**	**-2.05**
Memory Task × Information Type	0.02	0.02	-0.02	0.05	253.00	0.81
Memory Task × SDO	0.06*	0.03	0.00	0.11	253.00	1.99
Information Type × SDO	**0.02**	**0.03**	**-0.04**	**0.07**	**253.00**	**0.60**
Memory Task × Information Type × SDO	-0.02	0.02	-0.06	0.01	253.00	-1.24
Variance Components						
Residual	0.36***	0.03	0.30	0.42	-	-
Random Coefficient Variance						
Participant	0.40***	0.04	0.32	0.50	-	-
Memory Task	0.13***	0.02	0.09	0.17	-	-
Information Type	0.10***	0.02	0.07	0.14	-	-
Fit Statistics						
ML deviance (number of parameters)	2723.59(12)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Social Dominance Orientation (SDO) denotes the relationship between SDO and memory performance. The coefficient for Information type × SDO denotes variations in the relationship between SDO and memory performance for information related to sentience versus use. We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Study 4: Additional Analyses

Table S8.

Multi-level model predicting variations in memory performance, across memory tasks (recall, recognition) and information types (sentience, use) with Right-Wing Authoritarianism (RWA) and Social Dominance Orientation (SDO).

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.00	0.04	-0.09	0.09	252.00	0.00
Memory Task (-1=recall, 1=recognition)	0.00	0.03	-0.06	0.06	252.00	0.00
Information Type (-1=sentience, 1=use)	0.11***	0.03	0.06	0.16	252.00	4.05
Right-Wing Authoritarianism (RWA)	**-0.11***	**0.05**	**-0.20**	**-0.02**	**252.00**	**-2.38**
Social Dominance Orientation (SDO)	-0.05	0.05	-0.14	0.04	252.00	-1.01
Memory Task × Information Type	0.02	0.02	-0.02	0.05	252.00	0.81
Memory Task × RWA	0.04	0.03	-0.02	0.10	252.00	1.18
Memory Task × SDO	0.04	0.03	-0.02	0.11	252.00	1.39
Information Type × RWA	**0.06***	**0.03**	**0.01**	**0.12**	**252.00**	**2.16**
Information Type × SDO	-0.01	0.03	-0.06	0.05	252.00	-0.26
Memory Task × Information Type × RWA	0.04†	0.02	0.00	0.08	252.00	1.95
Memory Task × Information Type × SDO	-0.04†	0.02	-0.08	0.00	252.00	-1.89
Variance Components						
Residual	0.36***	0.03	0.30	0.42	-	-
Random Coefficient Variance						
Participant	0.40***	0.04	0.32	0.50	-	-
Memory Task	0.13***	0.02	0.09	0.17	-	-
Information Type	0.10***	0.02	0.07	0.14	-	-
Fit Statistics						

ML deviance (number of parameters)	2728.73(16)

NB: ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance whilst controlling for Social Dominance Orientation (SDO). The coefficient for Information type × RWA denotes variations in the relationship between RWA and memory performance for information related to sentience versus use whilst controlling for Social Dominance Orientation (SDO). We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Table S9.
Multi-level model predicting variations in memory performance, across memory tasks (recall, recognition) and information types (sentience, use), with Right-Wing Authoritarianism (RWA) and Social Dominance Orientation (SDO). Sentience information provides the reference category.

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	-0.11*	0.05	-0.20	-0.01	325.91	-2.28
Memory Task (-1=recall, 1=recognition)	-0.02	0.04	-0.08	0.05	448.17	-0.43
Information Type (0=sentience, 1=use)	0.22***	0.05	0.12	0.31	325.91	4.40
Right-Wing Authoritarianism (RWA)	**-0.17****	**0.05**	**-0.28**	**-0.07**	**325.91**	**-3.39**
Social Dominance Orientation (SDO)	-0.04	0.05	-0.14	0.06	325.91	-0.78
Memory Task × Information Type	0.03	0.04	-0.05	0.11	236.77	0.74
Memory Task × RWA	0.00	0.04	-0.08	0.07	448.17	-0.05
Memory Task × SDO	0.08*	0.04	0.01	0.16	448.17	2.12
Information Type × RWA	**0.13***	**0.05**	**0.02**	**0.23**	**325.91**	**2.35**
Information Type × SDO	-0.02	0.05	-0.12	0.09	325.91	-0.28
Memory Task × Information Type × RWA	0.08†	0.04	-0.01	0.17	236.77	1.77
Memory Task × Information Type × SDO	-0.08†	0.04	-0.16	0.01	236.77	-1.71
Variance Components						
Residual	0.43***	0.04	0.36	0.51	-	-
Random Coefficient Variance						
Participant	0.37***	0.05	0.28	0.47	-	-
Memory Task	0.11***	0.02	0.07	0.16	-	-
Information Type	0.19***	0.06	0.11	0.35	-	-
Fit Statistics						
ML deviance (number of parameters)	2740.51(16)					

NB: ***$p < .001$, **$p < .01$, *$p < .05$, †$p < .10$. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance for sentience information whilst controlling for Social Dominance Orientation (SDO). The coefficient for Information type × RWA denotes

variations in the relationship between RWA and memory performance for information related to sentience versus use whilst controlling for Social Dominance Orientation (SDO). We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

Table S10.
Multi-level model predicting variations in memory performance, across memory tasks (recall, recognition) and information types (sentience, use) with Right-Wing Authoritarianism (RWA) and Social Dominance Orientation (SDO). Use information provides the reference category.

Parameter	Coeff.	SE	95% CI		*df*	*t*
Fixed Effects						
Intercept	0.11*	0.05	0.02	0.20	318.32	2.31
Memory Task (-1=recall, 1=recognition)	0.02	0.04	-0.05	0.08	446.99	0.43
Information Type (0=use, 1=sentience)	-0.22***	0.05	-0.32	-0.12	318.32	-4.34
Right-Wing Authoritarianism (RWA)	**-0.05**	**0.05**	**-0.15**	**0.05**	**318.32**	**-0.96**
Social Dominance Orientation (SDO)	-0.06	0.05	-0.16	0.05	318.32	-1.08
Memory Task × Information Type	-0.03	0.04	-0.11	0.05	245.95	-0.75
Memory Task × RWA	0.08*	0.04	0.00	0.15	446.99	2.00
Memory Task × SDO	0.01	0.04	-0.07	0.08	446.99	0.15
Information Type × RWA	**-0.13***	**0.05**	**-0.23**	**-0.02**	**318.32**	**-2.31**
Information Type × SDO	0.02	0.05	-0.09	0.12	318.32	0.28
Memory Task × Information Type × RWA	-0.08†	0.04	-0.16	0.01	245.95	-1.80
Memory Task × Information Type × SDO	0.08†	0.04	-0.01	0.16	245.95	1.74
Variance Components						
Residual	0.41***	0.04	0.35	0.49	-	-
Random Coefficient Variance						
Participant	0.36***	0.05	0.28	0.46	-	-
Memory Task	0.11***	0.02	0.08	0.16	-	-
Information Type	0.23***	0.06	0.14	0.38	-	-
Fit Statistics						
ML deviance (number of parameters)	2734.59(16)					

NB: ****p* < .001, ***p* < .01, **p* < .05, †*p* < .10. Central hypothesis tests are highlighted in bold. The coefficient for Right-Wing Authoritarianism (RWA) denotes the relationship between RWA and memory performance for use information whilst controlling for Social Dominance Orientation (SDO). The coefficient for Information type × RWA denotes variations in the relationship between RWA and memory performance for information related to use versus

sentience whilst controlling for Social Dominance Orientation (SDO). We follow a maximum random effects structure approach, where random coefficients are only omitted in cases of non-convergence (see Barr et al., 2013). Recall and recognition scores together with RWA and SDO were standardised prior analysis so as to obtain standardised coefficients that are akin to an effect size (see Ferron et al., 2008; Nezlek, 2012).

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Appendix D – Chapter 5

Materials for Experiment 1

Clean meat instructions*: In the following section, you will be presented with images of food. The food in these pictures is made from clean meat, which is structurally identical to traditional meat but cultured in the laboratory. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

Traditional meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from regular meat. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

1.

2.

3.

4.

5.

6.

Dish evaluation: *Imagine you had this dish in front of you and please indicate how you feel it would look, smell, taste etc.*

[Looks]

1. Extremely appealing
2.

3.
4. Neither appealing nor repulsive
5.
6.
7. Extremely repulsive

[Smell]

1. Smells extremely good
2.
3.
4. Smells neither bad nor good
5.
6.
7. Smells extremely bad

[Taste]

1. Tastes extremely good
2.
3.
4. Tastes neither good nor bad
5.
6.
7. Tastes extremely bad

Imagine the dish above was offered on a buffet. How likely would you be to eat it?

1. Extremely likely
2.
3.
4. Neither likely nor unlikely
5.
6.
7. Extremely unlikely

Note. Images 1-3 display dishes with traditional meat and images 4-6 display images with clean meat, yet the labels assigned to the dishes were counterbalanced across images and participants. Categories in [brackets] not shown to participants.

The Food Technology Neophobia Scale (Cox & Evans, 2008)
Please indicate your response using the scale presented.

1. There are plenty of tasty foods around, so we don't need to use new food technologies to produce more.
2. The benefits of new food technologies are often grossly overstated.
3. New food technologies decrease the natural quality of food.
4. There is no sense trying out high-tech food products because the ones I eat are already good enough.
5. New foods are not healthier than traditional foods.
6. New food technologies are something I am uncertain about.
7. Society should not depend heavily on technologies to solve its food problems.
8. New food technologies may have long term negative environmental effects.
9. It can be risky to switch to new food technologies too quickly.
10. New food technologies are unlikely to have long term negative health effects. (R)
11. New products produced using new food technologies can help people have a balanced diet. (R)
12. New food technologies give people more control over their food choices. (R)
13. The media usually provides a balanced and unbiased view of new food technologies. (R)

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

The Natural Product Interest Scale (Roininen et al. 1999)
Please indicate your response using the scale presented.

1. I try to eat foods that do not contain additives.
2. I do not care about additives in my daily diet. (R)
3. I do not eat processed foods, because I do not know what they contain.
4. I would like to eat only organically grown vegetables.
5. In my opinion, artificially flavoured foods are not harmful for my health. (R)
6. In my opinion, organically grown foods are no better for my health than those grown conventionally. (R)

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

Materials for Experiment 2

Clean meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from clean meat, which is structurally identical to traditional meat but cultured in the laboratory. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

Traditional meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from regular meat. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

Plant-based meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from plant-based meat alternatives. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

1.

2.

3.

4.

5.

6.

7.

8.

9.

Dish evaluation: *Imagine you had this dish in front of you and please indicate how you feel it would look, smell, taste etc.*

[Looks]

8. Extremely appealing
9.
10.
11. Neither appealing nor repulsive
12.
13.
14. Extremely repulsive

[Smell]

8. Smells extremely good
9.
10.
11. Smells neither bad nor good
12.
13.
14. Smells extremely bad

[Taste]

8. Tastes extremely good
9.
10.
11. Tastes neither good nor bad
12.
13.

14. Tastes extremely bad

Imagine the dish above was offered on a buffet. How likely would you be to eat it?

1. Extremely likely
2.
3.
4. Neither likely nor unlikely
5.
6.
7. Extremely unlikely

Note. Images 1-3 display dishes with traditional meat, images 4-6 display dishes with clean meat, and images 7-9 display images with plant-based dishes. The labels assigned to the dishes were counterbalanced across images and participants. Categories in [brackets] not shown to participants.

The Food Technology Neophobia Scale (Cox & Evans, 2008)

Please indicate your response using the scale presented.

1. There are plenty of tasty foods around, so we don't need to use new food technologies to produce more.
2. The benefits of new food technologies are often grossly overstated.
3. New food technologies decrease the natural quality of food.
4. There is no sense trying out high-tech food products because the ones I eat are already good enough.
5. New foods are not healthier than traditional foods.
6. New food technologies are something I am uncertain about.
7. Society should not depend heavily on technologies to solve its food problems.
8. New food technologies may have long term negative environmental effects.
9. It can be risky to switch to new food technologies too quickly.
10. New food technologies are unlikely to have long term negative health effects. (R)
11. New products produced using new food technologies can help people have a balanced diet. (R)
12. New food technologies give people more control over their food choices. (R)
13. The media usually provides a balanced and unbiased view of new food technologies. (R)

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

The Natural Product Interest Scale (Roininen et al. 1999)

Please indicate your response using the scale presented.

1. I try to eat foods that do not contain additives.
2. I do not care about additives in my daily diet. (R)
3. I do not eat processed foods, because I do not know what they contain.
4. I would like to eat only organically grown vegetables.
5. In my opinion, artificially flavoured foods are not harmful for my health. (R)
6. In my opinion, organically grown foods are no better for my health than those grown conventionally. (R)

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

Materials for Experiment 3

Clean meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from clean meat, which is structurally identical to traditional meat but cultured in the laboratory. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

Traditional meat instructions: *In the following section, you will be presented with images of food. The food in these pictures is made from regular meat. After viewing each image, you will be asked a few questions. Please answer as accurately and honestly as you can.*

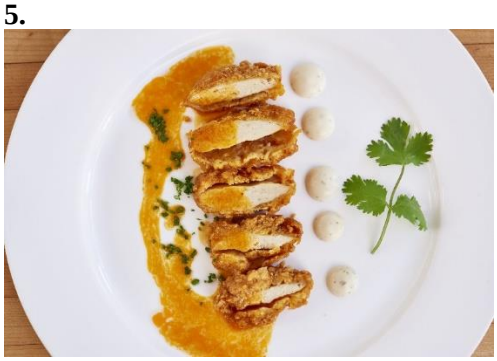
1.

2.

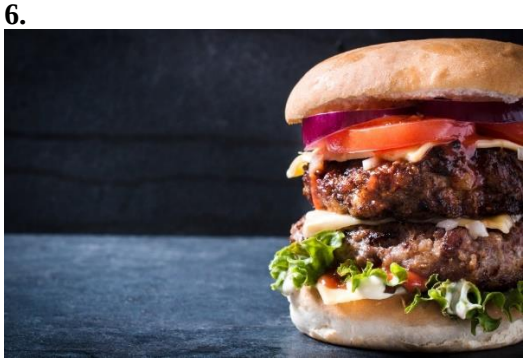
3.

4.

5.



6.



Dish evaluation: *Imagine you had this dish in front of you and please indicate how you feel it would look, smell, taste etc.*

[Looks]

15. Extremely appealing
16.
17.

18. Neither appealing nor repulsive
19.
20.
21. Extremely repulsive

[Smell]

15. Smells extremely good
16.
17.
18. Smells neither bad nor good
19.
20.
21. Smells extremely bad

[Taste]

15. Tastes extremely good
16.
17.
18. Tastes neither good nor bad
19.
20.
21. Tastes extremely bad

Imagine the dish above was offered on a buffet. How likely would you be to eat it?

8. Extremely likely
9.
10.
11. Neither likely nor unlikely
12.
13.
14. Extremely unlikely

Note. Images 1-3 display dishes with traditional meat and images 4-6 display images with clean meat, yet the labels assigned to the dishes were counterbalanced across images and participants. Categories in [brackets] not shown to participants.

The Food Technology Neophobia Scale (Cox & Evans, 2008)

Please indicate your response using the scale presented.

1. There are plenty of tasty foods around, so we don't need to use new food technologies to produce more.
2. The benefits of new food technologies are often grossly overstated.
3. New food technologies decrease the natural quality of food.
4. There is no sense trying out high-tech food products because the ones I eat are already good enough.
5. New foods are not healthier than traditional foods.
6. New food technologies are something I am uncertain about.
7. Society should not depend heavily on technologies to solve its food problems.
8. New food technologies may have long term negative environmental effects.
9. It can be risky to switch to new food technologies too quickly.
10. New food technologies are unlikely to have long term negative health effects. (R)
11. New products produced using new food technologies can help people have a balanced diet. (R)
12. New food technologies give people more control over their food choices. (R)
13. The media usually provides a balanced and unbiased view of new food technologies. (R)

Scale points:

1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree

4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

The Natural Product Interest Scale (Roininen et al. 1999)
Please indicate your response using the scale presented.

1. I try to eat foods that do not contain additives.
2. I do not care about additives in my daily diet. (R)
3. I do not eat processed foods, because I do not know what they contain.
4. I would like to eat only organically grown vegetables.
5. In my opinion, artificially flavoured foods are not harmful for my health. (R)
6. In my opinion, organically grown foods are no better for my health than those grown conventionally. (R)

Scale points:
1. Strongly disagree
2. Moderately Disagree
3. Slightly Disagree
4. Neither agree nor disagree
5. Slightly Agree
6. Moderately Agree
7. Strongly agree

Note. Items marked with (R) are reverse coded.

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Appendix E – Supplement for Experiments 1, 2, and 3

Table S11. The manuscript reports the main analyses, which includes gender, age, meat liking, and political ideology as covariates. This table reports the results of the MANCOVAs showing the effects of Food Technology Neophobia, Food Naturalness Importance, and their interactions with label condition on dish evaluation without controlling for gender, age, meat liking and political ideology.

	Food Technology Neophobia	Food Naturalness Importance	Food Technology Neophobia X Label	Food Naturalness Importance X Label
Experiment 1	$F(1,267) = 13.66$, $p < 001$, $\eta_p^2 = .04$	F (1, 267) = 5.22, p = 023, $\eta_p^2 = .02$	F (1, 267) = 12.33, $p = .001$, $\eta_p^2 = .05$	F (1, 267) = 3.93, $p = .048$, $\eta_p^2 = .02$
Experiment 2 - Omnivores	$F(1, 452) = 37.37$, $p < .001$, $\eta_p^2 = .076$	$F(1, 452) = 0.04$, p =.841, $\eta_p^2 = .00$	$F(2, 451) = 12.62$, $p < .001$, $\eta_p^2 = .05$	$F(2, 451) = 19.28$, $p < .001$, $\eta_p^2 = .08$
Experiment 2 – Veg*ns	$F(1, 168) = 16.68$, $p < .001$, $\eta_p^2 = .09$	$F(1, 168) = 5.82$, $p = .017$, $\eta_p^2 = .03$	$F(2, 167) = 10.03$, $p < .001$, $\eta_p^2 = .11$	$F(2, 167) = 0.65$, $p = .522$, $\eta_p^2 = .01$
Experiment 3	$F(1, 270) = 8.26$, $p = .004$, $\eta_p^2 = .03$	$F(1, 270) = 0.19$, $p = .667$, $\eta_p^2 = .00$	$F(1, 270) = 6.36$, $p = .012$, $\eta_p^2 = .02$	$F(1, 270) = 1.01$, $p = .316$, $\eta_p^2 = .00$