

The London School of Economics and Political Science

*An Embodied Approach to Informational
Interventions: Using Conceptual Metaphors to
Promote Sustainable Healthy Diets*

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Behavioural Science of the London School of Economics and
Political Science for the degree of Doctor of Philosophy, London,
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Declaration

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Statement of inclusion of previous work

I can confirm that two of the six studies in Chapter 4 (Studies 1a and 1b) came from my previous dissertation for the MSc in Social and Public Communication at LSE, even though the data were analysed differently.

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Abstract

Poor diet quality and environmental degradation are two major challenges of our times. Unhealthy and unsustainable dietary practices, such as the overconsumption of meat and consumer food waste behaviour, contribute greatly to both issues. Across seventeen online and field experiments, in two different cultures (US and China), this thesis investigates if the embodied cognition approach, and more specifically, research on conceptual metaphors, can be used to develop interventions to promote sustainable healthy diets. Interventions relying on conceptual metaphors have been shown to stimulate attitudinal and behavioural changes in other fields (e.g., marketing and political communications), but are rarely adopted to encourage sustainable healthy diets. To fill in this gap in the literature, I conducted five sets of experimental studies examining the effects of different metaphors on specific sustainable healthy dietary practices, each of which forms an independent empirical paper (Chapters 2-6 of the thesis). After introducing the current perspectives on embodied cognition and conceptual metaphors in the context of this research (Chapter 1), Chapter 2 looks into the conceptual metaphor “Healthy is Up”, demonstrating that US people implicitly associate healthiness with verticality, and offering recommendations for healthy eating guidelines. Chapter 3 extends this research to Chinese samples and partially replicates the results. Chapter 4 shows that the anthropomorphic metaphor “Animals are Friends” discourages meat consumption by inducing anticipatory guilt among US omnivores, whereas Chapter 5 reveals that Chinese omnivores are more responsive to another anthropomorphic metaphor, namely, “Animals are Family”. Bringing lab insights

to the real world, Chapter 6 demonstrates with a longitudinal field experiment that anthropomorphic metaphors together with environmental feedback result in a higher reduction in food waste as compared to other feedback interventions. The strengths, limitations and implications of those empirical papers are discussed in the conclusive part of the thesis.

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Chapter 1

General Introduction

The Food and Agriculture Organization of the United Nations and the World Health Organization deem malnutrition and environmental degradation as two major challenges of our times (FAO & WHO, 2019), both of which are aggravated by unhealthy and unsustainable dietary practices across the world (Tilman & Clark, 2014).

According to the WHO's updated definition, malnutrition refers to not only deficiencies in food intake (i.e., undernutrition or undernourishment), but also excesses and imbalances in one's intake of energy and nutrients - overweight, obesity, inadequacy of vitamins and minerals, and diet-related noncommunicable diseases (e.g., cardiovascular diseases and diabetes) are now considered as consequences of malnutrition too (WHO, 2021a). It was estimated in *the State of Food Security and Nutrition in the World Report* that between 720 and 811 million people were facing hunger in 2020, meaning that nearly one in three people in the world did not have access to adequate food (FAO & WHO, 2021). In the meantime, overweight and obesity keep rising among children and adults in all regions. In 2016, over 340 million children and adolescents aged 5-19 were overweight or obese, and more than 1.9 billion adults aged 18 years and older were overweight, of which over 650 million were obese (WHO, 2021b). Moreover, the global food system is a main contributor to climate change, freshwater depletion, aquatic and terrestrial pollution, and biodiversity loss (Campbell et al., 2017; Newbold et al., 2015; Vermeulen, Campbell, & Ingram, 2012).

Springmann and colleagues (2018) estimate that the food system emitted approximately 5.2 billion tonnes of greenhouse gases, occupied 12.6 million km² of cropland, and used 1,810 km³ of freshwater resources in 2010, and that these numbers could increase by 50-90% between 2010 and 2050 if no technological changes or mitigation measures were dedicated to the current food system, which will transgress the planetary boundaries that constitute “a safe operating space for humanity” (Rockstrom et al., 2009, p. 472).

Against this background, the FAO and the WHO call for global actions towards food system transformation. They have recommended six pathways (see Figure 1) and this thesis will focus on the last one - “strengthening food environment and changing consumer behaviour to promote dietary practices with positive impacts on human health and the environment” (FAO & WHO, 2021, p. 34). In particular, I intend to experimentally investigate if the embodied cognition approach and the conceptual metaphor theory from psychological and behavioural science can help develop interventions for sustainable healthy diets. The following two sections will advance on the social and practical relevance of this topic, as well as the theoretical framework of the current research. Lastly, an overview of the remaining chapters of the thesis will be provided.

Figure 1. Six pathways towards food system transformation (FAO & WHO, 2021, p. 34).



1. Sustainable healthy diets - what and why

Sustainable healthy diets are defined as “dietary patterns that promote all dimensions of individuals’ health and wellbeing, have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable” (FAO & WHO, 2019, p. 9). Since the foods associated with better health outcomes (e.g., whole grain cereals, fruits, vegetables, legumes, and nuts) often have remarkably lower negative environmental impacts than unhealthy foods (Clark, Springmann, Hill, & Tilman, 2019), promoting sustainable and healthy diets is a promising strategy to jointly tackle the global issues of malnutrition and environmental degradation (FAO & WHO, 2021; Springmann et al., 2018). Shifting dietary patterns will require initiatives throughout the food supply chain, from food production and distribution to consumption, and will need collaborations

across the international, national, industrial, and individual levels (Willett et al., 2019). Due to time and resource constraints, my PhD thesis will only target three subsectors within this field, namely, improving healthy eating guidelines, discouraging overconsumption of red meat, and reducing consumer food waste.

1.1. Healthy eating guidelines

Although dietary habits vary within and across nations and regions, economic growth and urbanization have been ubiquitously driving the global dietary structure towards diets with higher proportions of refined fats, refined sugars, and meat (Drewnowski & Popkin, 1997; Tilman & Clark, 2014). Initially occurred in high-income countries, the burden of this nutrition transition has been rapidly increasing in low- and middle-income countries during the past fifty years (Popkin & Gordon-Larsen, 2004; Popkin, Adair, & Ng, 2012), worsening both health and environmental problems all over the world. Based on the *Global Burden of Disease Study* data from 195 countries and territories, low intake of whole grains, fruits, and vegetables, and high intake of sodium, red meat, and sugar-sweetened beverages are among the leading risk factors for noncommunicable diseases and deaths (Afshin et al., 2019). Excessive consumption of “empty calories” (i.e., calorie-dense foods that have little to no nutritional value, such as refined sugars, fats and alcohols) also widens the nutritional disparities between the rich and the poor, and generates needless agricultural impacts on the environment (Ranganathan et al., 2016).

To curb this trend, the WHO has developed and updated more than 50 nutrition guidelines between 1996 and 2019, including recommending that adults and children limit fat intake to less than 30% of total energy intake (WHO, 2018), limit free sugar intake to less than

5% (WHO, 2015), and keep salt intake lower than 5 grams per day (WHO, 2012). Nonetheless, people eat food items rather than the ingredients, which necessitates translating the WHO guidelines into more accessible food-based dietary guidelines in each specific sociocultural context (FAO & WHO, 2019; Ritchie, Reay, & Higgins, 2018). Chapters 2 and 3 of this thesis will be devoted to this topic.

1.2. Meat reduction

Another widely advocated solution is to reduce meat consumption and adopt more plant-based diets (Neacsu, McBey, & Johnstone, 2017; Springmann et al., 2018, Swinburn et al., 2019). Indeed, meat production (i.e., the livestock industry) has long been accused of contributing disproportionately to the degradation of the environment and natural resources (Steinfeld et al., 2006; Clark & Tilman, 2017). Relying on US data, Pimentel and Pimentel (2003) estimate that producing 1 kilograms of animal protein requires 100 times more water and 11 times more fossil energy than producing 1 kilograms of plant-based protein. Combining statistics from different regions, Springmann, Godfray, Rayner, and Scarborough (2016) project that decreasing the consumption of animal-sourced foods or shifting to vegetarian diets could result in a 29%-63% reduction in greenhouse gas emissions associated with food consumption, compared to if no dietary changes are made. There is also ample evidence that overconsumption of red and processed meat is associated with higher risks of colorectal cancer (Bouvard et al., 2015) and cardiovascular mortality (Wang et al., 2016), and shifting to healthful plant-based diets can help alleviate those health risks (Madigan & Karhu, 2018; Satija & Hu, 2018). Decreasing red meat

consumption and moving towards more plant-based diets would benefit both planetary and personal health (Fresán & Sabaté, 2019; Hemler & Hu, 2019).

At the beginning of my PhD, empirical research on interventions to reduce red meat consumption was rather limited, and much attention was given to interventions operating “within the rational choice paradigm, based on reflective, conscious processing” (Godfray et al., 2018, p. 6). The potential of targeting - automatic processes is largely overlooked (Marteau, 2017). In Chapters 4 and 5, I will cater to this gap, integrating metaphors into intervention design and examining if they can alter consumers’ affective responses to meat-eating.

1.3. Food waste

The importance of reducing consumer food waste has been growingly recognized over the past decade (Dou & Toth, 2021), which is also reflected in the United Nations Sustainable Development Goals, i.e., the target of halving per capita global food waste by 2030 (UN, 2015). It was estimated by United Nations Environment Programme that 931 million tonnes of food were thrown away at the retail, food service and consumer levels in 2019 (UNEP, 2021). That is to say, 17% of the food produced worldwide was never eaten, with all the natural resources exploited in its production, transportation and disposal wasted in vain. To tackle this severe situation, scientists and policymakers have begun to test different anti-consumer-food-waste interventions and initiatives (Reynolds et al., 2019; Secondi, Principato, & Laureti, 2015), and are requesting more empirical assessments of intervention effectiveness (Aschemann-Witzel, De Hooge, Amani, Bech-Larsen, &

Oostindjer, 2015; Stöckli, Niklaus, & Dorn, 2018). Chapter 6 of this thesis will add to this literature.

1.4. Informational interventions

Across the abovementioned three subsectors, the most commonly used strategies are informational interventions, e.g., awareness campaigns, prompts, warnings, and labelling that aim to inform and educate the public about the health and environmental consequences of their dietary choices (Abrahamse & Matthies, 2018; Kwasny, Dobernig, & Riefler, 2022; Stöckli et al., 2018). Unfortunately, recent review papers on health and environmental interventions suggest that the effectiveness of informational interventions on behaviour is not always satisfying (Bolderdijk, Gorsira, Keizer, & Steg, 2013; de Ridder, Kroese, Evers, Adriaanse, & Gillebaart, 2017). Therefore, in this thesis, I will draw on insights from the embodied cognition approach to analyse why some informational interventions fail to work, and how we can develop more efficient behaviour-change interventions to facilitate sustainable healthy dietary practices.

2. Embodied cognition and its implications for sustainable healthy diets

Embodied cognition holds that “the mind must be understood in the context of its relationship to a physical body that interacts with the world” (Wilson, 2002, p. 625). Arising in the 1980s, this approach contests Descartes’ mind-body dualism (i.e., the mind and the body are distinct and separable; Guttenplan & Guttenplan, 1994) by gathering empirical evidence for six interconnected arguments (Wilson, 2002; see also Shapiro, 2010):

1) Cognitive activities are situated in a task-specific real-world context.

This line of research is also termed as “situated cognition” or “online embodiment” (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), where researchers show that performing certain sensorimotor tasks could automatically influence many so-called “higher-level” cognitive processes like social judgement or decision making. Famous examples include the effects of head movements (Wells & Petty, 1980) and facial muscle activities (Noah, Schul, & Mayo, 2018; Strack, Martin, & Stepper, 1988). People engaging in vertical head movement (i.e., nodding the head) agreed more with the content of a radio broadcast than those engaging in horizontal head movement (i.e., shaking the head), no matter if the broadcast content was discrepant or consistent with their prior opinions (Wells & Petty, 1980). Fostering (vs. inhibiting) the facial muscles typically associated with smiling led people to evaluate a cartoon as funnier and to report themselves as happier (Strack et al., 1988).

2) Cognition is time pressured.

The stress of solving real-time problems shapes cognitive functions (Clark, 1997). When fast responses and a continuous re-evaluation of the situation are demanded, the brain tends to rely on pragmatic bodily actions instead of abstractions or mental representations (Kirsh & Maglio, 1994). In a renowned experiment, Ballard, Hayhoe, Pook and Rao (1997) asked participants to quickly copy the pattern of some coloured blocks and found that participants commonly made way more eye movements than needed, paying attention to individual blocks at each fixation without inspecting or memorizing the sub-patterns of multiple blocks.

3) We off-load cognitive work onto the environment as our minds have limited information processing capacities.

This claim is associated to the “extended mind” hypothesis (Clark & Chalmers, 1998), and can be illustrated with everyday practices like setting a calendar alert on your phone or using a GPS to navigate your way (Risko & Gilbert, 2016). In developmental psychology, researchers have found that cognitive offloading assists learning. For instance, Glenberg and Robertson (1999) demonstrated that in a compass learning task, subjects who were allowed to index words to objects on a map followed new directions faster and performed the task more accurately than those who were prevented from indexing. In the same vein, Martin and Schwartz (2005) found that children gave more correct answers to fraction problems (e.g., “make 1/4 of 8 ”) when they could move actual pie wedges and tiles with their hands, as compared to when they could merely use a pencil to draw on pictures of those pieces.

4) The physical and social environment is part of the cognitive system.

As a radical extension of the previous notion, this “distributed cognition” hypothesis (Cole & Engeström, 1993; Hutchins, 1991) has created more controversy. Proponents theorize cognitive works offloaded to physical objects as “external representations” and argue that “external representations”, alongside “internal representations” in our brain, are indispensable components of those “distributed” cognitive processes (Zhang & Norman, 1994). Regarding the social environment, studies on spontaneous facial mimicry and postural synchrony are generally in favour of this hypothesis: humans unconsciously imitate the facial expressions and postures of other people in social

interactions, which enables and enhances social cognitive functions like emotion recognition and empathy (Chartrand & Bargh, 1999; Rogers, 1999; Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001). Nevertheless, opponents also reasonably point out that impacting the elements of a system is not identical to being part of the system (Wilson, 2002).

5) Cognition is for action.

Our perceptions, memories, and attitudes concerning a person or an object depend on their functional relevance to us, i.e., how we may interact with them (Casasanto & Chrysikou, 2011; Glenberg, 1997). Past works on motor fluency have provided rigorous evidence for this theory - expert typists recalled easy-to-type letter dyads better than hard-to-type ones (Yang, Gallo, & Beilock, 2009), and indicated a preference for the former (Beilock & Holt, 2007); consumers who habitually grasped things with their right hand evaluated products with a right-oriented (vs. left-oriented) handle more positively (Eelen, Dewitte, & Warlop, 2013), and had higher intentions to purchase a food item (e.g., yoghurt, soup, cake) when a spoon was placed on the right (vs. left) side of the bowl or the plate in the advertisement, unless their right hand was temporarily occupied by another task (Elder & Krishna, 2012).

6) Even when decoupled from the immediate environment, cognitive operations are still grounded in our sensorimotor experience.

Research under this theme often involves the use of language or other symbols, and is sometimes called “offline embodiment” (Niedenthal et al., 2005). Early evidence

mainly concerns the intra-conceptual mechanism of embodied simulation, i.e., how the brain processes concepts by re-enacting the associated perceptual and/or motor experience (Barsalou, 1999). For example, González and colleagues (2006) revealed that reading odour-related words such as “garlic”, “cinnamon” and “jasmine” elicited activation in participants’ primary olfactory cortex. Tschentscher, Hauk, Fischer and Pulvermüller (2012) showed that the primary motor cortex in the hemisphere contralateral to the hand used for counting (i.e., people have different finger counting habits, starting either from the right or the left hand) was activated in exposure to digit numbers 1 to 5, but not larger numbers.

Later on, inspired by Lakoff and Johnson’s (1980) conceptual metaphor theory, more researchers have turned to the inter-conceptual mechanism of metaphorical mappings, demonstrating that even the most abstract and imperceivable concepts like time and love are deeply rooted in bodily experience. For instance, the conceptual metaphor “Affection is Warmth” (e.g., “warm-hearted”, “cold-blooded”) maps the embodied thermal experience onto the abstract concept of affection in our cognitive structure. Correspondently, after having held a hot (vs. iced) beverage, people acted more cooperatively and judged the other person they interacted with as more friendly and

trustworthy (Williams & Bargh, 2008; Storey & Workman, 2013)¹, and that feelings of social exclusion led people to perceive the room temperature as lower and to crave hot drinks (Zhong & Leonardelli, 2008; Lee, Rotman, & Perkins, 2014). An fMRI study further suggested that reading loving messages from family and friends produced activations in the ventral striatum and middle insula, which overlapped with the neural activities during exposure to physical warmth (Inagaki & Eisenberger, 2013).

To my knowledge, embodied cognition is very much underrepresented in the literature on sustainable healthy diets. Only a handful of researchers have explicitly employed the embodied cognition approach to design interventions. Hung and Labroo (2011) showed that firming one’s muscles facilitated self-regulation, leading to higher consumption of healthy food and drinks among people who cared about long-term health goals. Van Ooijen, Fransen, Verlegh, and Smit (2017) demonstrated that consumers with a health-related shopping goal found healthy drinks in slim bottles more attractive than those in wide bottles. Other successful nudges, such as reducing portion size to lessen food intake and plate waste (Freedman & Brochado, 2010; Higgins et al., 2022), and manipulating multisensory cues (e.g., background music, package colour and transparency) to encourage sustainable

¹ Please note that the effects of physical warmth priming on social warmth judgments (Williams & Bargh, 2008) failed to replicate in two sets of high-powered direct replications (Chabris, Heck, Mandart, Benjamin, & Simons, 2018; Lynott, Corker, Wortman, Connell, Donnellan, Lucas, & O’Brien, 2014). A few successful indirect replications were also published over the years (e.g., Inagaki & Ross, 2021; Pijls, Galetzka, Groen, & Pruyn, 2021), but their sample sizes were inadequately small. A recent meta-analysis (Lynott, Corker, Connell, & O’Brien, 2023) found little support for the positive effects of warmth priming on prosocial behavioural outcomes. However, Barbosa Escobar, Velasco, Motoki, Byrne, and Wang (2021) demonstrated with well-powered explicit and implicit tests that people associated hotness with positive-valenced and high-arousal emotions, and coldness with negative-valenced and low-arousal emotions. Considering the current evidence, I think the effects of physical and social warmth priming are questionable, and the conceptual metaphor “Affection is Warmth” might be a fraction of the broader metaphorical mappings between temperature and emotions. The controversies around priming effects in general will be further discussed in Chapter 7.

healthy food choices (Mai, Symmank, & Seeberg-Elverfeldt, 2016; Motoki, Takahashi, Velasco, & Spence, 2022) are broadly compatible with the embodied cognition approach, as those studies have recognized that consumer behaviours are heavily determined by contextual factors and visceral states.

The vast majority of studies in this field, especially those on informational interventions, are rarely informed by the embodied cognition approach. Currently, the rational choice paradigm is the mainstream theoretical framework for research on sustainable healthy diets (Vermeulen, Park, Khoury, & Béné, 2020). It is understandable in that eating healthily and protecting the environment appear to be a rational choice for the individual and mankind. The standard informational interventions, exemplified by carbon calculators (Kim & Neff, 2009) and calorie labelling (Elbel, Kersh, Brescoll, & Dixon, 2009; Long, Tobias, Craddock, Batchelder, & Gortmaker, 2015), function via slow, deliberate, and effortful cognitive processes, and assume that people would quit unhealthy and unsustainable eating habits after knowing their costs. This line of thinking neglects the facts that dietary decisions are often made quickly, automatically, and impulsively (Liu, Wisdom, Roberto, Liu, & Ubel, 2014), and that people could have difficulties in interpreting numerical information (Liu, Bettman, Uhalde, & Ubel, 2015; Rothman et al., 2006). The mismatch in processing styles could have played a part in the failure, or the limited effect size of conventional dietary interventions (Bauer & Reisch, 2019; Liu et al., 2014). The embodied cognition approach, which recognizes the time-pressured nature of many cognitive activities as well as the experiential underpinning of some seemingly “rational” judgments and decisions, would be a good complement to the present information provision strategies.

This is by no means denying the significance of self-regulation and reflective thoughts in food-related behaviour changes. Rather, the embodied cognition approach maintains that bodily experience can impact not only intuitive thinking, but also rational thinking (Kahneman, 2003; Petit et al., 2016), making it particularly useful when we want to break consumers' bad eating habits (i.e., to interrupt some "intuitive" decision-making processes) and draw their attention to the consequences of unhealthy and unsustainable food choices (i.e., to promote "rational" self-regulation). In the next section, I will elaborate on how informational interventions may be strengthened by the embodied cognition approach, and precisely, the conceptual metaphor theory (CMT).

3. CMT and metaphors in informational interventions

Metaphors pervade language. According to the CMT, metaphors are more than a matter of words, but a cognitive tool enabling us to understand abstract concepts (i.e., the target domain) in terms of seemingly dissimilar concrete concepts (i.e., the source domain) representing embodied experience in the physical world (Lakoff & Johnson 1980, 1999). Metaphors thus have the ability to alter human thoughts and actions, which is backed up by an accumulating body of empirical works from social psychology (Landau, Meier, & Keefer, 2010; Gibbs & Matlock, 2008).

A variety of conceptual metaphors have been detected in public communication about healthy and sustainable lifestyles, such as "Health is Balance" (Lipworth, Hooker, & Carter, 2011), "Nature is A Person/Mother" (Liu, Geng, Ye, & Zhou, 2019; Tam, Lee, & Chao, 2013) and the prevalent "War" metaphors encompassing both health and environmental issues (Huang & Bisiada, 2021; Larson, 2011; Russell-Mayhew, Moules, & Estefan, 2022).

While the CMT is frequently cited by metaphor researchers, the notion that “conceptual metaphors are embodied” remains underappreciated. Here I will review Lakoff and Johnson’s major argumentations on why conceptual metaphors are embodied, and explain their relevance to informational interventions for sustainable healthy diets.

3.1. The embodied origin of metaphorical thinking

Despite the amendments made by subsequent researchers (Casasanto, 2014; Gibbs, 2014), Lakoff and Johnson (1980, 1999) initially asserted that people speak metaphorically because they think metaphorically, i.e., the linguistic metaphors are reflecting the cross-domain associations in our mind. This would naturally lead to a crucial question: where did those mental associations come from? The CMT answers that they emerged from our embodied experience.

More specifically, Lakoff and Johnson (1999) proposed a three-stage metaphor acquisition process in children’s early development. First, during the period of “conflation” (Johnson, 1999), non-sensorimotor experience in a target domain regularly co-occurs with sensorimotor experience in the source domain, making it difficult for children to separate the two and hence automatically associate one with another. For instance, infants acquire the metaphor “Affection is Warmth” from the embodied experience of being held by their caretakers, where they simultaneously feel “warm” and “loved”. Likewise, the perceptual experience of witnessing similar objects such as flowers and trees clustering together produces the metaphor “Similarity is Spatial Proximity” (e.g., “their opinions are close”, “my sister and I are poles apart in personality”).

Secondly, during the “differentiation” period, children manage to systematically distinguish between the source and the target domains, but the cross-domain associations persist in their neural system (Feldman & Narayanan, 2004; Lakoff, 2014), paving the way for the linguistic use of conceptual metaphors. Thirdly, at the stage of “conceptual blending” (Fauconnier & Turner, 2002), those primary metaphors derived from direct bodily experience would be brought together to form more complex metaphors (Grady, 1997). As an illustration, Lakoff and Johnson (1999) analysed the complex metaphor “Love is A Journey”, and revealed that it is composed of at least four simpler metaphors: “The Lovers are Travelers,” “Their Common Life Goals are Destinations,” “The Relationship Is A Vehicle,” “Difficulties are Impediments To Motion” (p. 140).

The implications of this embodied account are two-folded. On the one hand, informational interventions should be careful not to go against the primary metaphors in the target population’s mind. As emphasized by Lakoff and Johnson (1999), “primary metaphors are part of the cognitive unconscious” (p. 124) and human beings have no choice but to automatically acquire them “just by functioning normally in the world” (p. 130). Supposedly, a metaphor-incongruent intervention should yield poor results since incongruency with conceptual metaphors is constantly shown to decrease processing fluency in psychological experiments (Schubert, 2005; Sundar & Noseworthy, 2014), which, in turn, leads to unpleasant consumer experiences and negative responses (Reber, Schwarz, & Winkielman, 2004; Schwarz, Jalbert, Noah, & Zhang, 2021). Aligned with this reasoning, Chapters 2 and 3 will focus on the primary metaphor “Healthy is Up” and explore what happens if a healthy eating intervention contains elements in conflict with this metaphorical association.

On the other hand, informational interventions adopting metaphorical framing as their major instrument should consider building upon existing conceptual metaphors, akin to how complex metaphors are constructed with primary metaphors. There are novel metaphors completely independent of any preceding metaphorical associations for sure, but most metaphorical expressions in iconic poems are innovative instantiations of enduring conceptual metaphors (Gibbs, 1994; Lakoff & Turner, 1989), presumably because metaphors with experiential foundations are better accepted by the audience (Gibbs, 2003). Therefore, in Chapters 4 to 6, I will design novel informational interventions based on one type of pervasive conceptual metaphor - anthropomorphism - and test their effects on reducing meat consumption and food waste. Anthropomorphism, or personification, helps us make sense of nonhuman entities in human terms, and drives us to interact with them as if they are certain kind of people (Lakoff & Johnson, 1980). For example, the metaphor “Inflation is An Adversary” leads people to think that inflation “can attack us, hurt us, steal from us, even destroy us”, and thereby “justifies political and economic actions on the part of our government: declaring war on inflation, setting targets, calling for sacrifices, installing a new chain of command” (Lakoff & Johnson, 1980, p. 34). Similarly, metaphorically framing food as friendly people with emotional and social needs may change consumers’ eating behaviours and attitudes.

That said, it should be admitted that the stage of embodied “conflation” has not received sufficient empirical support from developmental psychology (Casasanto, 2014; Haser, 2005; Ruiz de Mendoza Ibáñez & Perez Hernandez, 2011), and that other mechanisms may also breed metaphorical thinking (Gibbs, 2013; Holyoak & Stamenković, 2018; Sanford, 2012). To showcase this, Casasanto (2014) puts forward an interesting instance: the left-

right spatial metaphor of politics. It is common for the US and European people to talk about liberal and conservative ideologies metaphorically on a left-right continuum (e.g., “the liberal left” and “the right-wing conservatives”). The association is beyond linguistic like many other conceptual metaphors. US students who were seated in a “broken” chair leaning leftward (vs. rightward) reported stronger liberal attitudes than conservative attitudes (Oppenheimer & Trail, 2010). Dutch participants responded faster when liberal parties were presented on the left side of the screen, and when conservative parties were presented on the right (van Elk, van Schie, & Bekkering, 2010). Unfortunately, it is hard to find a plausible embodied origin for this mental association. The historical root of this linguistic metaphor can be traced back to the French General Assembly in 1789, which arranged for the conservative members to sit on the right side of the room and the liberal members on the left (Bienfait & van Beek, 2001). The US Senate and House still adopt the same arrangement today, but the Democrats and Republicans are not always depicted like that in photos and videos (Casasanto, 2014), meaning that the general public does not have more perceptual experiences congruent with this metaphor. Thus, the most likely explanation would be that, contemporarily, people acquire this mental association after having repeatedly used the linguistic expressions. In other words, this linguistic metaphor originated in a culture-specific bodily experience more than two centuries ago, but is passed down to the modern people’s mind due to repeated language use. A paper probing into this kind of complex interplay between language, culture and embodiment in the healthy eating domain will be presented in Chapter 3.

3.2. Understanding the abstract through the concrete

The second CMT proposition about embodiment lies in the cognitive function of conceptual metaphors - abstract concepts are intangible and ambiguous, but the comprehension of them is critical to social information processing, so concrete concepts are metaphorically projected onto abstract concepts to ease this operation (Landau, et al., 2010; Keefer, Landau, Sullivan, & Rothschild, 2011).

Lakoff and Johnson (1999) conceive of concepts as image schemas, i.e., “a recurring dynamic pattern of our perceptual interactions and motor programs that gives coherence and structure to our experience” (Johnson, 1987, p. xiv). The CMT starts with the premise that infants learn concrete concepts straight from bodily interactions with the physical world, which is often illustrated with concepts related to “Space” (Gibbs & Colston, 1995; Mandler, 1992) :

Spatial-relations concepts are embodied in various ways. Bodily projections are obviously based on the human body. Concepts like front and back and those in Mixtec² arise from the body, depend on the body, and would not exist if we did not have the kinds of bodies we have. The same is true of fundamental force dynamic schemas: pushing, pulling, propelling, supporting, and balance. We comprehend these through the use of our body parts and our ability to move them, especially our arms, hands, and legs. (Lakoff & Johnson, 1999, pp. 87-88)

² Mixtec is spoken in Mexico and belongs to the Mixtecan group of the Oto-Manguean language family.

To understand abstract concepts like “Time” which we cannot directly see or touch, conceptual metaphors such as “Time is Space” step in to help (Casasanto, & Bottini, 2014; Gentner, 2001). In accordance with this posit, experimental studies show that we not only talk about time in terms of spatial distance, directions, and movements (e.g., “a short period of time”, “in the near future”, “dates back to the 19th century”), but also automatically factor in spatial information when making inferences about time: when a growing line was displayed on the screen, adults estimated the time duration as shorter when the line travelled a shorter distance, and estimated the duration as longer when the displacement of the line was longer (Casasanto & Boroditsky, 2008); replacing the growing line with two racing snails, researchers further found that children made more mistakes in judging which nail moved for a longer time when the distance information mismatched the duration (Casasanto, Fotakopoulou, & Boroditsky, 2010). The influence of concrete sensorimotor information on abstract concept processing has also been documented for a wide range of other metaphors, such as “Good is Up” (Meier & Robinson, 2004), “Power is Up” (Schubert, 2005; Zanolie et al., 2012), “Similarity is Spatial Proximity” (Casasanto, 2008), and so forth.

In public communication about sustainable healthy diets, however, the source concept of a metaphor may not always be more concrete than the target. The CMT considers a concept as more abstract than another when it is “less strongly associated with specific sensory experiences” (Grady, 1997, p. 28). The conceptual metaphors analysed by Lakoff and Johnson (1980) mostly have an abstract target and a concrete source. The metaphor “Healthy is Up”, which I will investigate in Chapters 2 and 3, is such an instance. The target concept “Healthy” is associated with a wide range of sensorimotor experiences, such

as standing upright (verticality), holding the body steady (balance and control), having rosy cheeks and glowing skin (colourfulness), eating sufficient leaf vegetables (bland taste and green colour), and so forth. All those experiences contribute to our comprehension of this concept, while no single one of them is essential or indispensable. By contrast, the source concept “Up” is straightforward to the mind since it signifies exclusively one type of spatial position and movement. Nonetheless, this logic may not apply to metaphors like “Animals are Friends” and “The Earth is A Mother”, since their target concepts are associated with tangible objects/agencies and are rather concrete in themselves. In my view, conceptual metaphors can serve the purpose of modifying people’s understanding of the target concept in those cases. People are used to perceiving pigs and cows merely as sources of food and to wasting food as if the Earth has infinite resources. It requires dramatical change in people’s taken-for-granted way of thinking to promote sustainable healthy diets. Metaphors could make belief updates easier, like they did for concept comprehension. This echoes Amin’s (2009; 2018) observation and proposition that conceptual metaphors facilitate conceptual change in science learning, such that people renew their comprehension of scientific concepts (e.g., “Heat”) by using different metaphors (e.g., from “Heat is A Substance” to “Heat is A Wave”). To elicit conceptual change with metaphors in practice, it is helpful to bear in mind that human beings grasp concrete concepts with less difficulties, and that we can reinforce the embodied experiences associated with the source concept to make a metaphor more accessible to the audience. Accordingly, in an attempt to discourage meat consumption with the metaphor “Animals are Friends” in Chapter 4, I will provide rich details of bodily interactions with friend-like animals in the metaphorical vignette (e.g. “They like interactive games such as fetch. As

soon as they see our team member with a Frisbee, they are ready to run and retrieve it.”), rather than just connecting the source with the target superficially.

In addition, the experiential nature of the source domain points to the possibility that individuals may import divergent life experiences from the source to the target. This reasoning gives rise to the source resonance hypothesis: “exposure to a metaphoric message will affect target processing differently depending on recipients’ pre-existing conceptions of the source” (Landau, Zhong, & Swanson, 2018, p. 60). So far, only a limited number of empirical studies have been carried out to check this hypothesis (Landau, Arndt, & Cameron, 2018; Spina, Arndt, Landau, & Cameron, 2018), and my Chapter 5 will contribute to this literature by investigating if culture-specific conceptions of the source would modulate the effects of anthropomorphic metaphors on meat consumption.

4. An overview of the thesis

The remaining chapters of this thesis consist of five empirical papers (Chapters 2-6), plus a conclusive chapter (Chapter 7) discussing the strengths and weaknesses of those empirical works.

Chapters 2 and 3 attend to the conceptual metaphor “Healthy is Up” and its potential influence on healthy eating guidelines. In Chapter 2, US people were shown to associate healthy food pictures with vertical up and unhealthy food pictures with vertical down in both implicit and explicit cognitive tasks, supporting that English expressions like “the peak of health” were more than just a figure of speech, but embedded in people’s conceptual representations. Two follow-up experiments demonstrated that US participants preferred a healthy-eating food pyramid depicting healthy food at the top (vs. bottom) and evaluated a food product as healthier when it is photographed from an upward- (vs. downward-) looking angle. In Chapter 3, the results for the cognitive tasks were successfully replicated with Chinese participants. However, Chinese participants indicated no preference when asked to choose between two food pyramids. Arguably, this is because the linguistic metaphor “Healthy is Up” is not used in the Chinese language, making the association between health and verticality less pronounced in Chinese people’s minds.

Having established the dual effects of embodiment and linguistic exposure, Chapters 4-5 utilize those insights to design metaphorical interventions for meat reduction. Chapter 4 is dedicated to the effects of the “Animals are Friends” metaphor on US omnivores. Across five online experiments, exposure to this friendship metaphor elicited less favourable attitudes toward (pork) meat dishes/products, and lowered consumers’ intentions to

patronize a (pork) meat restaurant and to buy (pork) meat products. Moreover, I showed that the discouraging effects of anthropomorphism on (pork) meat consumption were mediated by increased feelings of anticipatory guilt, but a sixth experiment found no such effect for another kind of meat (beef). Chapter 5 looks into Chinese and US omnivores' different responses to a pair of anthropomorphic metaphors: "Animals are Family" and "Animals are Friends". In line with the source resonance hypothesis, the family metaphor, which was tailored to the strong familism in Chinese culture, significantly decreased Chinese omnivores' meat purchase intentions, but did not have a significant impact on US omnivores. Surprisingly, Chinese people did not feel more guilty about eating meat after reading the family metaphor, so the mediation was not replicated.

Chapter 6 applies anthropomorphic metaphors to the domain of food waste reduction. I co-designed food waste interventions with Winnow, a UK company specializing in measuring food waste through smart technologies, and tested the effectiveness of those interventions in the staff cafeterias of Melco, a hotel chain in Macau, China. Modelling actual food waste weight data from 1,536,610 meals over four months and self-reported survey data of 1,198 respondents, I found that environmental messages with anthropomorphic metaphors resulted in a higher reduction in food waste as compared to other feedback interventions.

5. Key concepts and their operationalizations

In this section, I will discuss a series of concepts crucial to the current thesis, some of which are defined vaguely and/or operationalized in various ways by past researchers. The discussion aims not to offer the best definitions for those concepts, but to explain why I have selected certain definitions and operationalizations, and to ensure that readers would not misunderstand my usage of those terms.

5.1. Concepts associated with the conceptual metaphor theory (CMT)

Target vs. Source Domain	<p>The CMT defines metaphors as cross-domain mappings. The target domain is the abstract concept that we are trying to comprehend, and the source domain is the concrete concept from which we draw sensorimotor experiences. For example, in the metaphor “Affection is Warmth”, “Affection” is the target domain and “Warmth” is the source domain.</p> <p>As noted in section 3.2 of this chapter, sometimes a metaphor’s target domain may not be more abstract than its source domain. In those cases, the target domain would be the concept we are actually communicating about, while the source domain would foster a new understanding of the target. For instance, the metaphor “The Earth is A Mother” has our planet as the target domain and motherhood as the source domain.</p>
Conceptual vs. Linguistic Metaphor	<p>Lakoff and Johnson (1980) consider metaphors as fundamentally conceptual, i.e., the mental associations between concepts establish first, and then manifest themselves in verbal and non-verbal human communications. This theoretical standpoint leads successive researchers to name metaphorical thoughts as conceptual metaphors, and metaphorical language as linguistic metaphors (Casasanto, 2009; Steen, 1999).</p> <p>These two terms emphasize different properties of metaphors, and researchers usually validate the existence of conceptual metaphors with non-literal evidence. However, it does not indicate that conceptual metaphors should not be expressed linguistically, or that linguistic metaphors cannot build conceptual associations in people’s minds. In fact, most metaphors studied in the current thesis are both conceptual and linguistic, except that the conceptual metaphor “Healthy is Up” seems to lack linguistic manifestations in the Chinese language.</p>

<p>Primary vs. Complex Metaphor</p>	<p>It was initially put forward by Grady (1997) that complex metaphors like “Theories are Buildings” are made up of primary metaphors such as “Organizations are Physical Structures” and “Viability is Erectness”. Unfortunately, he did not offer an explicit definition of “primary metaphors”. It was hinted in his work that primary metaphors are directly motivated by recurring correlations in bodily experiences, while there is no plausible experiential basis for complex metaphors. Lakoff and Johnson (1999) formalized Grady’s (1997) ideas and argued for the universality and inevitability of primary metaphors in human thoughts, considering that the embodied experiences underlying those metaphors are shared by almost all mankind.</p> <p>It has to be admitted that the distinction between primary and complex/non-primary metaphors relies heavily on a few linguists’ subjective analyses. In a more cautious sense, it can be problematic to assert that one metaphor is more complex or less fundamental than another merely because those linguists cannot come up with a simple embodied explanation for its origin. After all, metaphors could also arise from coincidental historical events, cultural-specific practices, and/or repeated language use, as discussed in section 3.1 of the current chapter, as well as in Chapter 3.</p> <p>Nevertheless, the notions that some metaphors may have originated from universal bodily experiences, and that they could become the building blocks of other metaphors, are useful for intervention design. This thesis will thus continue to call metaphors with a plausible embodied origin “primary metaphors”, without adopting the theoretical point that “non-primary” metaphors are all constructed by primary ones.</p>
<p>Vertical Metaphor</p>	<p>There are plenty of conceptual metaphors with verticality as the source domain, such as “Good is Up”, “Power is Up”, “Moral is Up” and “Healthy is Up”. This common type of metaphor is called “vertical metaphor” by some researchers (Cian, 2017), and is often taken as an example of primary metaphors in the CMT (Grady, 1997; Lakoff & Johnson, 1999). The fact that many positive abstract concepts are coherently mapped onto verticality may suggest a more general schema rooted in various positive upward experiences.</p>

<p>Anthropomorphism & Anthropomorphic Metaphor</p>	<p>The Oxford English Dictionary defines anthropomorphism as “the attribution of human personality or characteristics to something non-human, as an animal, object, etc.” According to the CMT, anthropomorphism allows us to comprehend non-human target concepts through source concepts associated with humans (Lakoff & Johnson, 1980). This thesis sometimes refers to anthropomorphism as “anthropomorphic metaphor(s)” to highlight its metaphorical nature and to specify the source domain (e.g., “Animals are Friends” or “Animals are Family”).</p> <p>The operationalization of this concept is slightly tricky, for there is no consensus on what characteristics are uniquely “human”. While Zoologists think of hairlessness as a distinctive trait of Homo sapiens as compared with other primates (Desmond, 1967), the general public may not see it as a defining feature of human beings. In other words, the reference point and the opinion source create a variance.</p> <p>Therefore, I have taken these two factors into consideration when selecting the manipulation-check measurement for studies on anthropomorphism of meat animals. For instance, the scales of product anthropomorphism (Chen, Sengupta, & Adaval, 2018) and brand anthropomorphism (Golossenko, Pillai, & Aroean, 2020) have been ruled out as they contain inappropriate items such as “[the target] seems alive” or “[the target] is life-like”. People know that animals are living creatures even without anthropomorphism. Instead, I have adopted the pet anthropomorphism scale from McConnell, Brown, Shoda, Stayton, & Martin (2011), because it also deals with animal-human comparison. The measured items (i.e., thoughtful, sympathetic, considerate) are especially relevant to social connection (Epley, Waytz, & Cacioppo, 2007), which fit very well with the metaphors under examination. Although there is evidence from comparative psychology that pigs and cows possess many human-like social and emotional capabilities (Marino & Allen, 2017; Marino & Colvin, 2015), lay people are unlikely to be equipped with this scientific knowledge. Accordingly, our target participants, US and Chinese omnivores, should have adopted anthropomorphism if they saw those characteristics on meat animals.</p>
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5.2. Concepts associated with the dual system theory

<p>Rational Choice Paradigm</p>	<p>The rational choice paradigm, also known as the rational choice theory (RCT), postulates that individuals calculate costs and benefits in decision-making and will act to maximize utility in games with perfect information (Coleman & Farraro, 1992; Scott, 2000). While psychologists have continuously found experimental evidence that this paradigm poorly describes individuals' actual behaviours (Burns & Roszkowska, 2016; Herrnstein, 1990; Smith, 1991), scholars who are keen on promoting sustainable healthy diets “have conceptualized behavioural changes predominantly through the lens of rational choice” (Vermeulen et al., 2020, p. 6).</p> <p>Variants of the RCT, such as the health belief model (Becker, Drachman, & Kirscht, 1974), the stages of change model (Prochaska & DiClemente, 1986), and the theory of planned behaviour (Ajzen, 1985; 2015), prevail in the conventional research on health eating (Conner, Norman, & Bell, 2002; Deshpande, Basil, & Basil, 2009; Glanz et al., 1994), plant-based diets (Corrin & Papadopoulos, 2017; Lea, Crawford, & Worsley, 2006; Wyker & Davison, 2010), and food waste behaviours (Coşkun & Özbük, 2020; Graham-Rowe, Jessop, & Sparks, 2015; Pearson & Perera, 2018).</p>
<p>System 1 vs. System 2</p>	<p>A variety of theorists have divided human cognitions into two types, which could probably trace back to William James' (1890) differentiation between associative and true reasoning, or Sigmund Freud's (1913) unconscious and conscious mind. Other influential two-process models include Shiffrin and Schneider's (1977a; 1977b) automatic and controlled processing, Denes-Raj and Epstein's (1994) intuitive and rational processing, and Sloman's (1996) associative and rule-based system.</p> <p>In the Great Rationality Debate, Stanovich and West (2000) combine those similar ideas into a generic dual system theory, defining System 1 as “automatic, largely unconscious, and relatively undemanding of computational capacity” (p. 658), and System 2 as controlled and analytical. The Nobel Prize economist Daniel Kahneman (2011) further popularizes this theory, highlighting that System 1 and System 2 “respectively produce fast and slow thinking” (p. 12), and describing “System 1 as effortlessly originating impressions and feelings that are the main sources of the explicit beliefs and deliberate choices of System 2” (p. 21). The dual system theory challenges the rational choice paradigm by demonstrating how human cognitions are systematically irrational (i.e., failing to make optimal decisions), and even a-rational (i.e., involving no cost-benefit analysis).</p>

	<p>Regardless of the notable contribution it makes, this theorization is sometimes at the risk of oversimplification - the subtle distinctions between each specific two-process models in history have been overlooked (Evans, 2008). As I will discuss below, automatic processes may or may not be deemed as unconscious, and intuitive thinking does not only occur in high-speed processing.</p>
<p>Unconscious vs. Conscious Mind</p>	<p>In almost every introductory psychology textbooks, the Freudian theory of the unconscious mind would be illustrated with an iceberg metaphor - only a small proportion of our ideas and feelings are conscious, like the visible tip of an iceberg above the sea surface; most mental activities are unconscious, like the vast bulk of ice hidden beneath (Green, 2019). This metaphor helps people to grasp Freud's idea quite successfully, but leaves room for interpretation, and results in the slippery use of the term "unconscious".</p> <p>Contemporary researchers approach the "unconscious" mind with remarkably different perspectives (Bargh & Morsella, 2008). Cognitive psychologists and neuroscientists often equate unconscious information processing with subliminal stimuli processing (e.g., Greenwald, Klinger, & Schuh, 1995; Pessiglione et al., 2007; Winkielman & Berridge, 2004). The effects of subliminal primes (i.e., presenting stimuli at low energy levels, of brief durations, or with masking techniques) are shown to be much weaker than those of supraliminal ones, which makes some to conclude that the power of the unconscious mind is rather limited (Greenwald, 1992; Greenwald, Draine, & Abrams, 1996; Moore, 1982).</p> <p>Social psychologists, on the other hand, are interested in situations where the influence of a manipulation is unknown to the individual (Bargh, 1992; Nisbett & Wilson, 1977). They have thereby found evidence that social judgements and decision-making are massively influenced by mental processes of which people are unaware or "unconscious" (Gigerenzer, 2007; Hassin, Uleman, & Bargh, 2004).</p> <p>Research on embodied cognition and the CMT follows the tradition in social psychology. The physical and the linguistic stimuli in classical CMT experiments are indeed perceptually detectable (i.e., supraliminal), but the purpose of the manipulations has usually been disguised. Although I prefer to describe those effects of metaphorical thinking as "automatic", the wording "unconscious" or "non-conscious" are widely used in the literature of this field.</p>

<p>Automatic vs. Controlled Processing</p>	<p>Automatic and controlled processes differ in the level of attention and cognitive effort they demand (Kahneman, 2011; Schneider & Chein, 2003).</p> <p>Originally, this theory was derived from Shiffrin and Schneider's (1977a; 1977b) empirical studies on search and attention tasks. In its simplest form, participants were asked to memorize a set of characters or numbers, and then search them through a sequence of pages with time limits. If a page showed an item from the memory set, participants should make a positive response. If the items on a page did not match any of the memory set items, they should give no response or a negative response. Participants were randomly allocated to one of the two conditions. In the varied mapping (VM) condition, a character or number could be the target in one trial, but become a distractor in the next trial. In the consistent mapping (CM) condition, the memory set never overlaps with the distractor set, so a given stimulus was always associated with the same correct response. After hundreds of training trials, people in the CM condition started to respond much faster and more accurately than those in the VM condition. Further investigations revealed that task performance was improved in the CM condition as people gradually learnt the associations and shifted to an "automatic detection" mode.</p> <p>As per Shiffrin and Schneider's (1977a) definition, "an automatic process operates through a relatively permanent set of associative connections", and "any new automatic process requires an appreciable amount of consistent training to develop fully" (p. 2). Once developed, an automatic process "nearly always becomes active in response to a particular input configuration," and "is activated automatically without the necessity for active control or attention by the subject" (p. 2). By contrast, controlled processes are "activated under control of, and through attention by, the subject", and "are therefore tightly capacity-limited" (pp. 2-3).</p> <p>Later on, scholars have applied this model to mental processes that are not experimentally induced. Metaphorical thinking, which functions through associations acquired from either consistent bodily experiences or repeated language use, is a classic type of automatic processes (Gibbs & Chen, 2018; Morewedge & Kahneman, 2010). Dietary practices are also found to be largely automatic (e.g., people pay little attention to how much food they eat, and make food choices based on habits and convenience), which suggests a good compatibility between metaphors and dietary interventions (Cohen & Farley, 2008; Liu et al., 2014; Van Kesteren & Evans, 2020).</p>
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	<p>In my understanding, being relatively “fast” is a descriptive feature of automatic processing, not a defining one. People could rely on automatic processing even under no time pressure (Evans, 1996; Tversky & Kahneman, 1983), and the level of reliance varies across individuals and contexts (De Neys, 2006; Epstein, Pacini, Denes-Raj, & Heier, 1996; Phillips, Fletcher, Marks, & Hine, 2016).</p>
<p>Intuitive vs. Rational Thinking</p>	<p>Intuitions are automatic by nature, as they stem from associative patterns learnt from past experience, and are swiftly activated without any cognitive effort (Kahneman, 2011). Intuitive thinking has been blamed for causing a range of “cognitive biases”, i.e., deviations from the normatively correct response or the “rational choice” (Evans, 2010; Phillips et al., 2016). One of such phenomena was firstly demonstrated by Denes-Raj and Epstein (1994): in a multi-trial game where participants could win \$1 for every red bean they got, people frequently drew from the bowl which had a greater absolute number, but a smaller proportion, of red beans (e.g., 7 in 100 as compared to 1 in 10). They reported afterwards that they “knew” the odds were against them, but “felt” that they had a better chance of winning when picking from the bowl with more winning (red) beans.</p> <p>An important takeaway from this line of research is that controlled processes are not necessarily “rational”. Intuitive and rational thoughts can coexist in a decision-making process and jointly shape the final behaviour. It hence resonates with the proposition of promoting sustainable healthy diets through (automatic) metaphorical thinking - consumers are more likely to make a rational choice if their intuitions are not against it.</p>
<p>Implicit vs. Explicit Test</p>	<p>In social psychology papers, the term “implicit” is often used interchangeably with “automatic” and “unconscious”. The wording comes from research on implicit learning (Reber, 1976) and implicit associations (Greenwald, McGhee, & Schwartz, 1998). The present thesis mainly takes it to designate the implicit association test (IAT). Although there are debates on whether the IAT effects are absolutely unconscious (Gawronski, Hofmann, & Wilbur, 2006; Hahn, Judd, Hirsh, & Blair, 2014), researchers generally agree that the IAT measures automatic associations between concepts (Karpinski & Hilton, 2001; Nosek, Greenwald, & Banaji, 2007), which makes it a useful tool for studying conceptual metaphors (Bar-Anan, Liberman, & Trope, 2006; Rozin, Hormes, Faith, & Wansink, 2012). Preferences for metaphorically congruent or incongruent stimuli are directly asked and answered in explicit tests, but are hinted by differences in reaction time in an IAT.</p>

5.3. Concepts associated with cross-cultural psychology

<p>Culture</p>	<p>Culture is a notoriously fuzzy term (Spencer-Oatey & Franklin, 2012). Historically, researchers from multiple disciplines have provided hundreds of different definitions for this concept, each pertaining to some special aspects they have studied, such as values, rules of actions, traditions, organizations, artefacts, symbols, ideas, habits, social learning and so on (Kroeber & Kluckhohn, 1952). Psychological studies on culture have disproportionately focused on individualism vs. collectivism (Cohen, 2009; Fatehi, Priestley, & Taasobshirazi, 2020; Fiske, 2002; Miller, 2002). Correspondingly, psychologists tend to define “culture” as shared thinking patterns, exemplified by Hofstede’s (1984) famous proposition that culture is “the collective programming of the mind which distinguishes the members of one group or category from another” (p. 21).</p> <p>The current thesis does not endorse this definition, because the embodied cognition approach is against treating the mind as abstractions independent of the body and the material environment. I would, instead, adopt Tyler’s (1871) broader viewpoint that culture is a “complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society” (p. 1). It means that discussions about cultural differences in this thesis would not be narrowed down to Hofstede’s cultural dimensions, but would look at more concrete cultural products (e.g., oral tales, books and movies), habitual behaviours (e.g., language use, writing directions), and specific values and attitudes (e.g., familism, cultural image of animals).</p>
<p>Familism</p>	<p>Familism is a recurring theme in Asian studies (Ochiai & Hosoya, 2014), and is defined by Western researchers as the tendency to prioritize the needs of family members over one’s own needs (Campos, Ullman, Aguilera, & Dunkel Schetter, 2014; Schwartz, et al., 2010). Having grown up in mainland China, I do not think this definition captures familism in my culture particularly well. Chinese familism concerns taking family as more important and fundamental than any other type of social group, which I will further explain in Chapter 5. The available familism scales in the literature are strongly influenced by the Western conceptualization of familism, and often overstress the individual’s submission to the family (e.g., Steidel & Contreras, 2003). Nevertheless, developing a new measurement of familism is way beyond the scope of this thesis, so I could only propose familism as a potential reason for the cultural differences observed, without actually measuring it.</p>

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Chapter 2

The Peak of Health: The Vertical Representation of Healthy Food

Abstract

As expressed by the “Healthy is Up” metaphor, the conceptual metaphor theory argues that the representation of health is commonly associated with high verticality because, typically, people stay upright when they are healthy whereas illness may force them to lie down. Along this line of argument, this research is the first to empirically explore the metaphorical representation of healthy food in terms of verticality. Across five experiments ($N = 714$), this article first demonstrates that people are faster to pair healthy food with up than down in an implicit association test (Study 1, supporting a metaphorical congruency effect). Then, it shows that people associate healthy food with high verticality and unhealthy food with low verticality by placing healthy food up high and unhealthy food low down along the vertical axis, and by preferring a food pyramid that depicts healthy food at the top rather than at the bottom (Studies 2a, 2b and 3, supporting an abstract-to-concrete effect). Last, this research finds that people judge a food product as healthier when it is pictured from an upward-looking angle than when it is pictured from a downward-looking angle (Study 4, supporting a concrete-to-abstract effect). Further analyses test the interaction between individual differences in self-control and the effects of the “Healthy is Up” metaphor in

Studies 2a, 2b, 3 and 4. The article concludes with a discussion of the theoretical and practical implications of this research.

Keywords

Communication; Healthy food; Metaphor; Verticality³

³ This chapter is a published paper: Wang, F., & Basso, F. (2021). The peak of health: The vertical representation of healthy food. *Appetite*, 167, 105587.

1. Introduction

In the current obesogenic environment, increasing healthy food intake is one of the main public policy objectives (e.g., de Ridder, Kroese, Evers, Adriaanse & Gillebaart, 2017; Folkvord, 2020; Petit et al., 2016). Various solutions, ranging from behavioural interventions to education have been suggested thus far (e.g., Cadario & Chandon, 2020; Murimi et al., 2017; Robinson, Fleming, & Higgs, 2014). Evidence shows that conceptual metaphors can be an efficient technique to improve public health communication (e.g., Hauser & Schwarz, 2015; Landau, Arndt, & Cameron, 2018; Landau et al., 2019) and healthy choice (e.g., Dong, Huang, & Labroo, 2020; Hung & Labroo, 2011). For instance, the bodily experience of firming muscles has the metaphoric benefit of strengthening willpower and self-regulation, and may increase the purchase of healthy food and drinks (Hung & Labroo, 2011). Research also showed that high-pitched music metaphorically evoked morality thoughts, which increased participants' likelihood to engage in healthy activities considered virtuous and moral (Dong et al., 2020).

However, whereas communicating with metaphors may help promote healthier choices, to our knowledge, the metaphorical representation of health in terms of verticality has never been empirically investigated. The purpose of this article is to document this metaphorical representation and its applications to healthy food consumption. Verticality, defined as “the position of a physical object along the vertical dimension”, is a primary embodied experience underlying many abstract mental constructs through metaphorical thinking (Cian, 2017, p. 444; Lakoff & Johnson, 1999; Schnall, 2014). Past research in psychology has documented a wide range of abstract concepts (e.g., valence, concreteness, power) metaphorically associated with verticality in people's minds, and these vertical metaphors

have been shown to shape thoughts and actions in various ways (e.g., Aggarwal & Zhao, 2015; Meier & Robinson, 2004; Schubert, 2005; Sundar & Noseworthy, 2014; van Rompay, van Hoof, Rorink & Folsche, 2019).

The present research investigates how the metaphorical (in)congruence between verticality and healthy food influences processing speed and consumer behaviour, how vertical cues affect health-related judgments about food and vice versa, and how individual differences in self-control may change people's responsiveness to the metaphor "Healthy is Up". In the next section, we will discuss the conceptual foundations of the metaphorical connection between healthy food and high verticality and posit our hypotheses. We will then present a series of five experimental studies testing them, and conclude by discussing the main contributions of this work and future research avenues.

2. Theoretical background

2.1. The conceptual metaphor "Healthy is Up"

In Western philosophy, metaphors are traditionally considered as rhetoric devices (Kirby, 1997). Inspired by an embodied approach of the mind, Lakoff and Johnson (1980) contest this traditional viewpoint and originally propose that metaphors are deeply embedded in our cognitive structure, allowing us to make sense of an abstract concept (i.e., the target domain) in terms of a seemingly unrelated concrete concept (i.e., the source domain) representing certain sensorimotor experience. Those cross-domain conceptual mappings in our cognitive systems emerge automatically from our direct interactions with the physical world, where non-sensorimotor experiences in the target domains regularly co-occur with the sensorimotor experiences in the source domains (Grady, 1997; Lakoff & Johnson,

1999). Through the process of scaffolding (Williams, Huang, & Bargh, 2009), it is proposed that early pairings between a sensorimotor experience (e.g., up) and a subjective experience (e.g., health) are then used by adults to represent the concepts. For instance, as expressed by the “Healthy is Up” metaphor, Lakoff and Johnson (1980) argue that health is associated with up and sickness is associated with down in language (e.g., “he is at the peak of health”, “they felt under the weather”) because we share the physical experiences that healthy people typically stay upright while serious illness forces us to lie down.

This core claim of the conceptual metaphor theory, namely that people not only speak metaphorically but also think metaphorically, is supported by an accumulating body of empirical research in embodied cognition during the past two decades (Casasanto & Bottini, 2014; Landau, Meier, & Keefer, 2010). Conceptual metaphors have been found to influence attention, memory, social judgment and other higher cognitive processes “even in contexts where linguistic expressions of the relevant metaphors are not made salient” (Landau et al., 2010, p. 1048). The most common line of evidence is that people have better performance (e.g., shorter response time or a higher accuracy rate) in tasks where abstract and concrete concepts conveyed by the stimuli are metaphorically congruent (vs. incongruent). For example, as expected from the “Good is Up” metaphor, Meier and Robinson (2004) demonstrated in a Stroop-like task that participants categorized positive words faster when the words were in a higher rather than a lower position, whereas they categorized negative words faster when the words were in a lower rather than a higher position. Similarly, as expected from the “Power is Up” metaphor, Schubert (2005) showed that people spent less time responding and committed fewer errors in a categorization task when the powerful groups were placed up and the powerless groups were placed down, as

compared to when the powerful groups were placed down and the powerless groups were placed up. Those findings attest that the metaphorically congruent stimuli are easier to process than the metaphorically incongruent ones, suggesting that people's pre-existing expectations for the stimuli are in line with the "Good is Up" metaphor and the "Power is Up" metaphor. Accordingly, we hypothesize a metaphorical congruency effect on processing speed for the metaphor "Healthy is Up":

H₁: A match (vs. mismatch) between verticality and healthy food will lead to faster response speed.

The effects of metaphorical congruency on processing fluency are not only directly reflected in processing speed, but also in downstream attitudes and judgments. Because humans have limited cognitive capacity, stimuli demanding less mental effort, i.e., that can be processed more fluently, are usually preferred (Fiske & Taylor, 1984; Garbarino & Edell, 1997; Reber, Schwarz, & Winkielman, 2004). It has been found that the same statements were judged more positively when presented in colours that made them easier to read against a white background (Reber & Schwarz, 1999), and that repeated exposure to a stimulus facilitated fluent processing and fostered positive affective responses based on both self-reported and psychophysiological evidence (Harmon-Jones & Allen, 2001; Whittlesea, 1993; Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Consistently, the metaphorical congruence between abstract and concrete concepts improves processing fluency and produces more favourable attitudes and behavioural intentions towards the stimuli. Applied to consumer research, Sundar and Noseworthy (2014) demonstrated with the vertical metaphor "Power is Up" that consumers were more willing to purchase from a powerful brand when its logo was located in a higher (vs. lower) visual field, but more

willing to purchase from a less powerful brand when its logo was in a lower (vs. higher) visual field. Van Rompay and colleagues (2019) found that presenting consumers in a Dutch coffee house with an ad portraying verticality (vs. horizontality) cues metaphorically congruent (vs. incongruent) with economic power enhanced luxury perceptions, evaluations of taste intensity as well as purchase intention. In the context of this research, it is therefore hypothesized that:

H₂: A match (vs. mismatch) between verticality and healthy food will generate more positive consumer behavioural intentions.

2.2. Bidirectionality of metaphorical associations

Originally, Lakoff and Johnson (1980) describe metaphorical thinking as a unidirectional process, from the concrete “source domain” (e.g., verticality) to the abstract “target domain” (e.g., health). Empirical evidence however suggests that the psychological consequences of metaphorical mappings are often bidirectional, and thus may encompass concrete-to-abstract but also abstract-to-concrete effects (Lee & Schwarz, 2012). Bidirectional effects have been observed in many studies testing various conceptual metaphors such as “Social Suspicion is Fishy Smell” (Lee & Schwarz, 2012), “Affection is Warmth” (Zhong & Leonardelli, 2008) or “Hope is Light” (Dong, Huang, & Zhong, 2015). In relation to vertical metaphors, when testing the “Power is Up” metaphor, prior research found that more powerful leaders were placed in higher locations on the chart representing the organizational structure (abstract-to-concrete effect), and, conversely, that leaders located higher in the organization chart were perceived as more powerful (concrete-to-abstract effect; Giessner & Schubert, 2007). Likewise, when testing the “Rationality is

Up”/“Emotion is Down” metaphor, research showed that stimuli with rational connotations are placed higher on a screen than stimuli with emotional connotations (abstract-to-concrete effect) and, conversely, that ambiguous stimuli are perceived as having a more rational meaning when they are presented high rather than low on a website (concrete-to-abstract effect; Cian, Krishna, & Schwarz, 2015).

In light of this body of evidence, we investigate the bidirectionality of the “Healthy is Up” metaphor in the current research, and hypothesize that this metaphor has both abstract-to-concrete (H₃) and concrete-to-abstract (H₄) effects:

H₃: Healthy food is more likely to be placed in a higher position.

H₄: An upward-looking camera angle will increase the perceived healthiness of food.

2.3. Individual differences in self-control: a potential predictor

Although relatively less examined, individual differences in personality traits have been shown to interact with the effects of conceptual metaphors on intentions, attitudes and behaviour. Literature indicates that the accessibility of a metaphorical association between two concepts can be significantly influenced by individual predispositions (Landau et al., 2010). Some abstract concepts can be less relevant to certain individuals, who are thus less likely to think about those concepts, and to draw on concrete bodily experiences to understand them metaphorically (Meier, Sellbom, & Wygant, 2007b). For instance, Meier, Sellbom, and Wygant (2007) found that the metaphorical congruence between morality and verticality affected processing speed among participants low in psychopathy, but not among participants high in psychopathy. In other words, psychopaths, who were

characterized by being amoral (Cleckley, 1941; O’Kane, Fawcett, & Blackburn, 1996), were less responsive to the “Moral is Up” metaphor. A similar effect of dispositional individual differences was observed for the metaphor “Divinity is Up”, such that people high (vs. low) in religious belief showed a stronger tendency to implicitly associate God-related words with up and Devil-related words with down (Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007a).

Within the domain of health communication, prior research also found that muscle firming, which facilitated self-control by firming willpower, increased the purchase of healthy food and beverages, among health-oriented participants but not among indulgence-oriented participants (Hung & Labroo, 2011). In other words, the accessibility of the metaphorical association (between firming muscles and exerting willpower) was predicted by participants’ (health) goals. Similarly, drinking products with a slim package shape (vs. a wide package shape), which simulated a slim body shape, and thus metaphorically cued healthiness, were evaluated more positively and got chosen more often by consumers who had a health-related shopping goal but not by consumers who had a hedonic shopping goal (van Ooijen, Franssen, Verlegh, & Smit, 2017).

Following this line of thought, the current research tests whether trait self-control differentiates sensitivity to the “Healthy is Up” metaphor. Trait self-control is defined as the ability “to override or change one’s inner responses, as well as to interrupt undesired behavioural tendencies (such as impulses) and refrain from acting on them” (Tangney, Baumeister, & Boone, 2004, p. 274). Accordingly, self-control positively predicts a wide-range of health-promoting behaviours, such as consuming less alcohol and junk food, exercising regularly and maintaining sufficient sleep, among a variety of populations

(Frieese & Hofmann, 2009; Hagger, Gucciardi, Turrell, & Hamilton, 2019; Kroese, Evers, Adriaanse, & de Ridder, 2016; McCullough & Willoughby, 2009; Crescioni et al., 2011). In the context of this research, people who are high in trait self-control should think about the concept of health through the embodiment of verticality more often and thereby endorse the “Healthy is Up” metaphor more strongly than those who are low in self-control and are less concerned about their health. Formally, we hypothesize that:

H₅: The mental association between verticality and healthy food will be stronger among people who are high in self-control.

2.4. Overview of the studies

We test these five hypotheses across five experiments. Study 1 focuses on the basic effect of metaphorical congruency on processing speed (H₁), while Studies 2a, 2b and 3 investigate the abstract-to-concrete effect (H₃) and Study 4 examines the concrete-to-abstract effect (H₄). The relationship between self-control and endorsement of the “Healthy is Up” metaphor is explored in Studies 2a, 2b, 3 and 4 (H₅), and Study 4 further examines the metaphorical congruency effect on consumer behavioural intentions (H₂).

It should be noted that the effects of the “Healthy is Up” metaphor are usually compatible with another comprehensively studied vertical metaphor, “Good is Up”, since the concept of health is positive in nature (Gibbs, 2014). One may argue that any influence that the “Healthy is Up” metaphor exerts on processing fluency, perceptual judgments or consumer behaviour, is just a reflection of the general associations between valence and verticality. Therefore, to rule out “Good is Up” as an alternative explanation and show that the

“Healthy is Up” metaphor has distinct effects, we implement various strategies in each study.

2.5. Ethics statement and data availability

This series of studies received the approval of the Department of Psychological and Behavioural Science (DPBS) Ethics Committee of the London School of Economics (LSE). All participants gave informed consent before taking part in a study, and the privacy rights of human subjects have always been observed. The full dataset has been made available on the Open Science Framework at <https://osf.io/2uwha/>.

3. Study 1

Study 1 aimed to establish the mental association between health and verticality expected from H_1 in an implicit association test (IAT). The IAT is a reaction time task (Greenwald, McGhee, & Schwartz, 1998) that has been frequently used to determine “the automaticity of a metaphorical connection” in psychology (Cian et al., 2015, p. 6). More specifically, we asked participants to perform an IAT with healthy/unhealthy food pictures and words referring to verticality on the web-based behavioural research platform *Gorilla*.

3.1. Methods

Participants. Prior to data collection, the required sample size was computed based on a power analysis (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007). With $\alpha = 0.05$ and power = 0.80, the projected sample size needed to detect a medium effect size ($d = 0.50$) for a one-sample t -test difference from a constant was at least $N = 34$. We oversampled to enable a robust analysis of the order effect. One hundred participants from the United States

were recruited online through Amazon's Mechanical Turk (MTurk; Buhrmester, Kwang, & Gosling, 2016) and completed the study in exchange for monetary compensation. Of those, nine were excluded from the analysis because they produced more than 10% of trials with latencies less than 300 milliseconds, which indicated careless responding (Greenwald, Nosek, & Banaji, 2003). Thus, the final sample size for this study was 91 (Female = 34, Male = 56, Other = 1; $M_{\text{age}} = 38$, $SD_{\text{age}} = 12$).

Procedure. Following the standard IAT procedure (Greenwald et al., 2003), participants were presented with a series of words or images to classify into one of four groups (see Figure 1), one pair of the groups comprising the target categories (healthy or unhealthy) and the other pair comprising the attribute categories (up or down). Each stimulus (i.e., a word or an image) belonged to only one of those categories.

The stimuli for the attribute categories (up vs. down) were two sets of words matched on length and frequency drawn from previous research on vertical metaphors (Cian et al., 2015; Meier et al., 2007a): up (high, top, over, above, ascend), and down (low, bottom, under, below, descend).

The stimuli for the target categories (healthy vs. unhealthy) consisted of 10 food pictures from Food-Pics_Extended, an image database for eating and appetite research (Blechert, Lender, Polk, Busch, & Ohla, 2019). We selected the pictures #212 (veggie mix with dip), #213 (crisp bread with cottage cheese), #248 (blueberries), #325 (fruit salad) and #490 (potatoes and corn) for the healthy food category; and the pictures #46 (French fries), #150 (popcorn), #664 (ice cream in waffle bowl), #685 (pizza) and #880 (gummy bears) for the unhealthy food category, for two main reasons. First, because the pictures representing the

healthy and unhealthy categories were deemed similar in terms of shape after visual inspection (see Figure 2 for all the stimuli). Second, because, on the basis of the normative rating data provided by Bleichert et al. (2019), Mann-Whitney tests showed that both categories did not significantly differ in terms of valence “characterized by how negatively or positively” female and male omnivore participants “viewed the object; that is, whether they found it was repulsive or attractive” rated on 8-cm visual analogue scales (VAS) ranging from “very negative” to “very positive” (unhealthy: $M = 56.18$, $SD = 11.06$; healthy: $M = 59.76$, $SD = 12.35$; $U = 10.00$, $Z = -0.52$, $p = 0.690$). Additional analyses also found that the total kcal value for the depicted portion was significantly higher for the unhealthy food ($M = 422.64$, $SD = 266.85$) than for the healthy food category ($M = 118.36$, $SD = 167.21$; $U = 2.00$, $Z = -2.19$, $p = 0.032$).

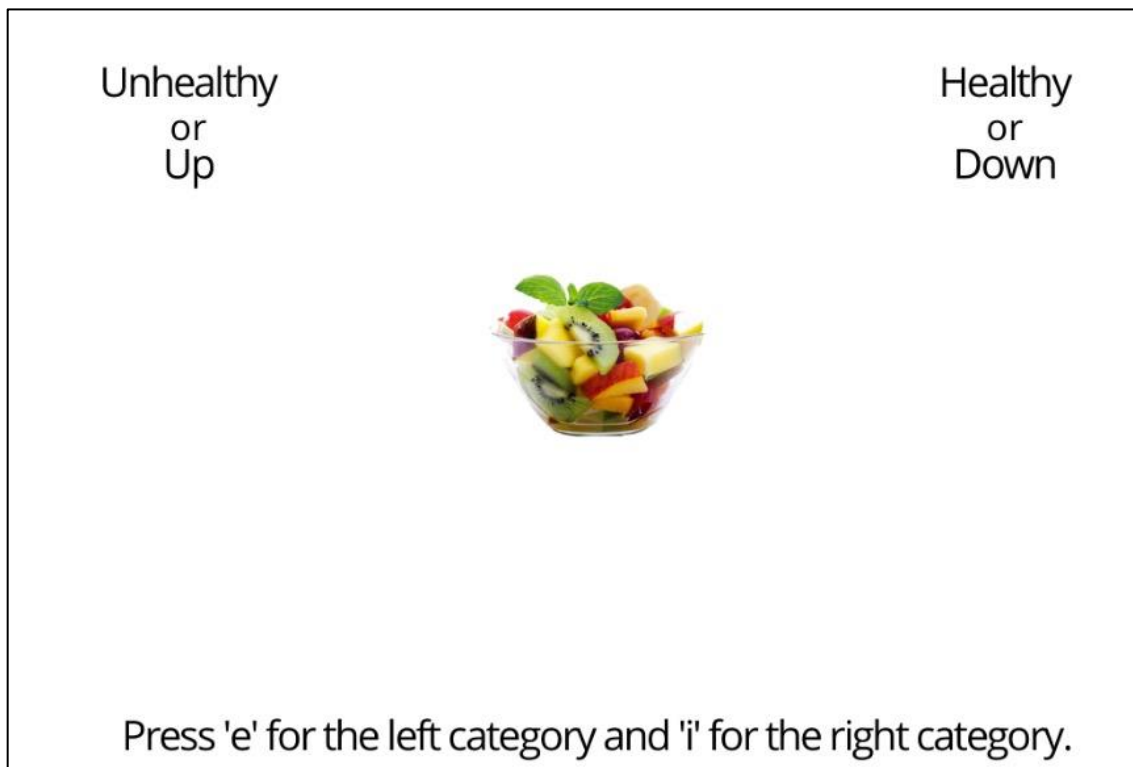
As per the standard IAT procedure (Greenwald et al., 2003), participants were directed to complete 7 blocks, each of which was composed of 20 or 40 trials (see Table 1). Half of the participants received the training block 1 and the congruent blocks (3 & 4) first, while the other half received the training block 5 and the incongruent blocks (6 & 7) first. The position of the training block 2 was the same for all participants.

Table 1. The sequence of trial blocks for the IAT on the association between health and verticality

Block n°	Block	N° of trials	Left key	Right Key
1	Training	20	Healthy	Unhealthy
2	Training	20	Up	Down
3	Congruent 1	20	Healthy or Up	Unhealthy or Down
4	Congruent 2	40	Healthy or Up	Unhealthy or Down
5	Training	20	Unhealthy	Healthy
6	Incongruent 1	20	Unhealthy or Up	Healthy or Down
7	Incongruent 2	40	Unhealthy or Up	Healthy or Down

Note. For half of the participants, the positions of blocks 1, 3, and 4 have been switched with those of blocks 5, 6, and 7, respectively.











Figure 1. The IAT screen (blocks 6 & 7) in Study 1.



As depicted in Figure 1, throughout the experiment, category labels (“Healthy”-“Unhealthy” and/or “Up”-“Down”) were presented on the upper left and right corners of the computer screen. In each trial, participants saw a stimulus in the centre of the screen and their task was to classify the given stimulus into the left or the right category by pressing “E” (left key) or “I” (right key) on their keyboard as quickly and accurately as possible.

In the training block 1, participants were only asked to discriminate target images (left key for “Healthy”, right key for “Unhealthy”). In the training block 2, participants were only asked to discriminate attribute words (left key for “Up”, right key for “Down”). In two congruent blocks (3 & 4), target images (“Healthy” or “Unhealthy”) and attribute words (“Up” or “Down”) were randomly presented in each trial. Participants should press the same key “E” for “Healthy” images and “Up” words (left key), and the same key “I” for “Unhealthy” images and “Down” words (right key). A red cross would appear if participants pressed the wrong key, and they had to press the correct key to fix the error. The response mappings were congruent with the “Healthy is Up” metaphor in these two blocks. Blocks 5-7 were identical to blocks 1, 3, and 4, except that the locations of the target categories will be reversed (left key for “Unhealthy”, right key for “Healthy”). In this way, the response mappings became incongruent with the “Healthy is Up” metaphor in the last two blocks (6 & 7). All the stimuli were presented twice in each block and in a randomized order.

Figure 2. The IAT stimuli in Study 1.

Healthy	Unhealthy	Up	Down
		high	low
		top	bottom
		over	under
		above	below
		ascend	descend

3.2. Results

Complying with Greenwald and colleagues' (2003) improved scoring algorithm, the reaction time data (*RT*, measured in milliseconds) from the congruent blocks (3 & 4) and the incongruent blocks (6 & 7) were used to compute the IAT *D* score for each participant.

The following formula was applied to calculate each *D score* = $[(RT_{\text{incongruent}_6} - RT_{\text{congruent}_3})/SD_1 + (RT_{\text{incongruent}_7} - RT_{\text{congruent}_4})/SD_2]/2$.

We calculated *RT* for each block by averaging response latencies for all trials in that block. Trials with response latencies above 10,000 milliseconds and participants whose latencies were less than 300 milliseconds in more than 10% of trials were eliminated from the dataset.

SD_1 was the pooled standard deviation for all trials in the congruent block 3 and the incongruent block 6. SD_2 was that for the congruent block 4 and the incongruent block 7.

A one-sample *t*-test showed that participants' average *D* score was significantly greater than zero ($M = 0.39$, $SD = 0.41$, $t(90) = 9.10$, $p < 0.001$, $d = 0.95$, $95\% CI = [0.31, 0.48]$), indicating, as expected from H_1 , that participants responded faster in the congruent blocks where "Healthy" is paired with "Up" than in the incongruent blocks where "Healthy" is paired with "Down".

Further to this, we also tested the order effect by comparing the *D scores* of participants who received the congruent blocks first ($n = 46$) with those of participants who received the incongruent blocks first ($n = 45$). An independent sample *t*-test yielded a significant order effect ($t(89) = 5.39$, $p < 0.001$, $d = 1.13$, $M_{diff} = 0.41$, $95\% CI = [0.26, 0.55]$). The average *D score* was significantly higher among participants who received the congruent blocks first ($M = 0.59$, $SD = 0.36$, $95\% CI = [0.49, 0.70]$), but still positive for participants who received the incongruent blocks first ($M = 0.19$, $SD = 0.36$, $95\% CI = [0.08, 0.29]$), which indicated that, despite the order effect, results remained aligned with our hypothesis.

3.3. Discussion

The results of Study 1 confirmed that a metaphorical congruence (vs. incongruence) between verticality and healthy food stimuli accelerated processing speed (supporting H_1).

However, the confounding effect of the “Good is Up” metaphor could not be completely ruled out as the category labels “Healthy” - “Unhealthy” still entailed valence (Lakens, 2012), even though the valence of healthy/unhealthy food stimuli was controlled. This limitation is addressed in the following studies.

4. Study 2a

Study 2a tested whether, as posited by H₃, healthy food was more likely than unhealthy food to be placed in a higher position, investigating the abstract-to-concrete effect of the “Healthy is Up” metaphor, and whether, as posited by H₅, this association was predicted by self-control. A web-based vertical placement task was adopted to achieve these goals.

4.1. Methods

Participants. Prior to data collection, the required sample size was computed based on a power analysis (G*Power 3.1; Faul et al., 2007). With $\alpha = 0.05$ and power = 0.80, the projected sample size needed to detect a medium effect size ($g = 0.30$) for a sign test was at least $N = 20$. We oversampled to allow an exploratory analysis of the association between trait self-control and the vertical placement test results of the metaphor “Healthy is Up”. One hundred participants from the United States were recruited online through MTurk and completed the study in exchange for monetary compensation. Unique Turker (<https://uniqueturker.myleott.com/>) was used to ensure that all participants were unique and different from those who took part in Study 1, and this study was collected via *Qualtrics*. Participants completed an attention check (“For quality control purposes, please select ‘Not at all’ ”) which was randomly inserted among the questions measuring trait self-control, and a seriousness check question (Aust, Diedenhofen, Ullrich, & Musch, 2013)

at the end of the survey (“It would be very helpful if you could tell us at this point whether you have taken part in this study seriously, so that we can use your answers for our scientific analysis, or you were just clicking through without reading the instructions and survey questions? Please answer honestly - you will receive the payment regardless of your answer”). Overall, five participants were excluded for the following reasons: failed the attention check ($n = 1$), did not pass the seriousness check ($n = 4$); leaving 95 participants (Female = 45, Male = 49, Other = 1; $M_{\text{age}} = 35$, $SD_{\text{age}} = 12$).

Procedure. We used a web-based adaptation of Casasanto’s (2009) paper-and-pencil diagram task for vertical metaphors. The original task was developed to test the metaphor “Good is Up”, where participants were given information about how a cartoon figure liked or disliked two animals, and then instructed to draw one animal in each of two boxes located either above or below the cartoon figure. In the present study, we asked participants to drag and drop the stimuli into the boxes instead of drawing them in order to make the task easier in the online setting (see Figure 3). The stimuli were a fruit salad picture and an ice cream picture similar in valence and visual characteristics from Study 1 and their presentation order was randomized and counterbalanced across participants. As in Casasanto (2009), participants were presented with two boxes with a cartoon figure in the middle and read the following instructions:

“The cartoon character depicted below loves fruit salad and ice cream. He thinks that fruit salad is healthier than ice cream but that ice cream is tastier than fruit salad. Your task is to place the picture of fruit salad into the box that best represents healthy food, and the picture of ice cream into the box that best represents tasty food.”

To ensure that participants' judgments were not confounded by the temporal order in which they read about the two stimuli, half of the participants were randomly assigned to another version of the instructions where all the descriptions about ice cream were mentioned before those about fruit salad. We also deliberately contrasted "healthy" with "tasty" to control for valence in the instructions, as the opposition between healthiness and tastiness of food was shown to be intuitive for Americans (Raghunathan, Naylor, & Hoyer, 2006).

After completing the vertical placement task, participants were asked to evaluate the healthiness and tastiness of the fruit salad picture and the ice cream picture on two 7-point scales ("How healthy do you think this dessert is?"; 1 = "Very unhealthy"/4 = "Neutral"/7 = "Very healthy"; "How tasty do you think this dessert is?"; 1 = "Not at all tasty"/4 = "Neutral"/7 = "Very tasty"). To control for the valence of the stimuli, participants were also asked to evaluate the valence of the fruit salad picture and the ice cream picture on the following 7-point scale adapted from prior literature (Gottwald, Elsner, & Pollatos, 2015; Sultson, Vainik, & Kreegipuu, 2019: "How much do you like this dessert?" (1 = "Strongly dislike"/4 = "Neutral"/7 = "Strongly like"). The presentation order of the two pictures was counterbalanced across participants and that of the three questions was randomized for each picture.

Eventually, before collecting the demographic data, the seriousness check question and comments, we required participants to fill in the 13-item Brief Self-Control Scale (BSCS; Tangney et al., 2004), in which they rated how much the given statements characterized themselves (e.g., "I am good at resisting temptation", "I have a hard time breaking bad habits" [reverse coded], "Sometimes I can't stop myself from doing something, even if I know it is wrong" [reverse coded]; 1 = "Not at all"/5 = "Very much"). Following Tangney

and colleagues' (2004) initial proposal as well as Lindner, Nagy, and Retelsdorf's (2015) suggestions, we treated the BSCS as a unidimensional measure and averaged the thirteen items to form a single composite score for trait self-control (Cronbach's $\alpha = 0.85$).

4.2. Results

Manipulation check. Paired-samples *t*-tests demonstrated that the fruit salad (healthiness: $M = 6.23$, $SD = 1.31$; tastiness: $M = 5.82$, $SD = 1.13$) was perceived as significantly healthier ($t(94) = 20.23$, $p < 0.001$, $d = 2.08$, $M_{\text{diff}} = 3.93$, $95\% CI = [3.54, 4.31]$) but less tasty ($t(94) = -4.23$, $p < 0.001$, $d = -0.43$, $M_{\text{diff}} = -0.57$, $95\% CI = [-0.84, -0.30]$) than the ice cream (healthiness: $M = 2.31$, $SD = 1.34$; tastiness: $M = 6.39$, $SD = 0.96$), which was in line with our intended manipulations. There was no significant difference in how much participants liked the two desserts, $t(94) = -1.31$, $p = 0.194$, $d = -0.13$, $M_{\text{diff}} = -0.22$, $95\% CI = [-0.56, 0.11]$ (fruit salad: $M = 5.80$, $SD = 1.06$; ice cream: $M = 6.02$, $SD = 1.22$), further suggesting a successful control of valence.

Vertical placement. As expected from H_3 , the majority of participants (75%) placed the fruit salad picture in the top box and the ice cream picture in the bottom box, associating healthy food rather than unhealthy food with a higher placement along the vertical axis. A sign test revealed a significant difference in the proportion of placements of the fruit salad picture up and placements of the ice cream picture up ($p < 0.001$).

Self-control. As expected from H_5 , a logistic regression with trait self-control as the independent variable and the placement of the fruit salad picture (0 = down, 1 = up; i.e., 1 = the vertical placement consistent with the "Healthy is Up" metaphor) as the dependent variable showed that higher self-control was associated with increased probability of

placing the fruit salad picture up ($\beta = 0.86$, $SE = 0.38$, $z = 2.25$, $p = 0.024$, $OR = 2.37$, 95% $CI = [1.12, 5.01]$).

4.3. Discussion




As predicted, results from Study 2a showed that people were more likely to place healthy food, as compared to tasty but unhealthy food, in a higher position along the vertical dimension (supporting H₃). Moreover, in line with our expectations, results also revealed a significant effect of self-control on the “Healthy is Up” metaphor showing that the effect of the “Healthy is Up” metaphor was stronger among people who had better self-control (supporting H₅).

Besides, Study 2a complemented Study 1 by 1) detecting the mental association between healthy food and verticality in a task with visual vertical cues rather than linguistic vertical descriptions (Meier et al., 2007a, 2007b), and 2) controlling for valence in both the stimuli and the instructions (Lakens, 2012). Nevertheless, as can be seen in Figure 3, due to technical reasons, the upper box was labelled “Box A” and the lower was labelled “Box B” in Study 2a, which could have confounded the effects of verticality. Therefore, we decided to replicate this study with those labels removed.

Figure 3. The task structure in study 2a.

The cartoon character depicted below loves fruit salad and ice cream. He thinks that fruit salad is healthier than ice cream but that ice cream is tastier than fruit salad.

Your task is to place the picture of fruit salad into the box that best represents healthy food, and the picture of ice cream into the box that best represents tasty food.

Items	Box A
	
	
	Box B

5. Study 2b

The aim of Study 2b was to eliminate the possible confounding effects of the “Box A” and “Box B” labels indicated on the top and bottom boxes. Apart from the absence of labels in this study, the experimental design was identical to Study 2a.

5.1. Methods

Participants. One hundred and forty-nine participants from the United States were recruited online through MTurk and completed the study in exchange for monetary compensation. Unique Turker (<https://uniqueturker.myleott.com/>) was used to ensure that all participants were unique and different from those who took part in other studies in this article. As in Study 2a, participants completed the measure of trait self-control (BSCS, Cronbach’s $\alpha = 0.90$) as well as the attention and seriousness check questions. Seven participants were excluded for the following reasons: failed the attention check ($n = 3$), did not pass the seriousness check ($n = 4$); leaving 142 participants (Female = 57, Male = 84, Other = 1; $M_{\text{age}} = 38$, $SD_{\text{age}} = 12$).

5.2. Results

Manipulation check. Paired-samples *t*-tests demonstrated that the fruit salad (healthiness: $M = 6.31$, $SD = 0.84$; tastiness: $M = 5.72$, $SD = 1.05$) was perceived as significantly healthier ($t(141) = 26.30$, $p < 0.001$, $d = 2.21$, $M_{\text{diff}} = 4.08$, $95\% \text{ CI} = [3.78, 4.39]$) but less tasty ($t(141) = -6.06$, $p < 0.001$, $d = -0.51$, $M_{\text{diff}} = -0.68$, $95\% \text{ CI} = [-0.90, -0.46]$) than the ice cream (healthiness: $M = 2.23$, $SD = 1.50$; tastiness: $M = 6.39$, $SD = 0.90$), which was in line with our intended manipulations. There was no significant difference in how

much participants liked the two desserts, $t(141) = -1.43$, $p = 0.156$, $d = -0.12$, $M_{\text{diff}} = -0.22$, $95\% \text{ CI} = [-0.52, 0.08]$ (fruit salad: $M = 5.70$, $SD = 1.27$; ice cream: $M = 5.92$, $SD = 1.27$), further suggesting a successful control of valence.

Vertical placement. As expected from H₃, participants generally placed the fruit salad picture in the top box and the ice cream picture in the bottom box (66%), associating healthy food rather than unhealthy food with a higher placement along the vertical axis. A sign test revealed a significant difference in the proportion of placements of the fruit salad picture up and placements of the ice cream picture up ($p < 0.001$).

Self-control. Contrary to H₅, a logistic regression with trait self-control as the independent variable and the placement of the fruit salad picture (0 = down, 1 = up; i.e., 1 = the vertical placement consistent with the “Healthy is Up” metaphor) as the dependent variable revealed no significant effect of self-control ($\beta = 0.20$, $SE = 0.22$, $z = 0.88$, $p = 0.378$, $OR = 1.22$, $95\% \text{ CI} = [0.79, 1.88]$).

5.3. Discussion

Study 2b addressed the limitations of Study 2a and provided additional support for the main effects of healthiness on the vertical placement of food, by showing that, when compared with tasty but unhealthy food, people placed healthy food in a higher position (H₃).

However, although the strengthening effect of self-control on the association between verticality and healthy food was observed, it did not reach significance, so, unlike Study 2a, Study 2b failed to support H₅. The implications of this result for this research are further developed in the general discussion section.

6. Study 3

Previous studies showed a robust association between healthiness and up at the implicit (Study 1) and explicit levels (Studies 2a and 2b). The purpose of this study was to extend this analysis by considering the implications of the “Healthy is Up” metaphor in the context of healthy eating guidelines, and more specifically in relation to the food pyramid where foods that should be consumed in greater amounts (i.e., healthy foods) are located at the bottom of the pyramid, while those that should be eaten sparingly (i.e., unhealthy foods) are at the top (Fernandez et al., 2021). In this perspective, Study 3 tested whether, as predicted by H₃, when compared to the standard version of the food pyramid where “Unhealthy is Up”, participants would favour a revised version of the pyramid that depicts healthy food at the top, in line with the “Healthy is Up” metaphor. This study also tested whether the choice of the “Healthy is Up” (vs. “Unhealthy is Up”) pyramid was predicted by self-control, as expected from H₅.

6.1. Methods

Participants. Prior to data collection, the required sample size was computed based on a power analysis (G*Power 3.1; Faul et al., 2007). With $\alpha = 0.05$ and power = 0.80, the projected sample size needed to detect a medium effect size ($g = 0.30$) for a sign test was at least $N = 20$. We oversampled to allow an exploratory analysis of the association between trait self-control and the probability of choosing the “Healthy is Up” pyramid. Two hundred participants from the United States were recruited online through MTurk and completed the study in exchange for monetary compensation. Unique Turker (<https://uniqueturker.myleott.com/>) was used to ensure that all participants were unique

and different from those who took part in other studies in this article. The study was collected via *Qualtrics*. Participants completed the trait self-control measure as in the previous studies (BSCS, Cronbach's $\alpha = 0.91$), along with the attention check and the seriousness check question. Overall, nine participants were excluded for the following reasons: failed the attention check ($n = 2$), did not pass the seriousness check ($n = 7$); leaving 191 participants (Female = 78, Male = 113; $M_{\text{age}} = 40$, $SD_{\text{age}} = 11$).

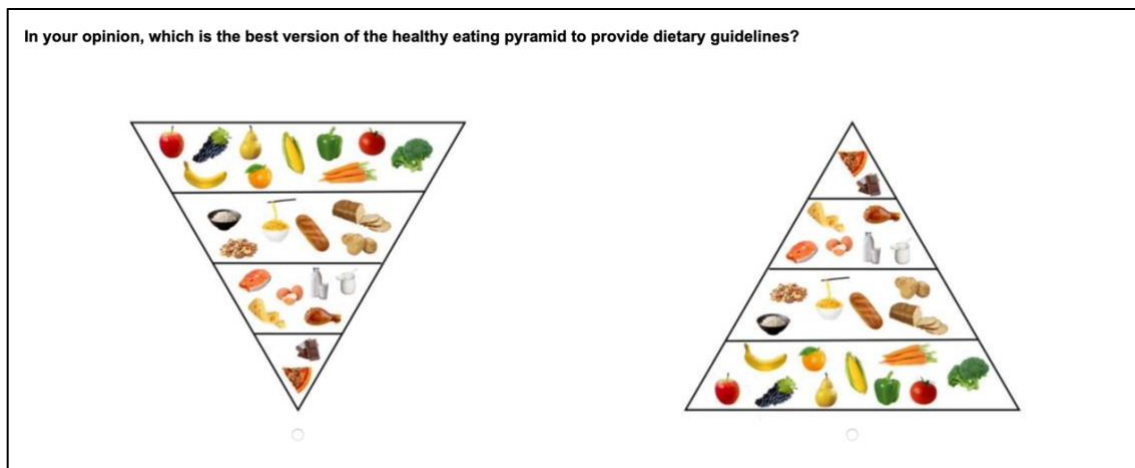
Procedure. Participants reported their level of hunger on a 100-point scale (100 = “Very hungry”) at the beginning of the survey (Loewenstein, 1996; Lozano, Crites, & Aikman, 1999), and were introduced to the task as follows: “You will see a healthy eating pyramid on the next page. A healthy eating pyramid is a recognizable nutrition guide that provides dietary guidelines in a visual format. Please look carefully at the two versions reported below for 30 s. You will be required to answer related questions afterwards.” Next, the two versions of the food pyramid were first presented in large size format, one above the other on the same webpage, for participants to be able to see that the food items displayed in each pyramid were identical. The two pyramids were adapted from the “food triangle” created by the Flemish Institute for Healthy Living in 2017⁴. The “Unhealthy is Up” pyramid classically depicted unhealthy food at the top and healthy food at the bottom, whereas the “Healthy is Up” pyramid depicted healthy food at the top and unhealthy food at the bottom. The presentation of the two versions of the food pyramid was counterbalanced, so that half of the participants viewed the “Unhealthy is Up” pyramid

⁴ <http://www.fao.org/nutrition/education/food-based-dietary-guidelines/regions/countries/belgium/en/>

above the “Healthy is Up” pyramid on their screen, and the other half viewed the “Healthy is Up” pyramid above the “Unhealthy is Up” pyramid.

Participants were then presented with the two food pyramids side by side in a smaller size format on the same screen (see Figure 4) and were asked to select one of them after reading the following instruction: “In your opinion, which is the best version of the healthy eating pyramid to provide dietary guidelines?” The presentation of each pyramid on the left or on the right side of the screen was also counterbalanced across participants to avoid potential side biases in healthy food perception (Manippa, Giuliani, & Brancucci, 2020; Romero & Biswas, 2016). Last, participants answered demographic questions, the seriousness check question, and a text box for comments, after completing the measure of trait self-control, which included the attention check question.

Figure 4. The task structure in study 3.



6.2. Results

Pyramid preference. As expected from H₃, participants were more likely to select the “Healthy is Up” pyramid in which healthy food was depicted at the top (59%) than the “Unhealthy is Up” pyramid in which unhealthy food was depicted at the top. A sign test further confirmed a significant difference in choice between the pyramids ($p = 0.014$).

Self-control. Contrary to H₅, a logistic regression with trait self-control as the independent variable and pyramid preference (0 = “Unhealthy is Up”, 1 = “Healthy is Up”) as the dependent variable revealed no significant effect of self-control ($\beta = 0.03$, $SE = 0.18$, $z = 0.16$, $p = 0.874$, $OR = 1.03$, $95\% CI = [0.72, 1.46]$). Including levels of hunger as a covariate did not substantially change the results (self-control: $\beta = 0.06$, $SE = 0.18$, $z = 0.35$, $p = 0.729$, $OR = 1.06$, $95\% CI = [0.75, 1.52]$; levels of hunger: $\beta = 0.01$, $SE = 0.01$, $z = 1.16$, $p = 0.248$, $OR = 1.01$, $95\% CI = [1.00, 1.02]$).

6.3. Discussion

Study 3 tested the “Healthy is Up” metaphor in the context of healthy eating guidelines and further supported the association between health and verticality (H₃). Indeed, people indicated that the “Healthy is Up” (vs. “Unhealthy is Up”) pyramid, where healthy (vs. unhealthy) food is depicted at the top, was the best version to provide dietary guidelines.

However, contrary to H₅, it is worthwhile to note that self-control did not significantly predict preference for the “Healthy is Up” pyramid. The implications of this result for this research are further developed in the general discussion section.

7. Study 4

Study 4 had three main purposes: 1) to examine whether a higher placement increased the perceived healthiness of food (H₄), 2) to test whether the metaphorical association between health and verticality could impact behavioural intentions (H₂), and 3) to investigate the interaction between trait self-control and the “Healthy is Up” metaphor (H₅). We employed a 2 (camera angle: upward vs. downward) * 2 (slogan: healthy vs. tasty) between-subject design where participants were required to evaluate the product (juice) featured in an advertisement.

7.1. Method

Participants. Prior to data collection, the required sample size was computed based on a power analysis (G*Power 3.1; Faul et al., 2007). With $\alpha = 0.05$ and power = 0.80, the projected sample size needed to detect a medium effect size ($f = 0.25$) for a two-way analysis of variance (ANOVA) with interaction was at least $N = 179$. We oversampled to allow an exploratory analysis of the effects of self-control. Two hundred and fifty-six participants from the United States were recruited online through MTurk and completed the study in exchange for monetary compensation. Unique Turker (<https://uniqueturker.myleott.com/>) was used to ensure that all participants were unique and different from those who took part in other studies reported in this article, and this study was collected via *Qualtrics*. Participants completed an attention check inserted into the measure of trait self-control and a seriousness check question at the end of the survey as in previous studies. They also answered a manipulation check question about the content of the advertisement that they had been exposed to (“What is the slogan of the fruit juice

advertisement that you were presented with?"; options: "Your healthy start to the morning!" "Your tasty start to the morning!" "I do not remember."; those who answered "I do not remember" and those who chose the slogan from the other condition were deemed as failing this check). An additional question asked whether they were allergic to the main ingredients of the juice product. Overall, sixty-one participants were excluded for the following reasons: failed the attention check ($n = 4$), failed the manipulation check ($n = 39$), did not pass the seriousness check ($n = 10$), allergic to the ingredients of the given juice product ($n = 8$); leaving 195 participants (Female = 110, Male = 85; $M_{\text{age}} = 37$, $SD_{\text{age}} = 10$).

Procedure. Since we used fruit juices as stimuli, participants were asked to report their level of hunger and thirst on two 100-point scales (100 = "very hungry"/"very thirsty") at the beginning of the survey (Loewenstein, 1996; Lozano et al., 1999).

Next, participants were randomly assigned to one of the four conditions, where they were exposed to an advertisement of a juice product for at least 10 seconds. In all conditions, the advertisement was made up of a fruit juice pictured on the left and a slogan on the right (see Figure 5)⁵. We manipulated verticality through the camera angle of the fruit juice picture (van Rompay, De Vries, Bontekoe, & Tanja-Dijkstra, 2012). In the upward conditions ($n = 97$), the product looked as if it was shot from an upward-looking angle,

⁵ We selected these fruit juice pictures for multiple considerations. First, a tall bottle would make the manipulation of (vertical) camera angles salient to the participants. Second, we would like to present a food product that was moderately healthy and tasty, so that it would go well with both slogans. It may not be convincing to the participants if the slogan described a can of potato chips as "healthy". Third, a moderately healthy food product could create uncertainty and leave room for different opinions. Previous studies suggested that people were more likely to be influenced by metaphorical framing when uncertain about the target (Keefer, Landau, Sullivan, & Rothschild, 2011; Landau, Keefer, & Rothschild, 2014). Indeed, consumer perceptions might not be easily changed if the target food was undoubtedly healthy (e.g., milk).

making participants feel that the product was placed in a higher location. By contrast, the product was pictured from a downward-looking angle in the downward conditions ($n = 98$), and hence its location looked relatively lower for participants. Two versions of slogans emphasizing either health or taste were also manipulated. Participants read “Healthy Me!” on the product along with the slogan “Your healthy start to the morning!” in the healthy conditions ($n = 106$), whereas they read “Tasty Me!” on the product along with the slogan “Your tasty start to the morning!” in the tasty conditions ($n = 89$). This manipulation was combined with the vertical manipulation to investigate if the metaphorical congruence (vs. incongruence) between the visual verticality conveyed by camera angles and the abstract concepts highlighted in the slogan would promote intentions to purchase and consume the product.

Participants were then asked to indicate their intentions to drink and purchase this product on two 7-point scales (“How likely would you be to drink this fruit juice if you had the opportunity?”, “How likely would you be to purchase this fruit juice?”; 1 = “Very unlikely”/4 = “Neutral”/7 = “Very likely”), after which they evaluated its healthiness and its tastiness (“How healthy do you think this fruit juice is?”, 1 = “Very unhealthy”/4 = “Neutral”/7 = “Very healthy”; “How tasty do you think this fruit juice is?”, 1 = “Not at all tasty”/4 = “Neutral”/7 = “Very tasty”). Drinking and purchase intentions were highly correlated (Spearman-Brown $\rho = 0.93$; Eisinga, Grotenhuis, & Pelzer, 2013) and were thus collapsed into one index capturing consumers’ behavioural intentions. Last, participants completed the measure of trait self-control (BSCS, Cronbach’s $\alpha = 0.88$), along with the manipulation check question, demographic questions, the seriousness check question, and a text box for comments.

Figure 5. The Stimuli used in Study 4.

	Healthy	Tasty
Upward		
Downward		

Note. These stimuli are adapted from a free 3D model provided on the website *Sketchfab*.

7.2. Results

Perceived healthiness. A two-way ANOVA with camera angle (0 = downward, 1 = upward) and slogan (0 = tasty, 1 = healthy) as between-subject factors yielded a significant main effect of camera angle on perceived healthiness of the fruit juice ($F(1, 191) = 4.71, p = 0.031, \eta^2 = 0.024, \beta = 0.41, 95\% CI = [0.03, 0.80]$). As predicted by H₄, participants evaluated the fruit juice in the upward conditions ($M = 5.37, SD = 1.20$) as healthier than in the downward conditions ($M = 4.96, SD = 1.49$). Results indicated no significant main effect of slogan ($M_{\text{Tasty}} = 5.17, SD = 1.40; M_{\text{Healthy}} = 5.16, SD = 1.35; F(1, 191) < 0.01, p = 0.954, \eta^2 < 0.001, \beta = -0.01, 95\% CI = [-0.40, 0.40]$) nor any significant interaction between camera angle and slogan on perceived healthiness of the fruit juice ($F(1, 191) = 0.52, p = 0.471, \eta^2 = 0.003, \beta = -0.28, 95\% CI = [-1.05, 0.49]$). As a robustness check,

additional analyses including levels of hunger and thirst as covariates found no substantial change in the results (see Table 2 for the regression model). Consistent with previous findings that hunger enhanced attitudes toward food (Lozano et al., 1999), level of hunger had a significant positive effect on perceived healthiness ($F(1, 189) = 4.11, p = 0.044, \eta^2 = 0.021, \beta = 0.008, 95\% CI = [0.0002, 0.0148]$). However, level of thirst did not impact how healthy participants perceived the fruit juice ($F(1, 189) = 0.50, p = 0.481, \eta^2 = 0.003, \beta = 0.003, 95\% CI = [-0.005, 0.012]$).

Perceived tastiness. A two-way ANOVA with camera angle (0 = downward, 1 = upward) and slogan (0 = tasty, 1 = healthy) as between-subject factors revealed no significant main effects of camera angle ($M_{\text{Downward}} = 5.34, SD = 1.32; M_{\text{Upward}} = 5.20, SD = 1.69; F(1, 191) = 0.49, p = 0.485, \eta^2 = 0.003, \beta = -0.14, 95\% CI = [-0.57, 0.29]$) or slogan ($M_{\text{Tasty}} = 5.19, SD = 1.64; M_{\text{Healthy}} = 5.33, SD = 1.41; F(1, 191) = 0.41, p = 0.521, \eta^2 = 0.002, \beta = 0.14, 95\% CI = [-0.29, 0.57]$) on the perceived tastiness of fruit juice. As expected, the interaction between camera angle and slogan was not significant either ($F(1, 191) = 0.38, p = 0.540, \eta^2 = 0.002, \beta = 0.27, 95\% CI = [-0.60, 1.13]$). Additional analyses including levels of hunger and thirst as covariates did not make any substantial change to the results (see Table 2 for the regression model). The effect of hunger on perceived tastiness was not significant ($F(1, 189) = 0.05, p = 0.820, \eta^2 < 0.001, \beta = -0.001, 95\% CI = [-0.01, 0.01]$) and the effect of thirst on perceived tastiness was only marginally significant ($F(1, 189) = 3.27, p = 0.072, \eta^2 = 0.017, \beta = 0.01, 95\% CI = [-0.001, 0.018]$). These results further support H₄ as they show that, in contrast with healthiness perceptions, tastiness perceptions were not influenced by the vertical placement.

Behavioural intentions. A two-way ANOVA with camera angle (0 = downward, 1 = upward) and slogan (0 = tasty, 1 = healthy) as between-subject factors showed that neither camera angle ($M_{\text{Downward}} = 4.38$, $SD = 1.85$; $M_{\text{Upward}} = 4.59$, $SD = 1.94$; $F(1, 191) = 0.60$, $p = 0.438$, $\eta^2 = 0.003$, $\beta = 0.21$, $95\% CI = [-0.33, 0.74]$) nor slogan ($M_{\text{Tasty}} = 4.33$, $SD = 1.98$; $M_{\text{Healthy}} = 4.62$, $SD = 1.82$; $F(1, 191) = 1.17$, $p = 0.281$, $\eta^2 = 0.006$, $\beta = 0.30$, $95\% CI = [-0.24, 0.83]$) had a significant main effect on participants' intentions to drink and buy the fruit juice. Unexpectedly, contrary to H₂, there was not a significant interaction between camera angle and slogan ($F(1, 191) = 0.02$, $p = 0.877$, $\eta^2 < 0.001$, $\beta = -0.08$, $95\% CI = [-1.16, 0.99]$), suggesting no effect of metaphorical congruency on consumers' behavioural intentions. The results did not change substantially when levels of hunger and thirst were controlled for (see Table 2 for the regression model). Level of thirst significantly predicted consumers' behavioural intentions ($F(1, 189) = 6.94$, $p = 0.009$, $\eta^2 = 0.035$, $\beta = 0.02$, $95\% CI = [0.004, 0.028]$), whereas level of hunger did not ($F(1, 189) = 0.02$, $p = 0.877$, $\eta^2 < 0.001$, $\beta = 0.001$, $95\% CI = [-0.01, 0.01]$).

Self-control. In order to test H₅, we regressed perceived healthiness, perceived tastiness and behavioural intentions, respectively, on camera angle manipulation, slogan manipulation, self-control and all the interactions. Camera angle ($\beta = 3.13$, $SE = 1.24$, $t = 2.53$, $p = 0.012$, $\eta^2 = 0.031$, $95\% CI = [0.69, 5.57]$) and self-control ($\beta = 0.54$, $SE = 0.26$, $t = 2.09$, $p = 0.038$, $\eta^2 = 0.023$, $95\% CI = [0.03, 1.04]$) had significant positive effects on perceived healthiness of the juice product and their interaction effect was negative and significant ($\beta = -0.78$, $SE = 0.37$, $t = -2.10$, $p = 0.037$, $\eta^2 = 0.020$, $95\% CI = [-1.51, -0.05]$). Unexpectedly, and contrary to H₅, this analysis revealed that the effect of verticality on perceived healthiness was attenuated as the level of self-control increased. No other effects

were significant and the results did not change substantially when levels of hunger and thirst were added into the models (see Table 3 for details).

Table 2. Regression models predicting perceived healthiness, perceived tastiness and behavioural intentions with camera angle manipulation, slogan manipulation and levels of hunger and thirst.

	Perceived healthiness ($R^2 = 0.06$)	Perceived tastiness ($R^2 = 0.02$)	Behavioural intentions ($R^2 = 0.05$)
Camera angle (0 = downward, 1 = upward)	0.65* [0.08, 1.21]	-0.24 [-0.88, 0.40]	0.36 [-0.42, 1.15]
Slogan (0 = tasty, 1 = healthy)	0.26 [-0.29, 0.80]	0.10 [-0.52, 0.72]	0.53 [-0.23, 1.29]
Camera angle*Slogan	-0.38 [-1.15, 0.38]	0.18 [-0.69, 1.05]	-0.26 [-1.33, 0.80]
Level of hunger	0.008* [0.0002, 0.0148]	-0.001 [-0.009, 0.007]	0.001 [-0.01, 0.01]
Level of thirst	0.003 [-0.01, 0.01]	0.01 [-0.001, 0.018]	0.02** [0.004, 0.028]

Note. Unstandardized regression coefficients and 95% CIs (in crotchets) are shown. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. Regression models predicting perceived healthiness, perceived tastiness and behavioural intentions with camera angle manipulation, slogan manipulation, self-control and levels of hunger and thirst.

	Without control variables			With control variables		
	Perceived healthiness ($R^2 = 0.08$)	Perceived tastiness ($R^2 = 0.02$)	Behavioural intentions ($R^2 = 0.03$)	Perceived healthiness ($R^2 = 0.10$)	Perceived tastiness ($R^2 = 0.04$)	Behavioural intentions ($R^2 = 0.06$)
Camera angle (0 = downward, 1 = upward)	3.13* [0.69, 5.57]	-0.68 [-3.46, 2.11]	2.76 [-0.71, 6.23]	3.18* [0.76, 5.59]	-0.65 [-3.43, 2.13]	2.82 [-0.59, 6.24]
Slogan (0 = tasty, 1 = healthy)	0.25 [-2.21, 2.70]	-0.46 [-3.26, 2.34]	1.97 [-1.52, 5.45]	0.53 [-1.91, 2.96]	-0.38 [-3.19, 2.42]	2.18 [-1.27, 5.63]
Self-control	0.54* [0.03, 1.04]	-0.19 [-0.77, 0.39]	0.45 [-0.28, 1.17]	0.53* [0.03, 1.03]	-0.18 [-0.76, 0.40]	0.46 [-0.25, 1.17]
Camera angle * Slogan	-2.04 [-5.47, 1.38]	-0.97 [-4.88, 2.94]	-3.80 [-8.67, 1.07]	-2.31 [-5.72, 1.10]	-0.87 [-4.79, 3.05]	-3.69 [-8.51, 1.14]
Camera angle * Self-control	-0.78* [-1.51, -0.05]	0.11 [-0.73, 0.95]	-0.77 [-1.81, 0.28]	-0.77* [-1.50, -0.04]	0.12 [-0.72, 0.95]	-0.75 [-1.78, 0.27]
Slogan * Self-control	-0.02 [-0.74, 0.70]	0.14 [-0.69, 0.96]	-0.49 [-1.51, 0.54]	-0.07 [-0.79, 0.65]	0.14 [-0.68, 0.97]	-0.49 [-1.51, 0.52]
Camera-angle * Slogan * Self-control	0.54 [-0.50, 1.57]	0.40 [-0.78, 1.57]	1.15 [-0.32, 2.61]	0.59 [-0.44, 1.62]	0.34 [-0.84, 1.52]	1.05 [-0.40, 2.51]
Level of hunger	/	/	/	0.007 [-0.0004, 0.0142]	-0.0004 [-0.009, 0.008]	0.001 [-0.009, 0.011]
Level of thirst	/	/	/	0.003 [-0.005, 0.012]	0.008 [-0.002, 0.018]	0.02* [0.003, 0.027]

Note. Unstandardized regression coefficients and 95% CIs (in crotchets) are shown. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

7.3. Discussion

Study 4 demonstrated that visual cues of high (vs. low) placement of a product led participants to perceive it as healthier, supporting H₄ and thereby confirming the concrete-to-abstract effect of the “Healthy is Up” metaphor. Importantly, the same visual cues of high placement did not lead participants to consider the product to be tastier, which excluded the alternative explanation that the effect of verticality on perceived healthiness was merely a spill-over of the valence-verticality association (i.e., the “Good is Up” metaphor). Tastiness has a positive valence but, unlike healthiness, is not metaphorically associated with verticality. Thus, the valence-verticality association expressed by the “Good is Up” metaphor cannot have caused the effect on perceived healthiness, otherwise an effect of similar magnitude on perceived tastiness should also be observed.

Contrary to H₂, the results provided little evidence that a mismatch (vs. match) between the visual verticality and the abstract concept made salient in an advertisement decreased consumers’ intentions to purchase and consume the product. The absence of the metaphorical congruency effect on consumer behavioural intentions may be attributed to the complex nature of our stimuli. For instance, the slogans “Tasty Me!” and “Healthy Me!” were featured at the bottom part of the juice product across all the conditions, which might have a possible confounding effect. The low placement of the slogan was incongruent with the concept of health (but not taste) and might offset the effect of our intended manipulation of metaphorical congruency (i.e., the match between the upward camera-angle and the concept of health). Future research may explore the competitive or accumulative effects of different types of vertical cues on abstract concept processing.

More surprisingly, in the current study, the effect of trait self-control on participants' sensitivity to the "Healthy is Up" metaphor had the opposite direction to what we hypothesized in H₅ and previously observed in Study 2a. Participants who had a lower level of self-control were more likely to perceive the fruit juice as healthier in the upward conditions than in the downward conditions. The implications of these contrasting results in Study 2a and Study 4 are further developed in the general discussion section.

8. General discussion

In the subsequent paragraphs, we outline the main contributions and implications of our findings at theoretical and practical levels together with the main limitations and research avenues.

8.1. Theoretical contributions

In spite of minor inconsistencies, this series of studies offers solid and convergent evidence for the "Healthy is Up" metaphor and contributes to the literature on conceptual metaphors (Lakoff & Johnson, 1980). The metaphorical association between the abstract concept of health and the concrete concept of verticality is manifested in various ways. Study 1 reveals that a conceptual match (vs. mismatch) between verticality and health facilitates faster response speed in an IAT, which corroborates previous findings of the metaphorical congruency effects on processing fluency (e.g., Meier & Robinson, 2004; Xie, Wang, & Chang, 2014). Studies 2a, 2b, 3 and 4 demonstrate the bidirectional effects of the "Healthy is Up" metaphor, namely, that people tend to position healthy food up high and to prefer a food pyramid depicting healthy food at the top (abstract-to-concrete effect), as well as to

consider a food product as healthier when it seems to be in a higher position (concrete-to-abstract effect).

Besides, it is worth mentioning that health-related information predicts the vertical placement of the product while taste-related information does not (Studies 2a and 2b), and vertical information impacts the perceived healthiness of the product but not the perceived tastiness (Study 4). In other words, this research shows that what is good for health is more strongly associated with high verticality than what tastes good. This result is aligned with prior literature showing that a given metaphorical cue can be related to healthiness but not to tastiness (van Ooijen et al., 2017). However, although we controlled the valence (Studies 1, 2a and 2b) and the tastiness (Study 4) of the stimuli to rule out the metaphorical association between high verticality and (positive) valence as an alternative explanation (Meier & Robinson, 2004) and to validate the novelty of our research, we cannot completely exclude that “healthiness” is more likely to be conceptually associated with “goodness” than “tastiness”. Moreover, verticality has been identified as a metaphorical representation for many other concepts in the literature (Cian, 2017), ranging from morality (Dong et al., 2020) to rationality (Cian et al., 2015) through power (Schubert, 2005; Sundar & Noseworthy, 2014) to name but a few. Similar experimental manipulations (e.g., a tall, elongated bottle) have also been metaphorically associated with different concepts such as luxury (van Rompay & Pruyn, 2011) and healthiness (van Ooijen et al., 2017). Likewise, an upward camera angle has been metaphorically associated with power in prior literature (van Rompay, De Vries, Bontekoe, & Tanja-Dijkstra, 2012) and with healthiness in the present research. Future studies might therefore examine the conditions under which

people infer healthiness rather than goodness, power, or another concept, from a vertical metaphorical cue.

The most surprising and stimulating result observed in the current research is that individual differences in self-control influence the concrete-to-abstract and the abstract-to-concrete effects of the “Healthy is Up” metaphor in the opposite directions. Indeed, as showed in Study 2a, and following a similar though not significant trend in Study 2b, people scoring high on self-control are more likely to associate a healthy product with a higher placement along the vertical dimension (reinforcing the abstract-to-concrete effect), whereas, as found in Study 4, people who score low on self-control are more likely to perceive a product as healthy when it is associated with a higher placement (reinforcing the concrete-to-abstract effect). This opposite pattern could not be anticipated, since, to our knowledge, no previous research has ever explored the role of the same dispositional trait in the bidirectional effects of a given metaphor. Instead, past researchers focused on how individual differences predict the metaphorical congruency effects which are intrinsically symmetric and are not directional (e.g., Meier, Hauser, et al., 2007a, 2007b), or tested only one of the bidirectional effects (e.g., Fay & Maner, 2012).

Although, asymmetric interactions between individual differences and conceptual metaphors have never been reported in the literature, this may be inferred from prior research. Across six experiments, Casasanto and Boroditsky (2008) consistently found a concrete-to-abstract effect with the “Time is Space” metaphor, but not the reverse, such that spatial information influenced judgment about time duration whereas duration did not affect estimates of spatial displacement. On the other hand, Meier and Robinson’s (2004) experiments on the “Good is Up” metaphor only revealed an abstract-to-concrete effect:

processing valence words altered participants' attention in vertical space, such that participants responded faster to stimuli presented at the top (vs. bottom) of the screen after categorizing a positive (vs. negative) word, whereas processing vertical information failed to impact reaction times in categorizing valence words. Those results imply that the concrete-to-abstract and the abstract-to-concrete effects may be driven by different psychological mechanisms, which may help explain why the same personality trait can facilitate one effect (the concrete-to-abstract effect) but undermine the other (the abstract-to-concrete effect). Furthermore, as shown in previous research, the metaphorical congruency effects on product judgement were less pronounced when consumers had more prior knowledge about a product featured in the advertisement, as they tended to rely on their prior knowledge rather than the advertisement to form their judgement (Cian et al., 2015). This may also contribute to explaining our unexpected results in Study 4. Indeed, along this line of argument, one may speculate that participants scoring high in self-control, are more knowledgeable about healthy choice (Schreiber, Bucher, Collins, & Dohle, 2020), and therefore less likely than participants who are low in self-control to be influenced by the vertical cues in the advertisement when they are judging the fruit juice featured.

The precise psychological mechanisms giving rise to the observed asymmetry remain to be elucidated in future research. A complementary research avenue might be to further explore the "Healthy is Up" metaphor in light of other individual difference measures. The interaction effect between the "Healthy is Up" metaphor and self-control observed in Studies 2a and 4 suggest that the accessibility of the metaphorical association between verticality and healthy food was predicted by self-control. However, this effect did not reach significance in Study 2b, whose purpose was to replicate Study 2a, and participants'

scores on self-control did not predict participants' choices in favour of the "Healthy is Up" pyramid in Study 3. One of the main limitations of the Brief Self-Control Scale (BSCS; Tangney et al., 2004) used in this research is that none of its items refer to healthy eating goals, whereas individual differences in terms of health (vs. hedonic) goals proved successful to moderate the effect of a metaphor on the perception of healthy food products (e.g., Hung & Labroo, 2011; van Ooijen et al., 2017). Future research investigating the metaphorical association between healthy food and verticality might thus consider measuring health goals to overcome some of the limitations of the present article.

8.2. Managerial and public policy implications

Our findings have important implications for practitioners in marketing management and in public policy. The use of metaphors by practitioners is well-documented in the marketing literature (e.g., Zaltman & Zaltman, 2008) and in public policy (e.g., Sopory, 2017). Metaphors in the marketplace can be verbal (e.g., "Are you up for the real food challenge?"⁶) and non-verbal (Hirschman, 2007). Non-verbal metaphors are commonly expressed via product packaging (e.g., Basso et al., 2014; Gil-Pérez, Rebollar, & Lidón, 2020; van Ooijen et al., 2017; van Rompay & Fennis, 2019) and advertising (e.g., Djafarova, 2016; Forceville, 1996). In everyday life, consumers are faced with a large amount of distracting information when they are shopping, and this research suggests that healthy items should be promoted with vertical metaphors to further emphasize their healthiness, especially among consumers who are low in self-control. Some advertisements used vertical metaphors to promote food products. For instance, in its campaign "Colour

⁶ <https://www.fitfatherproject.com/how-to-accomplish-the-100-days-of-real-food-challenge/>

the classics”⁷, Whole Foods Market, a multinational supermarket chain associated to a “healthy lifestyle” by consumers (Ma, 2020), employed a vertical metaphor to communicate about their products, depicting healthy food products (e.g., courgettes, aubergines, beans) but also less healthy food products (e.g., cake and ice cream) picked on a fork oriented upwards. In this perspective, it could be worthwhile to study the boundary conditions of the “Healthy is Up” metaphor that pertain to the product category it is applied to. Indeed, prior literature found that elongated bottles can serve as a metaphoric cue to communicate about the healthiness of a food product to consumers (van Ooijen et al., 2017). However, whereas an elongated shape enhances the perceived healthiness of healthy food products, it reduces the healthiness perceptions of unhealthy food products (Sheehan, van Ittersum, Craig, & Romero, 2020). By extension, one may speculate that the “Healthy is Up” metaphor, which enhances the perception of healthy food products, might not contribute to improving the perception of unhealthy food products.

In line with the “Healthy is Up” metaphor, verticality should also be further considered by practitioners when it comes to deciding where healthy food products should be placed on in-store displays. For instance, the Food Trust recommends to “place healthy beverages, fruit salads and yogurts on top shelves”⁸. This recommendation is supported by a field experiment showing that people prefer shelf displays offering a larger healthy snack assortment located on top shelves (van Kleef, Otten, & van Tripp, 2012). It is worthwhile to note that this recommendation should be implemented with caution for certain categories of products. For instance, if healthy cereals are displayed on the top shelves and, conversely,

⁷ <https://workingnotworking.com/projects/206856-whole-foods-market-holiday>

⁸ <https://thefoodtrust.org/wp-content/uploads/2022/07/sell-healthy-guide-2016.original.pdf>

sugary cereals on the bottom shelves, this means that sugary cereals will be at children's eye level and within their reach (Harris, Webb, J Sacco, & L Pomeranz, 2020), which could reinforce the “vertically exploitive elements of child-targeted marketing” in store (Berry & McMullen, 2008, p. 345). Future research might explore how solutions inspired by the “Healthy is Up” metaphor could be used to promote healthy food consumption among adults and children altogether.

In relation to public health policy, this research could also contribute to informing the implementation of healthy eating guidelines. Indeed, our results show that a revised version of the food pyramid depicting healthy food at the top, in line with the “Healthy is Up” metaphor, was favoured by people when compared to the classic version of the food pyramid. Although alternative depictions have been implemented in various countries across the world, such as a clay pot in Guatemala and a rainbow in Bolivia (Oliveira, Arceño, Sato, & Scagliusi, 2019), a five-storied pagoda in China (Yoshiike, Hayashi, Takemi, Mizoguchi, & Seino, 2007), or a plate in the UK, Canada and Mexico (Oliveira et al., 2019; Truman, 2018), one of the most recognized graphic presenting dietary guidelines is the Food Guide Pyramid (Kaufer-Horwitz, Valdés-Ramos, Willett, Anderson, & Solomons, 2005) or Healthy Eating Pyramid (Fernandez et al., 2021). However, the use of a food pyramid to represent dietary guidelines is at odds with the “Healthy is Up” metaphor since healthy food is depicted at the bottom of the pyramid whereas unhealthy food is depicted at the top of the pyramid. One practical solution to overcome this limitation is to turn the food pyramid upside-down. This is illustrated by the Japanese Food Guide, for instance, which employed a spinning top that looks like an inverted triangle or a triangular cone (Yoshiike et al., 2007). This visual strategy allowed the Japanese public health

authorities to depict the foods that should be eaten in largest amounts at the top rather than at the bottom of the nutrition guide (Yoshiike et al., 2007). Following a similar approach, the Flemish government updated its food guide in 2017, and adopted an inverted pyramid (“*food triangle*”) as a nutrition guide in the Flemish Region in Belgium. As such, the Japanese Food Guide spinning top and the Flemish food triangle are more consistent with the “Healthy is Up” metaphor than the classic food pyramid usually depicted in Western countries (Fernandez et al., 2021). Along this line of argument, a next step could be to examine whether visual food-based dietary guidance inspired by the “Healthy is Up” metaphor could be helpful to improve the provision of information on portion sizes (Benelam & Stanner, 2019).

8.3. Limitations and research avenues

In addition to the limitations already discussed, there are other potential elements in our experiments that may constrain the applicability of the present research and require further considerations and examinations.

First, unfortunately, no effect of metaphorical congruency effect on consumer behaviour intentions was observed in Study 4. This may be explained by the fact that the metaphor congruency effect influenced healthiness perceptions among consumers who are low in self-control whereas literature shows that healthiness weights less than tastiness when they are making food choices (e.g., Sullivan, Hutcherson, Harris, & Rangel, 2015). Complementary solutions relying, for instance, on heuristics might be useful to promote healthy choice among individuals with low self-control (e.g., Salmon, Fennis, de Ridder, Adriaanse, & de Vet, 2014).

Second, we have grounded our studies in the context of healthy food consumption, but the concept of health has much broader connotations. Future research can try to extend the effects of the “Healthy is Up” metaphor to other health-related fields such as physical exercise and sleep.

Last, our research relies solely on American samples because the “Healthy is Up” metaphor is initially documented by North American research on cognitive linguistics (Lakoff & Johnson, 1980). Nevertheless, the United States has less than five percent of the world’s population (United States Census Bureau, 2020) while it is a global goal to promote a healthy diet (World Health Organization, 2006). Considering that the embodied experience underpinning the “Healthy is Up” metaphor is not specific to US citizens since we witness healthy people standing up and sick ones lying down all around the world, it is plausible to expect similar conceptual associations between health and verticality in other cultures. Further investigation is thus needed in this regard.

9. Conclusion

In five studies, we have experimentally demonstrated that the metaphorical congruence between health and verticality enhances processing fluency, that health-related information impacts vertical judgments, and, in turn, that vertical information affects health-related judgments. This research contributes to the literature on the conceptual metaphor theory by providing the first set of comprehensive evidence for the cognitive influence of the “Healthy is Up” metaphor and its application to healthy food, as well as revealing the extent to which individual differences in self-control interact with the aforementioned effects of this metaphor. Overall, this research indicates that the “Healthy is Up” metaphor is a promising avenue to explore in developing practical strategies to encourage healthy food consumption as well as other healthy lifestyles.

Authors' contributions

Feiyang Wang: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Validation, Writing -original draft, Writing - review & editing, Visualization, Project administration.

Frédéric Basso: Conceptualization, Methodology, Investigation, Validation, Writing - review & editing, Visualization, Project administration, Funding acquisition.

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Ethical statement

This series of studies received the approval of the Department of Psychological and Behavioural Science (PBS) Ethics Committee of the London School of Economics (LSE). All participants gave informed consent before taking part in a study, and the privacy rights of human subjects has always been observed.

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Chapter 3

Language or Embodiment? The Vertical Representation of Healthy Food in Chinese People's Minds

Abstract

Human beings not only talk with metaphors, but also think metaphorically, mapping familiar concrete concepts onto unfamiliar abstract concepts to make sense of them. So, where does metaphorical thinking come from? The conceptual metaphor theory posits that cross-domain mental associations emerge from our bodily interactions with the physical world, and then surface themselves in language. On the contrary, the linguistic relativity hypothesis argues that we acquire metaphorical thinking by using metaphorical language every day. To shed new light on this controversy, the current research investigates if the mental association between healthiness and verticality, which has been observed among US people, also exists in Chinese people's minds. The linguistic metaphor "Healthy is Up" prevails in the English language but is absent in the Chinese language, so the linguistic relativity hypothesis would predict that Chinese people have no such mental association. By contrast, the embodied account would expect the effects to be successfully replicated among Chinese people as the perceptual-motor experience underlying this metaphor is apparently universal: healthy people stay upright and illnesses cause us to lie down. The three replication studies reported in this paper yield inconsistent results. Data suggests that

Chinese participants classify words and pictures faster when healthy (vs. unhealthy) food pictures and up- (vs. down-) related words are in the same category (Study 1), and that Chinese participants are more likely to place healthy food higher than unhealthy food along the vertical axis (Study 2). However, Study 3 finds no evidence that Chinese participants prefer the food pyramid displaying healthy food at the top (vs. bottom) or vice versa. Those findings seem to support a dual-origin hypothesis: we argue that both embodied experience and day-to-day language use contribute to the development of metaphorical thinking.

Keywords

Conceptual metaphor; Linguistic relativity; Healthy food; Verticality; Culture

1. Introduction

The metaphor “Healthy is Up” is commonly used in the English language, exemplified by phrases like “the peak of health”, “feel under the weather” and “fall sick”. Inspired by the conceptual metaphor theory (CMT, Lakoff & Johnson, 1980, 1999), previous research demonstrates that this metaphor is more than a way of speaking, but also shapes thoughts and actions, such that US people processed information more fluently when healthy food pictures were paired with up-related words rather than down-related words, and that they were more likely to put a healthy food picture into a higher-positioned box than a lower-positioned one (Wang & Basso, 2021). The CMT further argues that conceptual metaphors are derived from our embodied experience. For instance, Lakoff and Johnson (1980) believe the metaphorical association between healthiness and verticality stems from a physical phenomenon we all witness - healthy human beings can stay upright whereas patients often have to lie in the bed. The current research would like to empirically investigate Lakoff and Johnson’s proposition (1980) by replicating Wang and Basso’s (2021) Studies 1, 2b and 3 with Chinese participants. The linguistic metaphor “Healthy is Up” is not observed in the Chinese language⁹, but the embodied experience underlying this metaphor is universal, i.e., there is no culture-specific practice leading Chinese people not to lie down when they are ill. Therefore, if we find evidence that Chinese people also associate healthy food with up and unhealthy food with down, this mental association

⁹ To prove that something does not exist is always hard, as it would require perfect knowledge (omniscience). Strictly speaking, the absence of “Healthy is Up” in the Chinese language is a speculation made by the author. I would argue, though, that this speculation is reasonably supported. Apart from my own rich experience of using the Chinese language natively, I asked several other native Chinese speakers to think of some metaphorical expressions associating “Healthy” with “Up” or “Unhealthy” with “Down”, and none of them managed to do so. Professor Ning Yu, an influential Chinese linguist specialising in metaphor research, also confirmed in an informal email exchange that my observation “should be accurate” and that “such expressions seem to be rare in Chinese”.

should be originated from culturally ubiquitous bodily experience, without being cofounded by language use. The current research will thus contribute to the ongoing debate on the origin of metaphorical thinking.

1.1. CMT: embodied experience motivates metaphorical thinking

Metaphors are more than linguistic decorations. Metaphorical thinking structures the cognitive system, allowing us to comprehend an abstract concept (i.e., the target domain) through a superficially dissimilar concrete concept (i.e., the source domain) representing bodily experience (Lakoff & Johnson, 1980, 1999). This central notion of the CMT is attested by an increasing volume of experimental studies (Landau, Meier, & Keefer, 2010; Gibbs & Matlock, 2008). Well-known findings include that people who were sitting in a soft cushioned chair judged a job candidate to be more emotional than those sitting in a hard wooden chair, echoing the metaphorical association between softness and compassion (Ackerman, Nocera, & Bargh, 2010); and that in accordance with the “Good is Up” metaphor, positive words were identified more quickly when they appeared at the top rather than at the bottom of the screen (Meier & Robinson, 2004).

But why do human beings think metaphorically? Does the linguistic experience of using metaphorical expressions shape our thoughts? Or, conversely, do the cross-domain mental associations come first from elsewhere, and then manifest themselves in everyday language?

The CMT is in favour of the latter viewpoint, and proposes an embodied origin for metaphorical thinking, i.e., we acquire conceptual metaphors through physical interactions with the surrounding environment, where non-sensorimotor experience in the target domain and sensorimotor experience in the source domain are conflated in our mind due

to their regular co-occurrence (Clark, 1973; Grady, 1997; Lakoff & Johnson, 1999). For instance, Lakoff and Johnson (1999) argue that we learn the vertical metaphor “More is Up” unconsciously and automatically through bodily activities like pouring water into a glass and seeing the level go up, or stacking bricks to build a high wall. Linguistic metaphors like “my to-do list is piling up” and “the price rose by 10%” are secondary manifestations of the mental association between quantity and verticality. Social psychologists who advocate this account refer to the process as scaffolding (Williams, Huang, & Bargh, 2009), advancing that abstract and unfamiliar concepts are scaffolded on more concrete and familiar concepts during the course of either infants’ cognitive development (ontogenetic scaffolding) or hominid evolution (phylogenetic scaffolding).

Intriguing though it is, this embodied origin of metaphorical thinking lacks empirical validation (Casasanto, 2014). Most CMT studies cannot exclude the alternative that metaphorical thinking is acquired through the use of metaphorical language (Gibbs, 2013, 2014). To our best knowledge, the only exception is the series of studies on the metaphorical association between affective valence and left-right space. Among adults and children, right-handers made more positive judgments about the stimuli (e.g., animals, products, job candidates) presented on their right side, while left-handers tended to judge the stimuli on their left side more positively, even when they did not use their hands to respond (Casasanto, 2009; Casasanto & Henetz, 2012). In spatial memory tasks, right-handers misremembered positive events as taking place further right to their actual locations on a map, whereas left-handers did the opposite (Brunyé, Gardony, Mahoney, & Taylor, 2012). In word categorization tasks, right- and left-handers responded faster with their dominant hand to positive words and with their non-dominant hand to negative words

(de la Vega, de Filippis, Lachmair, Dudschig, & Kaup, 2012). Metaphorical language use cannot account for those effects as left-handers' thinking pattern contradicts the widely-used linguistic metaphor "Good is Right". Those results bear out the body-specificity hypothesis (Casasanto, 2009; 2011), i.e., people with different types of body think differently in ways that are correspondent to their body-specific motor experience. Left-handers implicitly associate "Good" with "Left" because they manipulate objects more fluently with their left hand, which is a pleasant experience.

1.2. Linguistic relativity: metaphorical language breeds metaphorical thinking

Nowadays, cognitive linguists mostly disagree with linguistic determinism, a strong hypothesis claiming that human beings can only perceive the world through the structures enforced by the language they habitually use (Penn, 2014; Whorf, 1997). The more accepted form, the linguistic relativity hypothesis, highlights that languages have a profound influence on their speakers' non-linguistic cognitive processes (Casasanto, 2008; Gumperz & Levinson, 1996; Kay & Kempton, 1984). The impact of colour naming on colour perception is a well-studied topic in this field (Regier & Kay, 2009; Roberson, Davies, & Davidoff, 2000). For example, native Russian speakers, whose mother tongue makes an obligatory distinction between lighter blues and darker blues, discriminated between two blues faster when they belonged to different linguistic categories than when they fell in the same linguistic category, whereas English speakers showed no recognition advantage in any of those colour combinations (Winawer et al., 2007).

Congruent with the linguistic relativity hypothesis, some researchers put forward that metaphorical thinking can also be emergent over language use (Casasanto, 2008; Sanford,

2012). Sanford (2013) tried to verify this postulation from a lexical frequency perspective - he identified a set of metaphors more and less frequently used in American English with corpus analysis, and demonstrated in several experiments that American participants understood the expressions corresponding to frequent (vs. infrequent) metaphors more easily and rated them higher on acceptability. This research lends rather limited support to the linguistic origin of metaphorical thinking, as we cannot rule out that certain metaphors gain high frequencies because they are consistent with our embodied experience, and this embodied underpinning also makes them more accessible and acceptable (Gibbs, 2013).

More reliable evidence was found by crosslinguistic studies on metaphors about time (Bylund & Athanasopoulos, 2017; Casasanto et al., 2004). The English, Indonesian, and Swedish languages predominantly refer to time as “short” or “long”, but the Spanish and Greek languages primarily frame time as “small” or “big”. Consequently, in a duration estimation task, distance-related information (i.e., a growing line) strongly interfered with native English, Indonesian and Swedish speakers’ performance, whilst quantity-related information (i.e., an empty container being filled gradually) had very weak impacts on them. In the meantime, native Spanish and Greek speakers suffered the interference of quantity on duration estimation more strongly than that of distance (Casasanto et al., 2004). A replication study on Spanish-Swedish bilinguals revealed that the quantity interference was more pronounced when participants performed the task in Spanish, and the distance interference was amplified when they performed the task in Swedish (Bylund & Athanasopoulos, 2017). The metaphors “Time is Distance” and “Time is Quantity” are both congruent with our perceptual experience, so the relative prevalence of distance metaphors and quantity metaphors in these languages better explains those findings.

1.3. Cultural similarities and differences in metaphorical thinking

Cross-cultural comparisons have been employed by researchers from both sides to justify their arguments. Unfortunately, few of those past studies can actually disentangle the linguistic relativity effects from the embodied cognition effects.

On the one hand, CMT researchers tend to attribute cross-cultural similarities in metaphorical thinking to the universal embodied foundations. For example, the conceptual “Power is Up”, which we supposedly learnt in infancy by experiencing parental dominance (Schwartz, Tesser, & Powell, 1982), has been shown to shape human cognition in multiple sociocultural contexts. Schubert (2005) initially demonstrated that native German speakers classified powerful groups (e.g., “boss”, “king”) faster when they were presented at the top (vs. bottom) of the screen, and classified powerless groups (e.g., “assistant”, “slave”) faster when they were presented at the bottom (vs. top) of the screen. Those results were successfully replicated with native Dutch and Chinese speakers (Wu et al., 2016; Zanolie et al., 2012). The vertical representation of power was even observed among 12- to 16-month-old Japanese infants, such that they gazed at the screen longer when a lower agent obtained the reward over a higher agent, compared to the inverse outcome (Meng, Nakawake, Nitta, Hashiya, & Moriguchi, 2019). Indeed, the mental association between power and verticality are too prevalent to be coincidental, and the shared embodied experience elegantly accounts for its occurrence in various cultures around the world (Schubert, 2005; Schwartz et al., 1982). However, the invariant use of this metaphor in many languages (Schwartz, 1981; Tolaas, 1991) points to the unignorable possibility that, at least for adults, linguistic practices could have reinforced this mental association.

On the other hand, cross-cultural variabilities in metaphorical thinking are often considered as evidence for linguistic relativity. For instance, English speakers tend to talk about time in terms of horizontal space (i.e., “Past is Behind/Future is Ahead”), while Mandarin Chinese speakers use both horizontal and vertical (i.e., “Past is Up/Future is Down”) metaphors to describe time (Scott, 1989). Drawing on the linguistic relativity account, Boroditsky (2001) reasoned that Mandarin speakers would rely on vertical spatial information more than English speakers when making temporal judgments. As she predicted, Mandarin speakers were faster to confirm that March comes earlier than April after exposure to vertical primes than to horizontal primes, and English speakers’ performance showed a reversed pattern. Moreover, Miles, Tan, Noble, Lumsden, and Macrae (2011) asked Mandarin-Chinese bilinguals to arrange the photos of the same individual at different ages into a temporally ordered sequence, and found that they were more likely to sort the photos of Brad Pitt (a US celebrity) horizontally from left to right, but photos of Jet Li (a Chinese celebrity) vertically from top to bottom. Nevertheless, this cultural difference cannot refute the embodied account. After all, people from different cultural backgrounds not only speak different languages, but also have culture-specific embodied experiences - our bodies move within social institutions and our activities are often shaped by cultural artefacts (Gillespie & Zittoun, 2013). In this regard, the metaphorical association between “Time” and “Vertical Motion” in Mandarin speakers’ minds might arise from their culture-specific reading and writing experiences. Ancient Chinese people predominantly read and wrote from top to bottom. Although most Mandarin speakers nowadays are more used to reading and writing from left to right, the top-to-bottom practices are common to be seen in historical movies, on festival banners,

and during calligraphy training. It is likely that those culture-specific practices have motivated this metaphorical association in the first place, which is later picked up by the language.

In sum, previous research has mainly probed into the situations where the embodied experience and the linguistic expressions covary. The current research targets a unique case where cultural differences are observed for the linguistic expressions of a metaphor but not for the underlying embodied experience. Cross-cultural similarities in endorsing the mental metaphor “Healthy is Up”, if observed, would provide more support to the embodied account of metaphorical thinking.

2. Study 1

Study 1 intended to replicate Study 1 from Wang and Basso (2021) with participants from mainland China. The hypothesis under examination was:

H₁: A match (vs. mismatch) between verticality and healthy food leads to faster response speed.

More specifically, an implicit association test (IAT) was adopted to investigate if Chinese participants would respond faster in the congruent blocks where the category “Healthy” was paired with the category “Up” than in the incongruent blocks where “Healthy” was paired with “Down”.

2.1. Methods

Participants. Prior to data collection, the required sample size was computed with a power analysis (G*Power 3.1; Faul, Erdfelder, Lang, & Buchner, 2007). The original effect with US participants had a large effect size, *Cohen's d* = 0.95, 95% *CI* = [0.31, 0.48]. With $\alpha = 0.05$ and power = 0.95, the minimum number of participants needed to detect an effect size of *d* = 0.95 for a one-sample *t*-test difference from a constant was *N* = 17. We suspected that the effect size might be smaller with Chinese participants, as they were not exposed to the linguistic metaphor “Healthy is Up” in their everyday language. Therefore, we oversampled to reduce the possibility of committing type II errors. One hundred and twelve participants from mainland China were recruited online through InsightWorks, a Chinese consumer research company. The study was built on *Gorilla.sc* and participants completed it in exchange for monetary compensation. Of those, five were excluded from the analysis as they produced more than 10% of trials with latencies less than 300 milliseconds, which indicated careless responding (Greenwald, Nosek, & Banaji, 2003). Therefore, there were 107 valid answers left for formal analysis (Female = 60, Male = 47; *M*_{age} = 32, *SD*_{age} = 7).

Procedure. The stimuli for the target categories (healthy vs. unhealthy) were five pair of healthy and unhealthy food pictures matched on shape, colour, and valence, which were exactly the same as those in Wang and Basso's (2021) Study 1. The stimuli for the attribute categories were ten Chinese words related to either “up” or “down” - up: “高峻” (high), “顶端” (top), “高于” (over), “上面” (above), “上升” (ascend); down: “低矮” (low), “底部” (bottom), “低于” (under), “下面” (below), “下降” (descend). Two Chinese-English bilinguals checked the translated textual stimuli and ensured that they were equivalent to

the English words used by Wang and Basso (2021). A small-scale focus-group interview also confirmed that Chinese participants could easily recognize all the textual and graphical stimuli.

Following the standard IAT procedure (Greenwald et al., 2003), the whole task was composed of seven blocks. As illustrated in Figure 1, participants were instructed to quickly classify the displayed picture or word into the left or right category by pressing “E” (left hand) or “I” (right hand).

Blocks 1, 2 and 5 were training blocks, each of which had 20 trials. Participants only needed to discriminate target images in block 1 (left for “Healthy”, right for “Unhealthy”) and block 5 (left for “Unhealthy”, right for “Healthy”), and to discriminate attribute words in block 2 (left for “Up”, right for “Down”).

Blocks 3, 4, 6 and 7 were experimental blocks, each of which had 40 trials, displaying both target images and attribute words. In the congruent blocks (3 & 4), participants should respond to “Healthy” food pictures and “Up” words with their left hand, and “Unhealthy” food pictures and “Down” words with their right hand, i.e., the response arrangements were compatible with the “Healthy is Up” metaphor. In the incongruent blocks (6 & 7), participants should respond to “Unhealthy” food pictures and “Up” words with their left hand, and “Healthy” food pictures and “Down” words with their right hand, i.e., the response arrangements were incompatible with the “Healthy is Up” metaphor.

Figure 1. The IAT screen (blocks 3 & 4) in study 1.



To balance out the learning effect, we presented half of the participants with the training block 1 and the congruent blocks (3 & 4) first, and the other half with the training block 5 and the incongruent blocks (6 & 7) first. The position of the training block 2 was always the same (i.e., after block 1 or 5). Within each block, the presentation order of all words and/or pictures were fully randomized. A red cross would appear if participants gave a wrong classification, and they had to correct their answer to proceed to the next trial.

2.2. Results

Complying with Greenwald and colleagues' (2003) improved scoring algorithm, the reaction time data (measured in milliseconds) from the congruent (3 & 4) and incongruent blocks (6 & 7) were used to compute the IAT *D score* for each participant. In line with H₁, a one-sample *t*-test showed that participants' average *D score* was significantly greater than

zero ($M = 0.37$, $SD = 0.44$, $t(106) = 8.66$, $p < 0.001$, $d = 0.84$, $95\% CI = [0.28, 0.45]$), suggesting that participants responded faster in the congruent blocks where “Healthy” was paired with “Up” than in the incongruent blocks where “Healthy” was paired with “Down”.

Furthermore, we tested the order effect by comparing the *D scores* of participants who received the congruent blocks first ($n = 51$) with those of participants who received the incongruent blocks first ($n = 56$). An independent sample t-test revealed a significant order effect ($t(105) = 4.90$, $p < 0.001$, $d = 0.95$, $M_{diff} = 0.38$, $95\% CI = [0.22, 0.53]$). The average *D score* was significantly higher among participants who received the congruent blocks first ($M = 0.56$, $SD = 0.36$, $95\% CI = [0.46, 0.67]$), but still positive for participants who received the incongruent blocks first ($M = 0.19$, $SD = 0.42$, $95\% CI = [0.07, 0.30]$), which supported a robust effect despite the order of blocks.

3. Study 2

Study 2 was a Chinese replication of Wang and Basso’s (2021) Study 2b. Since the modulating effects of self-control were inconsistent across the original studies, we put this covariate aside and focused on the main hypothesis:

H₂: People are more likely to place healthy food in a higher position and unhealthy food in a lower position.

3.1. Methods

Participants. Prior to data collection, the required sample size was computed based on a power analysis (G*Power 3.1; Faul et al., 2007). The original effect with US participants had a medium effect size, *Cohen’s g* = 0.16, $95\% CI = [51.83\%, 66.20\%]$. With $\alpha = 0.05$

and power = 0.95, the minimum sample size needed to detect an effect size of *Cohen's g* = 0.16 for a sign test was $N = 125$. Two hundred and thirty-three participants from mainland China were recruited through WJX, a Chinese online survey platform. The study was built on *Qualtrics.com* and participants filled out the survey in exchange for monetary compensation. Five participants were excluded for the following reasons: took the survey more than once ($n = 1$), answered “I have not taken part seriously, please throw my data away” to the seriousness check question ($n = 4$); leaving 228 participants for analysis (Female = 109, Male = 119; $M_{\text{age}} = 32$, $SD_{\text{age}} = 7$).

Procedure. After giving informed consent, participants were presented with two boxes and a cartoon figure in the middle. The instructions were as follows (see Figure 2):

“The cartoon character depicted below loves fruit salad and ice cream. He thinks that fruit salad is healthier than ice cream but that ice cream is tastier than fruit salad. Your task is to place the two pictures into the two boxes, respectively. Please drag the picture of fruit salad into the box which you consider as more suitable for healthy food, and the picture of ice cream into the box more suitable for tasty food.”

To eliminate any confounding effects fostered by presentation order, half of the participants were randomly assigned to another version of the instructions where ice cream was mentioned before fruit salad in all the relevant sentences. The arrangement of pictures was fully randomized as well. We contrasted “healthy” with “tasty” to keep the procedure as close to that in the original study as possible, even though we were aware that Chinese people do not implicitly oppose the healthiness of food to tastiness (Wang, 2015).

Next, participants were asked to assess how healthy and tasty the figured fruit salad and ice cream were on two 7-point scales (“How healthy do you think this dessert is?”; 1 = “Very unhealthy”/4 = “Neutral”/7 = “Very healthy”; “How tasty do you think this dessert is?”; 1 = “Not at all tasty”/4 = “Neutral”/7 = “Very tasty”). They also needed to evaluate the valence of the two stimuli on the following 7-point scale as in the previous research (Gottwald, Elsner, & Pollatos, 2015; Wang & Basso, 2021): “How much do you like this dessert?” (1 = “Strongly dislike”/4 = “Neutral”/7 = “Strongly like”). The presentation order of the two pictures was counterbalanced across participants and that of the three questions was randomized for each picture. The survey ended with demographic questions, a seriousness check question, and a text box for comments.

3.2. Results

Manipulation check. Paired-samples *t*-tests showed that fruit salad (healthiness: $M = 6.44$, $SD = 0.91$; tastiness: $M = 5.83$, $SD = 1.06$) was perceived as significantly healthier ($t(227) = 22.71$, $p < 0.001$, $d = 1.50$, $M_{diff} = 2.54$, 95% $CI = [2.32, 2.76]$) and slightly (but not significantly) less tasty ($t(227) = -1.52$, $p = 0.131$, $d = -0.10$, $M_{diff} = -0.14$, 95% $CI = [-0.31, 0.04]$) than ice cream (healthiness: $M = 3.91$, $SD = 1.42$; tastiness: $M = 5.96$, $SD = 1.09$). Participants also liked fruit salad ($M = 5.92$, $SD = 1.03$) more than ice cream ($M = 5.65$, $SD = 1.18$), $t(227) = 2.64$, $p = 0.009$, $d = 0.17$, $M_{diff} = 0.27$, 95% $CI = [0.07, 0.47]$, suggesting that valence was not perfectly controlled in the current study.

Vertical placement. As expected from H₂, the majority of participants put the fruit salad picture (i.e., healthy food) into the top box and the ice cream picture (i.e., unhealthy food) into the bottom box (71.1%). A sign test confirmed a significant difference in the

proportion of placing fruit salad in a higher position and that of placing fruit salad in a lower position ($p < 0.001$).

Figure 2. The main question page in study 2.

下图中的小人喜欢吃水果沙拉和冰淇淋。
他觉得水果沙拉比冰淇淋更健康，而冰淇淋比水果沙拉更美味。
你的任务是将两种食物的图片分别拖拽到两个方框中：
请把水果沙拉拖入你认为更适合健康食物的方框中，把冰淇淋拖入你认为更适合美味食物的方框中。

项目



The figure shows a task interface. On the left, under the heading '项目' (Items), there are two food items: a bowl of fruit salad and a cup of ice cream. On the right, there are three stacked rectangular boxes. The middle box contains a stick figure representing a person. The task is to drag the fruit salad to the box representing 'healthier food' and the ice cream to the box representing 'tastier food'.

4. Study 3

Study 3 attempted to replicate the main effect of Wang and Basso's (2021) Study 3 with Chinese participants and tested the following hypothesis:

H₃: People prefer the healthy eating pyramid arranging healthy food higher than unhealthy food over the one arranging healthy food lower than unhealthy food.

4.1. Methods

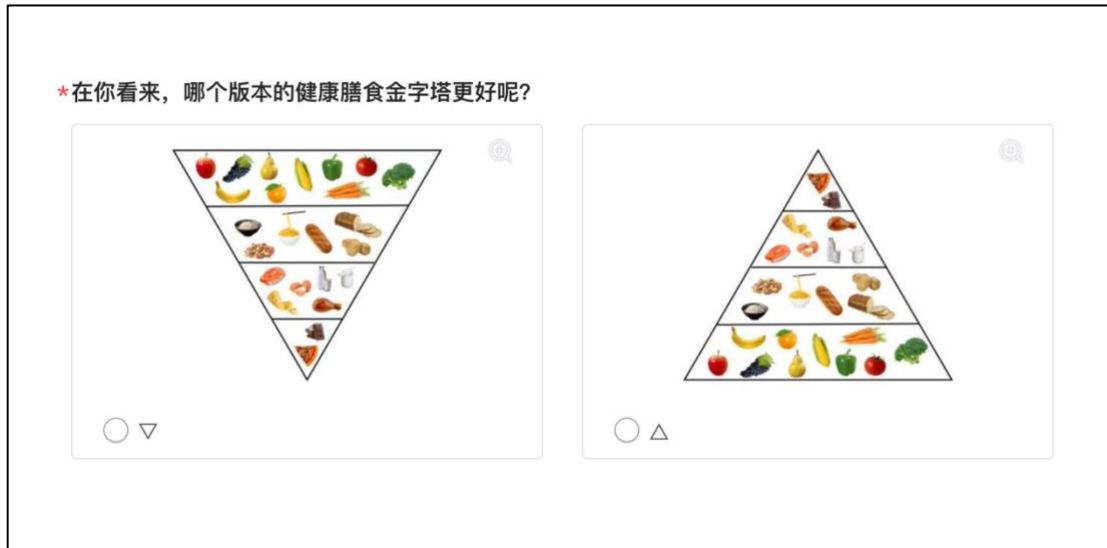
Participants. Prior to data collection, the required sample size was computed with a power analysis (G*Power 3.1; Faul et al. , 2007). The original effect with US participants had a small effect size, *Cohen's g* = 0.09, 95% *CI* = [51.83%, 66.20%]. With $\alpha = 0.05$ and power = 0.95, the minimum number of participants needed to detect an effect size of $g = 0.09$ for a sign test was $N = 405$. Five hundred and fifteen participants from mainland China completed the study in exchange for monetary compensation. The survey was built and collected online via WJX. Overall, fifteen participants were excluded for the following reasons: took the survey more than once ($n = 12$), did not pass the seriousness check ($n = 3$); leaving 500 participants (Female = 231, Male = 269; $M_{age} = 33$, $SD_{age} = 8$).

Procedure. At the beginning of the survey, participants were asked to indicate how hungry they felt on a 100-point scale (100 = "very hungry") (Lozano, Crites, & Aikman, 1999). Thereafter, they would read a brief task introduction: "You will see two healthy eating pyramids on the next page. A healthy eating pyramid is a recognizable nutrition guide that provides dietary guidelines in a visual format. Please inspect them carefully. You will be required to answer related questions afterwards."

Subsequently, two versions of the food pyramid were first displayed in large size format, one above the other on the same page. The pyramids were exactly the same as those in Wang and Basso's (2021) Study 3: the "Healthy is Up" pyramid depicted healthy food (e.g., fruits and vegetables) at the top and unhealthy food (e.g., pizza and chocolates) at the bottom, while the "Unhealthy is Up" pyramid did the opposite. The presentation of the two versions of the food pyramid was randomized, with half of the participants seeing the "Unhealthy is Up" pyramid above the "Healthy is Up" pyramid on their screen, and the other half viewing the "Healthy is Up" pyramid above the "Unhealthy is Up" pyramid.

After inspecting for at least 30 seconds (a timer was in place), participants would be able to proceed to the main question page, where two food pyramids were displayed horizontally together in a smaller size (see Figure 3). The outcome question was binary: "In your opinion, which version of the healthy eating pyramid is the better?" To avoid bringing in any horizontal biases related to food perception (Cho, 2022; Manippa, Giuliani, & Brancucci, 2020; Romero & Biswas, 2016), the arrangement of the pyramids was also randomized, with half of the participants seeing the "Healthy is Up" pyramid on the right, and the other half viewing the "Healthy is Up" pyramid on the left. The survey ended with demographic questions, a seriousness check question, and a text box for comments.

Figure 3. The main question page in study 3.



4.2. Results

Contrary to our expectations, Chinese participants were almost equally likely to choose the “Healthy is Up” pyramid (49.8%) and the “Unhealthy is Up” pyramid (50.2%). A sign test further demonstrated no significant difference between the two proportions ($p = 0.964$), providing no evidence for H_3 . A logistic regression showed that levels of hunger had no impact on participants’ choices either, $\beta = -0.001$, $SE = 0.004$, $z = -0.32$, $p = 0.749$, $OR = 1.00$, $95\% CI = [0.99, 1.01]$.

5. Discussion & conclusions

The replication attempts yield inconsistent yet interesting results. Studies 1 and 2 produce similar findings as the US studies, and thereby offer supportive evidence for the CMT postulation that omnipresent embodied experience underlies the metaphor “Healthy is Up”. Regardless of the fact that Chinese people do not talk about healthiness with vertical

metaphors, they automatically associate “Healthy Food” with “Up” and “Unhealthy Food” with “Down”, which is predicted by the embodied account. However, Study 3 fails to replicate US people’s preference for the “Healthy is Up” food pyramid. Chinese people’s likings for metaphorically congruent and incongruent arrangements are nearly identically, which is better aligned with the linguistic relativity hypothesis.

One possible explanation is that embodied experience lays the foundation for metaphorical thinking, but language determines how salient and active a metaphor is in its speakers’ minds. The cognitive tasks in Studies 1 and 2 compel participants to associate healthy and unhealthy food pictures with either up or down. The source and target domains have already been made salient. Accordingly, participants find it easier to accept the associations consistent with their bodily experience. By contrast, the scenario in Study 3 does not highlight any particular cross-domain mappings, so Chinese participants do not spontaneously think about the metaphor “Healthy is Up” given its absence in the Chinese language. In this sense, embodied experience and language use may have jointly contributed to many enduring metaphorical representations in our cognition. This accords with the earlier observations that some metaphors have plausible embodied origins whilst others seem to be rooted in linguistic conventions (Casasanto, 2014; Casasanto & Bottini, 2013), and showcases for the first time that the linguistic relativity effect and the embodied cognition effect can coexist for the same metaphor in a differentiable way.

To further examine this dual-origin hypothesis for metaphorical thinking, future research might investigate the interactions between embodied experience and language use. In a set of past experiments on linguistic relativity, researchers trained Dutch speakers with an unfamiliar Farsi metaphor “High Pitch is Thin/Low Pitch is Thick”, and found that their

performance in a pitch-reproduction task suffered from thickness interference as Farsi speakers did (Dolscheid, Shayan, Majid, & Casasanto, 2013). Nonetheless, the linguistic metaphor they provided was still congruent with our perceptual experience - thinner and lighter (vs. thicker and heavier) strings normally vibrate faster and can create a higher pitch. It could be informative to test whether exposure to the incongruent metaphor “High Pitch is Thick/Low Pitch is Thin” shows an attenuated effect, i.e., whether it is harder to acquire a new linguistic metaphor when it contradicts embodied experience. Endeavours like this can help us better understand the psychological mechanisms behind metaphorical thinking, and choose metaphors more wisely in interpersonal and public communications. The current research thus has implications for the development of metaphorical interventions: metaphors reflecting universal bodily experience should be prioritized, especially if we want to appeal to an audience with diverse cultural backgrounds.

Another potential confounding effect comes from non-metaphorical linguistic practices. While the Chinese language seems not to metaphorically express healthiness in terms of verticality, there is a coordinate phrase in Chinese which pairs up these two concepts - “健康向上”. “健康” means “Healthy” and is more strongly associated with mental health in this phrase. “向上” denotes “Upwards”, but metaphorically conveys “working hard” or “making progress” in this specific context. This usage can also be seen in phrases like “天天向上” (“working hard every day”) and “积极向上” (“having a positive and progressive attitude”). It remains unclear whether fixed phrases pairing up concepts in such a manner would also cultivate mental associations. Future research could investigate if linguistic

phenomena other than metaphors would also impact language users' thoughts and if they are likely to root from bodily experiences too.

Open Practices

All three replication studies in this research have been preregistered. The preregistrations and data will be made available at <https://osf.io/2uwaha/> upon the publication of the article. During the review process, the preregistrations can be accessed via the following anonymous links:

https://osf.io/f93r4/?view_only=62d0255ed947428a8e363c7c27ed5ffa

https://osf.io/adfpt/?view_only=1a81b6dd937c4903b8d82764634d4263

https://osf.io/eh3gj/?view_only=9789dfa7e3914be790600d835c0cee08

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Chapter 4

“Animals Are Friends, Not Food”: Anthropomorphism Leads to Less Favourable Attitudes toward Meat Consumption by Inducing Feelings of Anticipatory Guilt

Abstract

Why do people befriend animals, yet don't feel conflicted about eating some of them? Previous research on the “meat paradox” suggests that the dehumanization of meat animals plays a crucial role in attenuating the negative affective states that consumers may experience when consuming meat. However, relatively little is known about how the converse process, namely, anthropomorphism, influences meat consumption. The current research provides evidence that anthropomorphizing meat animals through the friendship metaphor, “Animals are Friends”, can alter (omnivorous) consumers' attitudes and behavioural intentions toward meat eating, and induce feelings of guilt. More specifically, our experimental findings reveal that anthropomorphism has a negative effect on consumers' attitudes toward the food served in a restaurant and their intentions to patronize it when (pork) meat is on offer. This effect holds whether consumers are invited to consider themselves (Study 1a) or staff members (Study 1b) as taking part in a friendly human-animal interaction. We also demonstrate a similar effect of anthropomorphism on attitudes

toward a (pork) meat product and their intentions to buy it, when consumers consider animal-animal friendship or human-animal friendship (Study 2). Last, we show that the negative effect of anthropomorphism on consumers' attitudes and behavioural intentions toward (pork) meat consumption is mediated by increased feelings of anticipatory guilt (Studies 3a and 3c). Nevertheless, no such effect was found with another kind of meat (beef), which indicates that anthropomorphizing meat animals through the friendship metaphor cannot be successfully applied to all commonly eaten species (Study 3b). Implications of these results for meat consumption are discussed.

Keywords

Anthropomorphism; Anticipatory guilt; Meat consumption; Meat paradox; Metaphor¹⁰

¹⁰ This chapter is a published paper: Wang, F., & Basso, F. (2019). "Animals are friends, not food": Anthropomorphism leads to less favorable attitudes toward meat consumption by inducing feelings of anticipatory guilt. *Appetite*, 138, 153-173.

1. Introduction

“Animals are friends, not food” has become an increasingly popular slogan commonly used by animal rights organizations such as People for the Ethical Treatment of Animals (PETA, 2011, 2013), and is heard beyond the vegan and the vegetarian communities. In this article, we argue that this friendship metaphor anthropomorphizes meat animals, which is the inverse of dehumanizing, a psychological process that attenuates the negative affective states that could be associated with their consumption (Bastian, Loughnan, Haslam, & Radke, 2012b; Haslam & Loughnan, 2014). Across six experimental studies, our main results support this view and show that anthropomorphism leads to less favourable attitudes toward (pork) meat consumption because of increased feelings of guilt.

2. Theoretical background

2.1. Meat paradox and dehumanization

Eating meat is considered to be part of our human evolutionary heritage (Smil, 2002). Our early ancestors began eating meat more than 2 million years ago (Stanford, 1999). Unsurprisingly, meat consumption is thus usually considered natural, normal, necessary, and nice (Piazza et al., 2015) and justified by carnism, a specific subset of speciesist beliefs and practices (Caviola, Everett, & Faber, 2018), according to which humans are unique and superior to other species (Monteiro, Pfeiler, Patterson, & Milburn, 2017; Singer, 1995). However, people in Western societies also show great love and care for some animals, exemplified by high levels of pet ownership (American Pet Products Association [APPA], 2017; McConnell, Lloyd & Buchanan, 2016) and a growing concern for farm animal welfare (Bayvel & Cross, 2010; Ingenbleek, Immink, Spoolder, Bokma, & Keeling, 2012).

On one hand, people enjoy eating meat; on the other hand, they do not want to hurt animals and even cherish some of them like friends or family members (Hirschman, 1994; McConnell, Brown, Shoda, Stayton, & Martin, 2011). This curious phenomenon is known as the “meat paradox” in psychology (Bastian et al., 2012b; Loughnan, Bratanova, & Puvia, 2012). It provides a striking illustration of cognitive dissonance (Bastian & Loughnan, 2017), which describes the state of psychological discomfort that arises when people hold contradictory attitudes and engage in inconsistent behaviours (Festinger, 1962). Evidence indicates that people tend to resolve this dissonance by spontaneously dehumanizing meat animals to deny their capacity for pain, suffering or understanding, and to justify their consumption (Bastian et al., 2012b; Haslam & Loughnan, 2014). For instance, it has been experimentally demonstrated that when people had just consumed meat (Loughnan, Haslam, & Bastian, 2010), or were merely told that they were going to consume meat in a while (Bastian et al., 2012b), they ascribed diminished mental capacities to the animal they had eaten or expected to eat. Correlational evidence further indicates that the perceived mental capacities of different animals are negatively associated with their perceived edibility (Ruby & Heine, 2012) and that omnivores attribute less humanlike emotional capacities to animals than vegetarians do (Bilewicz, Imhoff, & Drogosz, 2011).

In this article, we examine if the converse is true. Namely, we propose to test whether people are more reluctant to eat and buy meat when they are induced to think about meat animals in anthropomorphic terms, i.e. if they are prompted to humanize them.

2.2. Anthropomorphism and metaphorical thinking

Anthropomorphism is essentially about attributing humanlike characteristics to non-human agents (Epley, Waytz, & Cacioppo, 2007), which plays a crucial role in determining how a person interacts with those agents (Epley, Waytz, Akalis, & Cacioppo, 2008). Applied to human-animal interaction, past research consistently showed that anthropomorphizing animals promotes pro-animal attitudes. For instance, it has been demonstrated that people reported more willingness to help dogs in need and more support for animal rights when canines were described in anthropomorphic (vs. non-anthropomorphic) language (Butterfield, Hill, & Lord, 2012). Thinking or reading about how animals are similar to humans (vs. how humans are similar to animals) increased the perceived mental capacities of animals, which in turn reduced speciesism and raised moral concerns about animal welfare (Bastian, Costello, Loughnan, & Hodson, 2012a). Correlational evidence also shows that a higher individual tendency to anthropomorphize animals predicts greater empathic concern for animals, which is also associated with lower meat consumption (Niemyjska, Cantarero, Byrka, & Bilewicz, 2018).

Epley and colleagues (2007) further suggest that one could differentiate between a strong and a weak version of anthropomorphism, which might help understand an important boundary condition of the effect of anthropomorphism on attitudes toward animals. Contrary to weaker ones, strong forms of anthropomorphism require an explicit endorsement of anthropomorphic beliefs. For example, dog owners can hold beliefs that their pet experiences love towards them or knows when something is wrong (McConnell et al., 2016). However, it seems that people are relatively impervious to the strong form of anthropomorphism when the animals involved are currently used as food in their own

culture, which tends to limit the practical implications of this strong form of anthropomorphism (namely, mind attribution) on reducing meat consumption. Indeed, when they manipulated the perceived intelligence of three different animals (pigs, tapirs, and a fictional animal), Piazza and Loughnan (2016) found that this manipulation had no significant effect on attitudes toward eating pigs whereas eating the other two animals was judged significantly more morally wrong when they were depicted as highly intelligent (vs. unintelligent).

In the present research, we thus propose to study an alternative strategy: investigating the effect of a weaker form of anthropomorphism on attitudes toward meat eating. This form of anthropomorphism does not require conscious endorsement that the agent actually possesses humanlike traits but “may only entail ‘as if’ metaphorical reasoning” and the tendency to behave toward the agent as if it were human (Epley et al., 2007, p. 867). This view echoes Lakoff and Johnson’s (1980) conceptual metaphor theory, which posits that an ontological metaphor makes us understand experiences with non-human entities in terms of human motivations, characteristics, and activities, and shapes our attitude and behaviour accordingly. In this vein, it has been shown that the friendship metaphor induces people to think about non-human entities in anthropomorphic terms, and, for instance, makes them less willing to replace objects because one does not replace friends when they get old (Chandler & Schwarz, 2010). More generally, friendship can be seen as a paradigmatic relationship between human beings that involves emotional sharing, caring, and concern for another person, and is a source of interpersonal morality (Keller, 1994). When applied to animals, we suggest that friendship should make people less willing to consume meat because one does not harm friends (or friendly beings) to “eat” them.

2.3. Anthropomorphism, meat consumption and anticipatory guilt

Literature suggests that dehumanizing meat animals may reduce the negative affective states that could be associated with their consumption (Bastian et al., 2012b; Haslam & Loughnan, 2014). Among these negative states, qualitative and quantitative studies find that meat consumption often causes feelings of guilt (Berndsen & van der Pligt, 2004; Serpell, 1986). Guilt is defined as “an aroused form of emotional distress that is distinct from fear and anger and based on the possibility that one may be in the wrong” (Baumeister, Stillwell, & Heatherton, 1994, p. 245). It can be experienced either after one has really caused harm or suffering to others such as friends (Keller, 1994), or prior to a potential act of transgression (Burnett & Lunsford, 1994). The latter type is often referred to as anticipatory (or anticipated) guilt, which has been well documented to facilitate prosocial behaviour and ethical consumer choice (e.g., Massi, 2005; Renner, Lindenmeier, Tscheulin, & Drevs, 2013; Steenhaut & Van Kenhove, 2006; Tam, Lee, & Chao, 2013). Interestingly, research further shows that anthropomorphizing a social cause increased compliance with it and that feelings of anticipatory guilt mediated this effect (Ahn, Kim, & Aggarwal, 2014). Consistently, we hypothesized that anticipatory guilt will mediate the effect of anthropomorphizing meat animals on consumers’ attitudes toward meat consumption. Indeed, the feeling of guilt resulting from eating meat, and incidentally from harming animals, is likely to be amplified when meat animals are anthropomorphized, and the motivation to avoid this negative moral feeling may thus lead to less favourable attitudes toward meat consumption.

2.4. Predictions

We tested the following two main hypotheses across six studies (Study 1a-3c):

H₁: Exposure to anthropomorphism through the friendship metaphor results in less favourable attitudes toward meat consumption.

H₂: Exposure to anthropomorphism through the friendship metaphor lowers intentions to consume meat.

We also tested the following hypothesis across three of these six studies (Studies 3a-3c):

H₃: The negative effect of anthropomorphism on attitudes toward meat consumption is mediated by increased anticipatory guilt feelings.

2.5. Overview

In a nutshell, we expect that, when they are prompted by the friendship metaphor to think about meat animals in anthropomorphic terms, people will have less favourable attitudes and lower behavioural intentions toward meat consumption and will experience more guilt feelings. Six studies test these predictions. In a first set of two studies, we show that anthropomorphism leads to less favourable attitudes toward (pork) meat and lower intentions to patronize the restaurant where (pork) meat is on offer, when consumers are induced to imagine themselves (Study 1a) or other people (Study 1b) taking part in a friendly human-animal interaction. In a subsequent study, our findings reveal that exposure to anthropomorphism also results in less positive attitudes toward a (pork) meat product and lower intentions to purchase it, whether consumers are prompted to think about either

animal-animal friendship or human-animal friendship (Study 2). In the last three studies, we find that the negative effect of anthropomorphism on attitudes toward meat consumption is mediated by increased feelings of anticipatory guilt about eating (pork) meat (Studies 3a and 3c), but that it may not be extended to all species of meat animals (Study 3b).

2.6. Ethics statement, data availability and quality control

This series of studies received the approval of the Department of Psychological and Behavioural Science (DPBS) Ethics Committee of the London School of Economics (LSE), and the full dataset has been made available on the Open Science Framework at <https://osf.io/7wjmz/>.

Across all studies, we used adapted specific quality control techniques for online research (Mason & Suri, 2012). First, at the end of each study, participants completed a manipulation check (described below). A voluntary withdrawal question also asked whether they answered with care and diligence. It was explicitly stated that there would be no penalty for answering no. Moreover, a timer (ranging from 5 to 10 seconds) was added to each page (but not displayed on the screen) to ensure that participants read all the stimuli carefully. Last, duplicate IP addresses were reviewed and systematically removed. Studies collected after the EU General Data Protection Regulation (GDPR) became applicable in May 2018 used Unique Turker (<https://uniqueturker.myleott.com/>) to avoid duplicates.

3. Study 1a

Study 1a tested H_1 and H_2 in the context of a restaurant. Namely, it tested whether exposure to anthropomorphism through consumer-animal friendship results in less favourable attitudes toward the food served in a restaurant (H_1) and lowers intentions to patronize it (H_2) when meat (vs. non-meat) is on offer.

3.1. Material and methods

Participants. Study 1a was a two-group between-subjects design. The number of participants recruited was based on an *a priori* power analysis using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007), which indicated that a sample size of 64 per condition would be needed to detect a medium size effect ($d = 0.50$) with an alpha level of 0.05 and a desired power of 0.80 (Cohen, 1992). One hundred and sixty-three participants from the United States were recruited online through Amazon's Mechanical Turk (Buhrmester, Kwang, & Gosling, 2011) and completed the study in exchange for \$0.30. Of those, 25 were excluded for the following reasons: duplicate IP addresses ($n = 1$), failed manipulation check ($n = 9$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 14$); allergic to animals and unable to interact with them ($n = 1$); leaving 138 participants (Female = 64; $M_{\text{age}} = 37.51$, $SD_{\text{age}} = 12.00$).

Procedure and measures. Participants were first exposed to anthropomorphism by being presented with web pages describing a piglet café ("Mr. Piggy's Café") that offered a unique experience where customers could play with cute piglets whilst enjoying food and drink: "Piglets are like dogs. They love to play lots of interactive games such as fetch. So try tossing a stick to see if our piglets will retrieve it. Piglets also enjoy pushing balls around

with their noses. Try giving them a big bouncy ball to push around their pens or around the yard of our café! You'll love it!" Participants were then randomly assigned to one of two conditions: those assigned to the meat condition ($n = 72$) read that the café served "pork sausages and [our] famous smoked bacon rolls" as breakfast specials, whereas those assigned to the non-meat condition ($n = 66$) read that the café served "spinach omelette and [our] famous baked egg rolls" (see Appendix A1 for all materials used in this study). Last, participants were asked to report their intentions to patronize the restaurant and their attitudes toward the food served in the restaurant.

Intentions to patronize the restaurant were measured using a three-item scale adapted from Bohner, Einwiller, Erb and Siebler (2003): "Based on your general impression, Mr. Piggy's Café is..." (1 = "very bad" to 7 = "very good"); "You would very much like to visit Mr. Piggy's Café..." (1 = "not true at all" to 7 = "exactly true"); and "The likelihood that you would visit a restaurant providing services similar to Mr. Piggy's Café during the next 12 months is..." (1 = "very low" to 7 = "very high").

Attitudes toward the food served in the restaurant were measured using a two-item scale adapted from Raghunathan, Naylor and Hoyer (2006): "How tasty do you think the food at Mr. Piggy's Café would be?" and "How much do you think you would enjoy eating at Mr. Piggy's Café?" (1 = "not at all" to 7 = "very"). This particular measure combined inferred tastiness and enjoyment of food and was chosen because the gustatory enjoyment of meat was found to be the most salient barrier to adopting a vegetarian diet (Lea & Worsley, 2003; Pohjolainen, Vinnari, & Jokinen, 2015).

Last, participants were required to complete the manipulation check. They were asked to recall: “What breakfast specials does Mr. Piggy’s Café offer?” and were presented with three options: (1) “Spinach omelette and baked egg rolls”, (2) “Pork sausages and smoked bacon rolls”, (3) “I do not remember”. Participants who did not pass this check (because they selected either the incorrect option or reported that they did not remember) were excluded from subsequent analyses. Information with regard to dietary practice (Piazza & Loughnan, 2016) was collected afterwards, along with demographic data, the voluntary withdrawal question and space for comments (e.g., on food allergies).

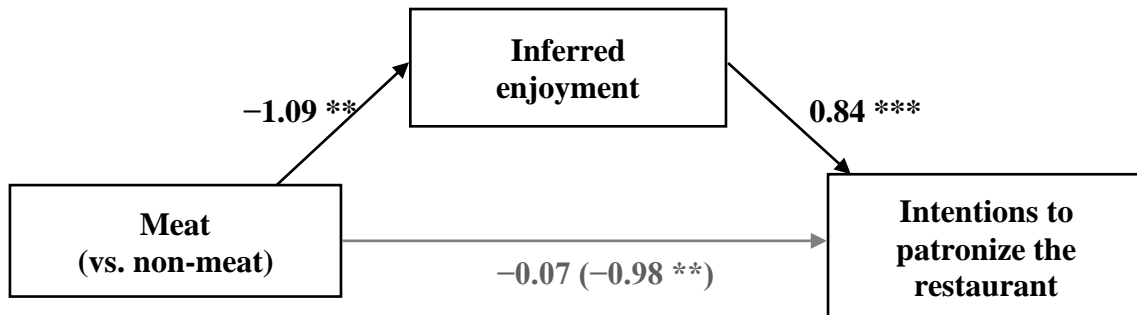
3.2. Results

Intentions to patronize the restaurant. The items used to measure consumers’ intentions to patronize the restaurant were highly correlated (Cronbach’s $\alpha = 0.94$) and were thus averaged. As predicted, an independent samples *t*-test revealed that consumers had lower intentions to patronize the restaurant that provided meat ($M = 3.38$, $SD = 1.98$) (vs. non-meat; $M = 4.36$, $SD = 1.93$), $t(136) = -2.93$, $p = 0.004$, $d = -0.50$.

Attitudes toward the food served in the restaurant. Given the low reliability of the scale in this study (Cronbach’s $\alpha = 0.63$), inferred tastiness and enjoyment of food were analysed separately. Independent samples *t*-test analyses revealed that consumers inferred that eating food was less enjoyable in the restaurant that provided meat ($M = 3.51$, $SD = 2.12$) (vs. non-meat; $M = 4.61$, $SD = 2.07$), $t(136) = -3.06$, $p = 0.003$, $d = -0.52$. Unexpectedly, there was no significant difference in inferred tastiness of the food served between the meat ($M = 5.14$, $SD = 1.45$) and the non-meat ($M = 4.92$, $SD = 1.30$) conditions, $t(136) = 0.912$, $p = 0.363$, $d = 0.16$.

Mediation analyses. In the absence of significant direct effect of our experimental manipulation on inferred tastiness, we only tested whether inferred enjoyment of food mediated the effect on consumers' intentions to patronize the restaurant providing meat (vs. non-meat). We conducted this mediation analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2013). We dummy coded the conditions as follows: 0 = non-meat, 1 = meat, and we entered inferred enjoyment of food as potential mediator and intentions to patronize the restaurant as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated that the indirect effect was negative and significant ($\beta = -0.91$, $SE = 0.29$, $95\% CI = [-1.47, -0.33]$), whereas the direct effect was not significant ($\beta = -0.07$, $SE = 0.16$, $95\% CI = [-0.37, 0.24]$, $p = 0.668$), showing that inferred enjoyment of food fully mediated the negative effect of anthropomorphism on intentions to patronize the restaurant (see Figure 1). The model accounted for 81% of the variance in intentions to patronize the restaurant ($R^2 = 0.81$).

Figure 1. Mediation model showing that providing meat (vs. non-meat) in a restaurant where animals are friends reduces inferred enjoyment of food which in turn leads to decreased intentions to patronize the restaurant in Study 1a ($*p < 0.05$, $**p < 0.01$, $***p < 0.001$). The model accounted for 81% of the variance in intentions to patronize the restaurant ($R^2 = 0.81$).



3.3. Discussion

As predicted by H₂, consumers had lower intentions to patronize a restaurant where they can have friendly interactions with animals when meat (vs. non-meat) was on offer. However, contrary to H₁, only one dimension of attitudes toward the food served, namely the enjoyment of food, but not its tastiness, was reduced in the meat condition. Interestingly, though, the inferred enjoyment of food fully mediated the negative effect of anthropomorphism on consumers' behavioural intentions. This suggests that when they are prompted to think about meat animals in anthropomorphic terms, participants would have less pleasure eating meat, such pleasure being the most salient barrier to adopting a vegetarian diet (Lea & Worsley, 2003; Pohjolainen, Vinnari, & Jokinen, 2015)

One might speculate that, unexpectedly, the taste associated with meat (vs. non-meat) was not significantly affected by anthropomorphism because participants were presented with different types of food (meat vs. non-meat), of which tastiness is likely to have a different reference point (or initial baseline value). Along this line of argument, even if anthropomorphism actually decreased the taste associated with meat (bacon) and conversely enhanced the taste associated with a non-meat item (omelette), its effect was statistically non-significant when both conditions were compared with each other, because the taste scores associated with meat (bacon) might have had a reference point higher than the non-meat item (omelette). We thus conducted Study 1b to address this limitation and improve several features of this study.

4. Study 1b

Study 1b also tested H₁ and H₂ in the context of a restaurant. More specifically, it examined whether exposure (vs. non-exposure) to anthropomorphism through staff-animal friendship results in less favourable attitudes toward the food served in a meat restaurant (H₁) and lowers intentions to patronize it (H₂).

Unlike Study 1a, in this study, meat was on offer in both conditions but anthropomorphism was induced in one condition only. Study 1b also used a different and more realistic scenario, where staff members rather than consumers played with meat animals. Indeed, while pet cafés are becoming increasingly popular around the world, they are still rare, and involve mostly cats or dogs (Giannitrapani, 2018). Moreover, in order to protect animal health and welfare and to reduce boredom, some regulations require farmers to provide meat animals (e.g., pigs) with “proper investigation and manipulation activities” (e.g., European Directive 2001/93/EC), which could be achieved with games (Bracke, 2018). Focusing Study 1b on a more realistic farm context where staff members play with the pigs they rear also allowed us to remove any explicit reference (word or picture) to piglets’ cuteness, which could have, to some extent, influenced participants’ willingness to eat meat (Zickfeld, Kunst, & Hohle, 2018). Last, Study 1b allowed us to be more specific with small adjustments in the wording of the scales measuring the intentions to patronize the restaurant (to specify the likelihood of “eating at” rather than “visiting” the restaurant) and the attitudes toward meat (to specify that “pork dishes” were served in the restaurant).

4.1. Material and methods

Participants. Study 1b was a two-group between-subjects design. As in Study 1a, a target sample size of 64 participants per condition was determined to detect a medium size effect ($d = 0.50$) with an alpha level of 0.05 and a desired power of 0.80 (Cohen, 1992). One hundred and fifty-seven participants from the United States who had not participated in the previous study were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 40 were excluded for the following reasons: duplicate IP addresses ($n = 2$), failed manipulation check ($n = 21$), did not answer with care and diligence ($n = 2$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 15$); leaving 117 participants (Female = 52; $M_{\text{age}} = 33.23$, $SD_{\text{age}} = 9.58$).

Procedure and measures. Participants were presented with web pages describing a meat restaurant ("Mr. Piggy's") that offered delicious pork dishes. They were then randomly assigned to one of two conditions. In the anthropomorphism condition, participants ($n = 53$) read that pigs were playing games with staff:

"Our meat is unique because our team entertains our farm pigs, which keeps them in good emotional and physical health! Pigs love to play the games that man's best friends, dogs, enjoy too. They like interactive games such as fetch. As soon as they see our team member with a Frisbee, they are ready to run and retrieve it. They also enjoy pushing a big bouncy ball around the green yard with their noses, which allows them to be active all day long!"

In the control condition, participants ($n = 64$) read that pigs were raised in a free-range environment:

“Our meat is unique because our farm pigs grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm pigs are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!” (see Appendix A2 for all materials used in this study).

Participants were then asked to report their intentions to patronize the meat restaurant and their attitudes toward meat. The scales were adapted from those used in Study 1a to be more specific. Intentions to patronize the meat restaurant were measured using the following three-item scale: “Based on your general impression, Mr. Piggy’s is...” (1 = “very bad” to 7 = “very good”); “You would very much like to eat at Mr. Piggy’s...” (1 = “not true at all” to 7 = “exactly true”); and “The likelihood that you would eat at a restaurant providing services similar to Mr. Piggy’s during the next 12 months is...” (1 = “very low” to 7 = “very high”). Attitudes toward the food served in the restaurant were measured using the following two-item scale: “How tasty do you think the pork dishes at Mr. Piggy’s would be?” and “How much do you think you would enjoy eating pork dishes at Mr. Piggy’s?” (1 = “not at all” to 7 = “very”).

Last, before collecting information about dietary practice along with demographic data, the voluntary withdrawal question and space for comments, participants were required to

complete the manipulation check (“According to them, what makes the meat at Mr. Piggy’s so unique?”) (1) “Their farm pigs are reared to the highest welfare standards”, (2) “Their farm pigs can play interactive games”, (3) “I do not remember”).

4.2. Results

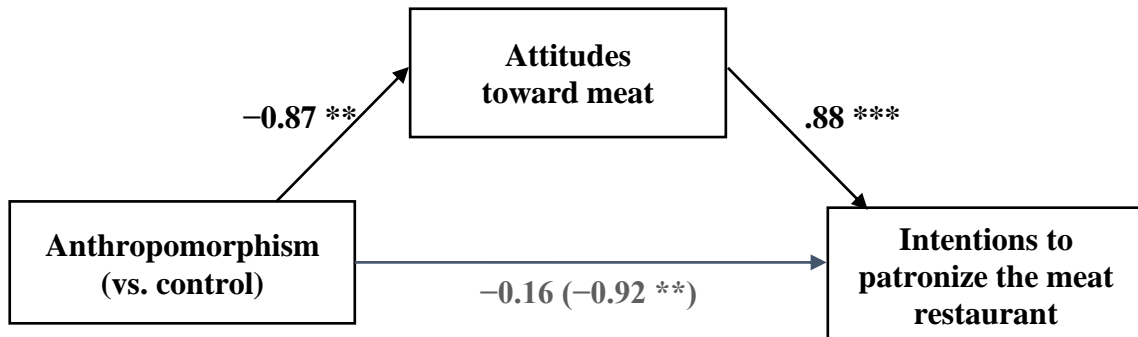
Intentions to patronize the meat restaurant. The items used to measure consumers’ intentions to patronize the meat restaurant were highly correlated (Cronbach’s $\alpha = 0.87$) and were thus averaged. As predicted, an independent samples *t*-test revealed that consumers had lower intentions to patronize the meat restaurant in the anthropomorphism condition ($M = 4.85$, $SD = 1.90$) (vs. control; $M = 5.77$, $SD = 1.04$), $t(115) = -3.33$, $p = 0.001$, $d = -0.62$.

Attitudes toward meat. The items used to measure consumers’ attitudes toward meat were highly correlated (Cronbach’s $\alpha = 0.81$) and were thus averaged. As predicted, an independent samples *t*-test revealed that consumers had less favourable attitudes toward meat in the anthropomorphism condition ($M = 5.33$, $SD = 1.86$) (vs. control; $M = 6.20$, $SD = 0.85$), $t(115) = -3.36$, $p = 0.001$, $d = -0.62$.

Mediation analysis. We then conducted a mediation analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2013) to test whether consumers’ attitudes toward meat mediated the effect of anthropomorphism on their intentions to patronize the restaurant. We dummy coded the conditions as follows: 0 = control, 1 = anthropomorphism, and we entered attitudes toward meat as potential mediator and intentions to patronize the restaurant as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated that the indirect effect was negative and significant ($\beta = -0.76$, $SE = 0.23$, 95%

$CI = [-1.23, -0.33]$), whereas the direct effect was not significant ($\beta = -0.16$, $SE = 0.17$, $95\% CI = [-0.49, 0.17]$, $p = 0.346$), showing that the negative effect of anthropomorphism on intentions to patronize the meat restaurant was fully mediated by attitudes toward meat (see Figure 2). The model accounted for 70% of the variance in intentions to patronize the restaurant ($R^2 = 0.70$).

Figure 2. Mediation model showing that anthropomorphism (vs. control) leads to less favourable attitudes toward meat which in turn leads to decreased intentions to patronize the meat restaurant in Study 1b ($*p < 0.05$, $**p < 0.01$, $***p < 0.001$). The model accounted for 70% of the variance in intentions to patronize the restaurant ($R^2 = 0.70$).



4.3. Discussion

As predicted, anthropomorphism (vs. control) decreased consumers' intention to patronize the meat restaurant (supporting H₂) by reducing the inferred tastiness and enjoyment of meat (supporting H₁). Together with Study 1a, these findings indicate that anthropomorphism has a negative effect on consumers' attitudes toward meat, which in turn reduces their intentions to patronize a meat restaurant. This effect holds whether consumers consider themselves (Study 1a) or staff members (Study 1b) to be taking part in a friendly human-animal interaction. However, one might argue that such friendly consumer-animal and staff-animal interactions could also have prompted participants to

think about piglets and pigs as pets, and therefore inedible animals (Bekker, Tobi, & Fischer, 2017). Study 2 thus tested whether our previous effect would be observed when anthropomorphism through animal-animal friendship is under consideration.

5. Study 2

We had one main goal for Study 2: applying the friendship metaphor to animal-animal interactions in order to avoid any potential implicit reference to petting. We set out to test if describing animals as friends of each other (animal-animal friendship) would have the same effects as describing animals as friends of humans (human-animal friendship). In addition, we sought an additional replication of the negative effect of anthropomorphism on attitudes toward meat consumption in a different consumption context (buying a meat product rather than patronizing a meat restaurant). Study 2 thus tested whether exposure (vs. non-exposure) to anthropomorphism through staff-animal friendship or animal-animal friendship results in less favourable attitudes toward a meat product (H₁) and decreases intentions to buy it (H₂).

5.1. Material and methods

Participants. Study 2 was a three-group between-subjects design. Based on an *a priori* power analysis using G*Power 3.1 (Faul et al., 2007), the target sample size was set at 159 participants in total to detect a medium size effect ($f = 0.25$) with an alpha level of 0.05 and a desired power of 0.80 (Cohen, 1992). Two hundred and eleven participants from the United States who had not participated in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 49 were excluded for the following reasons: failed manipulation check ($n = 25$), did

not answer with care and diligence ($n = 4$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 20$); leaving 162 participants (Female = 95; $M_{\text{age}} = 33.44$, $SD_{\text{age}} = 11.25$).

Procedure and measures. Participants were presented with web pages describing a pork brand (“Mr. Piggy’s”) that offered delicious pork chops. They were then randomly assigned to one of three following conditions: animal-animal friendship ($n = 52$) vs human-animal friendship ($n = 52$) vs. control ($n = 58$). Participants read the same vignettes as Study 1b in the control condition where pigs were raised in a free-range environment and in the human-animal friendship condition where pigs were playing games with staff. In the animal-animal friendship condition, participants read that pigs were friends with each other:

“Healthy pigs are delicious, nutritious pigs. Our farm pigs play games with each other, which keeps them in good emotional and physical health. Pigs are social animals, so they need each other to feel well just as we need friends. They require other pigs as companions with whom to eat, sleep, play and sort out group dynamics. They always enjoy pushing a big bouncing ball together around the green yard with their noses, which allows them to be active all day long!” (see Appendix A3 for all materials used in this study).

Subsequently, as in previous studies, participants were asked to report their attitudes toward meat (“How tasty do you think the pork produced by Mr. Piggy’s would be?” and “How enjoyable do you think the pork produced by Mr. Piggy’s would be?”; 1 = “not at all” to 7 = “very”). They were also required to rate the likelihood of purchasing the meat product that was featured on the web page on the following scale: “How likely would you

be to purchase pork chops from Mr. Piggy's?" (1 = "not at all likely" to 7 = "very likely"). Last, before collecting information about dietary practice along with demographic data, the voluntary withdrawal question and space for comments, participants completed the manipulation check ("How does Mr. Piggy's keep their farm pigs in good health?" (1) "Their pigs grow in a free-range natural environment", (2) "Their pigs play games with each other", (3) "Their team plays interactive games with their pigs", (4) "I do not remember").

5.2. Results

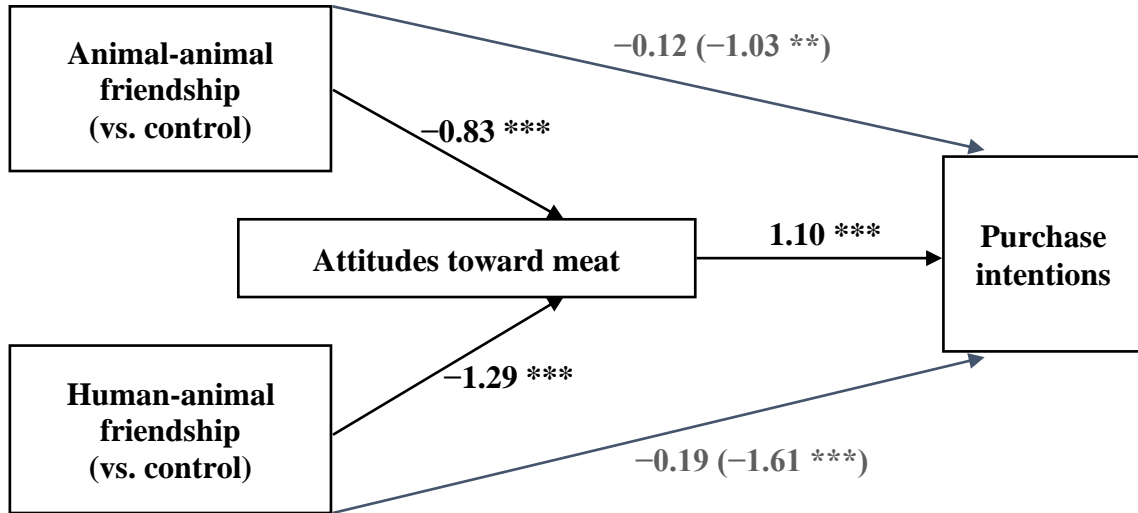
Attitudes toward meat. The items used to measure consumers' attitudes toward meat were highly correlated (Cronbach's $\alpha = 0.84$) and were thus averaged. A one-way analysis of variance (ANOVA) indicated significant differences in attitude scores between the three conditions ($F(2, 159) = 15.18, p < 0.001, \eta^2 = 0.16$). As expected, Bonferroni-corrected post-hoc *t*-tests indicated that the mean scores of attitudes toward meat were significantly lower in both anthropomorphism conditions (animal-animal friendship condition: $M = 5.40, SD = 1.31, p = 0.002, d = -0.76$; human-animal friendship condition: $M = 4.94, SD = 1.54, p < 0.001, d = -1.06$) than in the control condition ($M = 6.23, SD = 0.83$); and that the difference between the two anthropomorphism conditions was not significant ($p = 0.184, d = -0.32$).

Purchase intentions. Likewise, a one-way ANOVA indicated significant differences in purchase intentions between the three conditions ($F(2, 159) = 11.92, p < 0.001, \eta^2 = 0.13$). As expected, Bonferroni-corrected post-hoc *t*-tests indicated that purchase intentions were significantly lower in both anthropomorphism conditions (animal-animal friendship

condition: $M = 4.67$, $SD = 1.99$, $p = 0.007$, $d = -0.60$; human-animal friendship condition: $M = 4.10$, $SD = 1.82$, $p < 0.001$, $d = -0.98$) than in the control condition ($M = 5.71$, $SD = 1.46$). Post-hoc analyses further indicated that the difference in purchase intentions between the two anthropomorphism conditions was not significant ($p = 0.289$, $d = -0.30$).

Mediation analysis. We then conducted a mediation analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2013) to test whether consumers' attitudes toward meat mediated the effect of anthropomorphism on their purchase intentions. The mediation model included experimental manipulation as the multi-categorical independent variable (indicator coding; Hayes & Preacher, 2014), attitudes toward meat as mediator, and purchase intentions as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated that the indirect effect of animal-animal friendship (vs. control) on purchase intentions through attitudes toward meat was significant ($\beta = -0.91$, $SE = 0.23$, $95\% CI = [-1.37, -0.46]$). Likewise, the indirect effect of human-animal friendship (vs. control) on purchase intentions through attitudes toward meat was significant ($\beta = -1.42$, $SE = 0.26$, $95\% CI = [-1.95, -0.93]$). The direct effects were both non-significant ($\beta = -0.12$, $SE = 0.22$, $95\% CI = [-0.55, 0.31]$, $p = 0.576$; $\beta = -0.19$, $SE = 0.23$, $95\% CI = [-0.64, 0.26]$, $p = 0.404$), which indicated a full mediation (see Figure 3). The model accounted for 66% of the variance in purchase intentions ($R^2 = 0.66$).

Figure 3. Model testing that attitudes toward meat mediate the negative effect of anthropomorphism on purchase intentions in Study 2 (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounted for 66% of the variance in purchase intentions ($R^2 = 0.66$).



5.3. Manipulation check for anthropomorphism

An additional study was conducted to check whether the meat animals (pigs) in the two anthropomorphism conditions were perceived as more humanlike than those in the control condition. We performed this manipulation check separately from Study 2 because asking about anthropomorphic beliefs primes anthropomorphism and could impact people’s follow-up attitudes toward meat eating (Ruby & Heine, 2012). Moreover, reflecting on one’s own meat consumption could also change people’s subsequent anthropomorphic beliefs and motivate them to dehumanize meat animals (Bastian et al., 2012b). Thus, measuring anthropomorphic beliefs could have influenced consumers’ attitudes toward meat and purchase intentions.

Two hundred and forty-two participants from the United States who had not participated

in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 68 were excluded for the following reasons: failed manipulation check ($n = 25$), did not answer with care and diligence ($n = 8$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 35$); leaving 174 participants (Female = 81, Other = 1; $M_{\text{age}} = 39.98$, $SD_{\text{age}} = 13.64$).

Participants were randomly assigned to one of the three following conditions (further detailed in Study 2): animal-animal friendship ($n = 58$) vs. human-animal friendship ($n = 55$) vs. control ($n = 61$), where they were instructed to read the web pages describing the pork brand ("Mr. Piggy's") and then to evaluate the pigs described on three anthropomorphic traits: "thoughtful", "sympathetic" and "considerate" (1 = "not at all true", 7 = "completely true"), identified as especially relevant to social connection (Epley, Waytz, & Cacioppo, 2007; McConnell, Brown, Shoda, Stayton, & Martin, 2011). Additionally, participants were asked to report on two separate 7-point Likert scales the extent to which the pork produced by "Mr. Piggy's" is "organic" and is "ecological" (these results are discussed in Appendix B).

The three items used to measure consumers' anthropomorphic beliefs were highly correlated (Cronbach's $\alpha = 0.93$) and were thus averaged. A one-way ANOVA indicated significant differences in anthropomorphic beliefs between the three conditions ($F(2, 171) = 5.41, p = 0.005, \eta^2 = 0.06$). In line with our expectations, Bonferroni-corrected post-hoc t -tests indicated that anthropomorphic beliefs were significantly higher in both anthropomorphism conditions (animal-animal friendship condition: $M = 4.14, SD = 1.82, p = 0.008, d = 0.54$; human-animal friendship condition: $M = 4.00, SD = 1.60, p = 0.036,$

$d = 0.49$) than in the control condition ($M = 3.18$, $SD = 1.73$). Post-hoc analyses further indicated that the difference in anthropomorphic beliefs between the two anthropomorphism conditions was not significant ($p > 0.999$, $d = 0.09$).

Overall, these results confirmed that, when compared with consumers in the control condition, consumers exposed to the friendship metaphor (applied to animal-animal interactions and human-animal interactions) were more likely to anthropomorphize the meat animals (pigs) by endowing them with humanlike traits that are associated with social connection.

5.4. Discussion

As predicted, whether expressed through animal-animal friendship or human-animal friendship, anthropomorphism (vs. control) decreased consumers' intentions to buy a meat product (supporting H₂) by leading to less favourable attitudes toward it (supporting H₁). This finding suggests that the negative effect of anthropomorphism on attitudes toward meat consumption is not contingent on human-animal interaction that could be implicitly associated with petting, but is generated by the friendship metaphor even when applied to animal-animal interaction. The subsequent series of studies was designed to replicate these results and to explore their underlying psychological mechanism.

6. Study 3a

The purpose of Study 3a was twofold. First, we sought to replicate the negative effect of anthropomorphism through animal-animal friendship on consumers' attitudes toward meat

(H₁) and purchase intentions (H₂). Second, we wanted to test whether this negative effect was mediated by feelings of anticipatory guilt (H₃).

6.1. Material and methods

Participants. Study 3a was a two-group between-subjects design. An *a priori* power analysis conducted in G*Power 3.1 (Faul et al., 2007) and based on an estimated effect size $d = 0.60$ (i.e. the weakest significant effect observed in Study 2) indicated that a sample size of 45 participants per condition would be needed to have a desired power of 0.80 with an alpha level of 0.05 (Cohen, 1992). One hundred forty-eight participants from the United States who had not participated in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 37 were excluded for the following reasons: duplicate IP addresses ($n = 1$), failed manipulation check ($n = 15$), did not answer with care and diligence ($n = 7$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 14$); leaving 111 participants (Female = 62; $M_{\text{age}} = 37.53$, $SD_{\text{age}} = 10.67$).

Procedure and measures. Instructions and procedure were similar to Study 2 but included only two conditions: animal-animal friendship ($n = 56$) vs. control ($n = 55$), to which participants were randomly assigned (see Appendix A4 for all materials used in this study). After being asked to report their attitudes toward meat and to rate the likelihood of purchasing the meat product, they were instructed to complete an additional four-item measure of anticipatory guilt adapted from Ahn, Kim and Aggarwal (2014). Participants were required to imagine eating the pork chops produced by Mr. Piggy's and to indicate how strongly they would feel "guilty", "responsible", "accountable" and "ashamed" on a

7-point scale (1 = “not at all” to 7 = “very strongly”). Last, before collecting information about dietary practice along with demographic data, the voluntary withdrawal question and space for comments, participants completed the manipulation check (“How does Mr. Piggy’s keep their farm pigs in good health?” (1) “Their pigs grow in a free-range natural environment”, (2) “Their pigs play interactive games with each other like friends”, (3) “I do not remember”).

6.2. Results

Attitudes toward meat. The items used to measure consumers’ attitudes toward meat were highly correlated (Cronbach’s $\alpha = 0.77$) and were thus averaged. As predicted, an independent samples *t*-test revealed that consumers had less favourable attitudes toward meat in the anthropomorphism condition ($M = 5.59$, $SD = 1.28$) (vs. control; $M = 6.24$, $SD = 0.90$), $t(109) = -3.08$, $p = 0.003$, $d = -0.59$.

Purchase intentions. Consistently, an independent samples *t*-test indicated that purchase intentions were significantly lower in the anthropomorphism condition ($M = 4.95$, $SD = 1.99$) (vs. control; $M = 5.76$, $SD = 1.60$), $t(109) = -2.39$, $p = 0.019$, $d = -0.45$.

Anticipatory guilt. Whereas Ahn and colleagues (2014) treated the scale as unidimensional, Pinto and Priest (1991) demonstrated that “responsible” and “accountable” did not load on the same factor as the other two items. A factor analysis of item scores, using principal axis factoring extraction with varimax rotation, confirmed that there were two distinct factors that we labelled anticipatory guilt and anticipatory responsibility. Both the scree plot and parallel analysis suggested this two-factor solution that explained 92.99% of the total variance (anticipatory guilt, 66.28%; anticipatory responsibility, 26.71%).

Individual factors also demonstrated adequate internal consistency (anticipatory guilt, Cronbach's $\alpha = 0.94$; anticipatory responsibility, Cronbach's $\alpha = 0.90$). As expected, an independent samples *t*-test indicated that anticipatory guilt was significantly higher in the anthropomorphism condition ($M = 3.02, SD = 2.22$) (vs. control; $M = 1.65, SD = 1.15$), $t(109) = 4.08, p < 0.001, d = 0.77$. To the contrary, additional analyses did not reveal any significant difference in anticipatory responsibility between the anthropomorphism condition ($M = 4.05, SD = 2.02$) and the control condition ($M = 3.67, SD = 2.10$), $t(109) = 0.97, p = 0.332, d = 0.19$. A summary of the results is presented in Table 1.

Mediation analysis. We then conducted a mediation analysis using the PROCESS Model 6 macro for SPSS (Hayes, 2013) to test whether consumers' purchase intentions were mediated by anticipatory guilt and attitudes toward meat. We dummy coded the conditions as follows: 0 = control, 1 = anthropomorphism, and we entered anticipatory guilt as first mediator, attitudes toward meat as second mediator and purchase intentions as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated a significant indirect effect of anthropomorphism on purchase intentions through anticipatory guilt and attitudes toward meat ($\beta = -0.46, SE = 0.17, 95\% CI = [-0.89, -0.19]$), with no other pathways significant (see Table 2, Table 3, and Figure 4). Therefore, being exposed to anthropomorphism (vs. control) increased consumers' feelings of anticipatory guilt about eating meat, which led to less favourable attitudes toward meat, and eventually, to lower purchase intentions. The model accounted for 56% of the variance in purchase intentions ($R^2 = 0.56$).

Table 1. Means and standard deviations (in parentheses) of dependent variables by condition in Studies 3a-3c (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

	Study 3a (Pigs)		Study 3b (Cows)		Study 3c (Pigs)	
	Anthropomorphism (animal-animal friendship)	Control	Anthropomorphism (animal-animal friendship)	Control	Anthropomorphism (human-animal friendship)	Control
Attitudes toward meat	5.59 ** (1.28)	6.24 ** (0.90)	5.90 (1.30)	6.12 (0.99)	5.43 *** (1.31)	6.24 *** (0.81)
Purchase intentions	4.95 * (1.99)	5.76 * (1.60)	5.37 (1.90)	5.68 (1.18)	4.87 *** (1.88)	5.93 *** (1.16)
Anticipatory guilt	3.02 *** (2.22)	1.65 *** (1.15)	2.28 (1.89)	1.84 (1.06)	3.36 *** (2.26)	2.12 *** (1.50)
Anticipatory responsibility	4.05 (2.02)	3.67 (2.10)	3.95 (2.04)	4.11 (1.56)	4.04 (1.91)	4.24 (1.74)

Table 2. Direct and indirect effects of anthropomorphism (vs. control) on consumers' purchase intentions through anticipatory guilt and attitudes toward meat in Study 3a.

<i>Pathways</i>	β	<i>SE</i>	<i>95% CI</i>
Anthropomorphism → Purchase intentions (Direct effect)	0.04	0.25	[-0.46, .54]
Anthropomorphism → Attitudes toward meat → Purchase intentions	-0.25	0.21	[-0.67, .13]
Anthropomorphism → Anticipatory guilt → Purchase intentions	-0.14	0.15	[-0.48, .10]
Anthropomorphism → Anticipatory guilt → Attitudes toward meat → Purchase intentions	-0.46	0.17	[-0.89, -0.19]

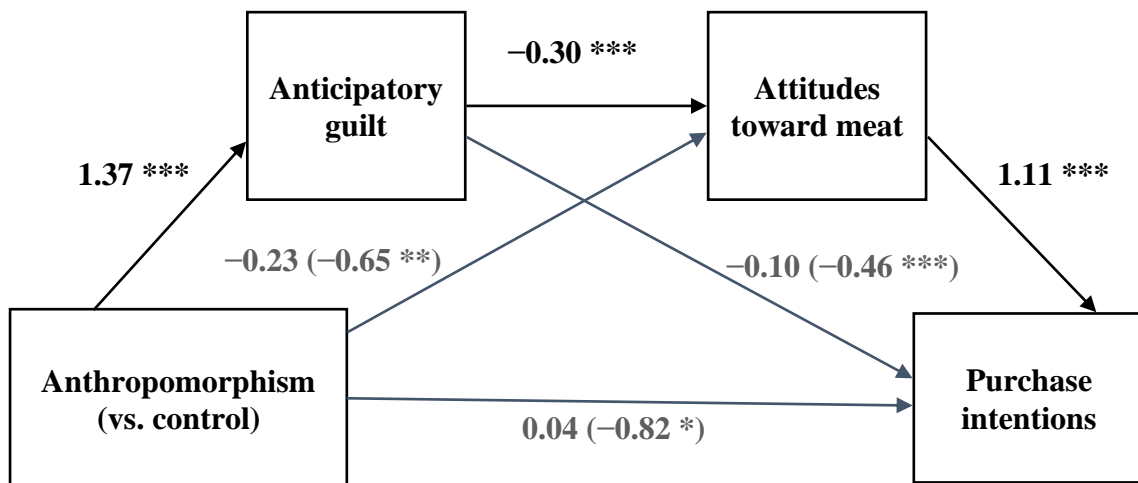
Note. Significant pathways are in bold text.

Table 3. Two phases of the serial mediation through anticipatory guilt and attitudes toward meat to purchase intentions in Study 3a.

<i>Phases</i>	β	<i>SE</i>	<i>95% CI</i>
Anthropomorphism -> Anticipatory guilt -> Attitudes toward meat	-0.42	0.16	[-0.79, -0.17]
Anticipatory guilt -> Attitudes toward meat -> Purchase intentions	-0.36	0.08	[-0.53, -0.22]

Note. Significant pathways are in bold text.

Figure 4. Model testing the negative effect of anthropomorphism (vs. control) on purchase intentions through anticipatory guilt and attitudes toward meat in Study 3a (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounted for 56% of the variance in purchase intentions ($R^2 = 0.56$).



6.3. Discussion

Replicating the previous experiment with the friendship metaphor applied to animal-animal interactions, anthropomorphism (vs. control) decreased consumers' intentions to buy a meat product (supporting H₂). As expected, the current study also showed that this effect was mediated by increased feelings of anticipatory guilt (supporting H₃) which led to less favourable attitudes toward meat (inferred tastiness and enjoyment of meat) (supporting H₁). This finding supports our assumption: anthropomorphizing meat animals amplifies the negative moral feelings associated with eating meat. In Study 3b, we tried to replicate and extend these results to a meat animal other than pigs.

7. Study 3b

Thus far, four studies showed, in two different consumption contexts (meat restaurant and meat product), that, through the friendship metaphor, anthropomorphism had a negative effect on attitudes toward meat consumption. Our previous study further showed that this effect might be explained by increased guilt feelings. While these results strongly support our assumptions, our studies only considered pork, the most widely eaten meat in the world according to the Food and Agriculture Organization (2017). In Study 3b, we sought to replicate and extend our previous findings to another popular meat, beef.

7.1. Material and methods

Participants. Study 3b was a two-group between-subjects design. As in Study 3a, a target sample size of 45 participants per condition was determined to detect an estimated size effect of $d = 0.60$ with an alpha level of 0.05 and a desired power of 0.80. One hundred and

forty-three participants from the United States who had not participated in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 35 were excluded for the following reasons: duplicate IP addresses ($n = 3$), failed manipulation check ($n = 11$), did not answer with care and diligence ($n = 5$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat beef for religious or other reasons ($n = 16$); leaving 108 participants (Female = 53, Other = 1; $M_{\text{age}} = 35.12$, $SD_{\text{age}} = 9.16$).

Procedure and measures. Procedure and instructions were similar to Study 3a with two conditions: anthropomorphism ($n = 51$) vs. control ($n = 57$), except that the stimuli were about a beef brand ("Mr. Moo's") that offered delicious beef steaks (see Appendix A5 for all materials used in this study).

7.2. Results

The items used to measure consumers' attitudes toward meat were highly correlated (Cronbach's $\alpha = 0.88$) and were thus averaged, and a principal axis factor analysis with varimax rotation yielded two factors for the anticipatory guilt scale as in Study 3a. The two factors (anticipatory guilt, 59.86%; anticipatory responsibility, 32.07%) explained 91.93% of the total variance and demonstrated adequate internal consistency (anticipatory guilt, Cronbach's $\alpha = 0.93$; anticipatory responsibility, Cronbach's $\alpha = 0.89$). However, contrary to our expectations, independent samples t -tests did not reveal any significant difference in attitudes toward meat ($t(106) = -1.00$, $p = 0.320$, $d = -0.19$), purchase intentions ($t(106) = -1.04$, $p = 0.303$, $d = -0.20$), anticipatory guilt ($t(106) = 1.52$, $p = 0.130$, $d = 0.29$), or anticipatory responsibility ($t(106) = -0.47$, $p = 0.640$, $d = -0.09$) between the

anthropomorphism condition and the control condition, even though the trend was similar to that of Study 3a. A summary of the results is presented in Table 1.

7.3. Discussion

Contrary to our expectations (H₁-H₃), the negative effect of anthropomorphism on attitudes toward meat consumption was not significant in this study. In other words, results from Study 3a on pork meat did not extend to beef meat in Study 3b. This lack of significance is possibly due to the metaphorical association of cows with anger and irritability in English (e.g., “to have a cow”, “a red flag to a bull”), which is, to some extent, in contradiction to the friendship metaphor. This may have hindered consumers from thinking of cows as friendly beings. In line with this explanation, literature documents that a new metaphor can actually be unsuccessful (or even backfire) when its association is too incongruous (Basso & Oullier, 2011). In light of these results, the effect of the friendship metaphor may be limited to animals associated with positive expressions (e.g., “happy as a pig in mud”).

A complementary explanation could be that unlike cows, which are usually portrayed as somewhat idiotic (e.g., “stupid cow”), pigs are commonly considered more highly intelligent than other species produced for food in the United States (Davis & Cheeke, 1998). Past results in the literature also showed that cows were in general perceived as less cute than pigs (Zickfeld, Kunst & Hohle, 2018). This could be due to popular stories and movies such as *Animal Farm*, *Charlotte’s Web* and *Babe* that anthropomorphized pigs exceptionally well. In support of this argument, evidence documents that, to some extent, a short fictional narrative can have an impact on attitudes toward animals (Małecki, Pawłowski, Cieński, & Sorokowski, 2018; Małecki, Pawłowski, & Sorokowski, 2016) and

it is claimed that a significant number of young people became vegetarians after watching *Babe* (Nobis, 2009).

8. Study 3c

Since no significant effects of anthropomorphism on beef consumption were detected in Study 3b, we tested whether the mediating role of guilt feelings could be replicated on pork consumption with another instantiation of anthropomorphism. Namely, in Study 3c, we tested whether staff-animal friendship would discourage pork consumption (H_1 and H_2) by inducing anticipatory guilt feelings (H_3).

8.1. Material and methods

Participants. Study 3c was a two-group between-subjects design. A target sample size of 79 participants per condition was determined with an estimated effect size of $d = 0.45$ (i.e. the weakest significant effect observed in Study 3a), an alpha level of 0.05 and a desired power of 0.80. Two hundred participants from the United States who had not participated in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 33 were excluded for the following reasons: failed manipulation check ($n = 11$), did not answer with care and diligence ($n = 2$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 20$); leaving 167 participants (Female = 85; $M_{age} = 38.93$ $SD_{age} = 13.05$).

Procedure and measures. Instructions and procedure were similar to Study 3a with two conditions: anthropomorphism ($n = 78$) vs. control ($n = 89$), except that the

anthropomorphism condition was the human-animal friendship condition from Study 2 (see Appendix A3 for all materials used in this study).

8.2. Results

Attitudes toward meat. Reliability of this scale for the present sample was somewhat low but acceptable (Cronbach's $\alpha = 0.68$)¹¹ and items were thus averaged. As predicted, an independent samples *t*-test revealed that consumers had less favourable attitudes toward meat in the anthropomorphism condition ($M = 5.43$, $SD = 1.31$) (vs. control; $M = 6.24$, $SD = 0.81$), $t(165) = -4.90$, $p < 0.001$, $d = -0.76$.

Purchase intentions. Similarly, an independent samples *t*-test indicated that purchase intentions were significantly lower in the anthropomorphism condition ($M = 4.87$, $SD = 1.88$) (vs. control; $M = 5.93$, $SD = 1.16$), $t(165) = -4.45$, $p < 0.001$, $d = -0.69$.

Anticipatory guilt. A principal axis factor analysis with varimax rotation yielded two factors for the anticipatory guilt scale as in the previous studies. The two factors (anticipatory guilt, 55.80%; anticipatory responsibility, 36.89%) explained 92.68% of the total variance and demonstrated adequate internal consistency (anticipatory guilt, Cronbach's $\alpha = 0.95$; anticipatory responsibility, Cronbach's $\alpha = 0.88$). As expected, an independent samples *t*-test indicated that anticipatory guilt was significantly higher in the anthropomorphism condition ($M = 3.36$, $SD = 2.26$) (vs. control; $M = 2.12$, $SD = 1.50$), $t(165) = 4.21$, $p < 0.001$, $d = 0.65$. To the contrary, additional analyses did not reveal any

¹¹ Additional analyses showed that the effects of the experimental manipulation were statistically significant on both items (inferred tastiness: $t(165) = -2.96$, $p = 0.004$, $d = -0.45$; enjoyment of meat, $t(165) = -5.24$, $p < 0.001$, $d = -0.81$).

significant difference in anticipatory responsibility between the anthropomorphism condition ($M = 4.04$, $SD = 1.91$) and the control condition ($M = 4.24$, $SD = 1.74$), $t(165) = -0.70$, $p = 0.486$, $d = -0.11$. A summary of the results is presented in Table 1.

Mediation analysis. We then conducted a mediation analysis using the PROCESS Model 6 macro for SPSS (Hayes, 2013) to test whether consumers' purchase intentions were mediated by anticipatory guilt and attitudes toward meat. We dummy coded the conditions as follows: 0 = control, 1 = anthropomorphism, and we entered anticipatory guilt as first mediator, attitudes toward meat as second mediator and purchase intentions as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated two significant indirect pathways (see Table 4, Table 5, and Figure 5). As shown below, exposure to anthropomorphism (vs. control) increased consumers' feelings of anticipatory guilt about eating meat, which partially mediated the effects on attitudes toward meat, and eventually, on purchase intentions. The model accounted for 67% of the variance in purchase intentions ($R^2 = 0.67$).

Table 4. Direct and indirect effects of anthropomorphism (vs. control) on consumers' purchase intentions through anticipatory guilt and attitudes toward meat in Study 3c. Significant pathways are in bold text.

<i>Pathways</i>	β	<i>SE</i>	<i>95% CI</i>
Anthropomorphism → Purchase intentions (Direct effect)	-0.12	0.16	[-0.43, 0.20]
Anthropomorphism → Attitudes toward meat → Purchase intentions	-0.42	0.16	[-0.78, -0.14]
Anthropomorphism → Anticipatory guilt → Purchase intentions	-0.07	0.09	[-0.28, 0.06]
Anthropomorphism → Anticipatory guilt → Attitudes toward meat → Purchase intentions	-0.45	0.12	[-0.71, -0.22]

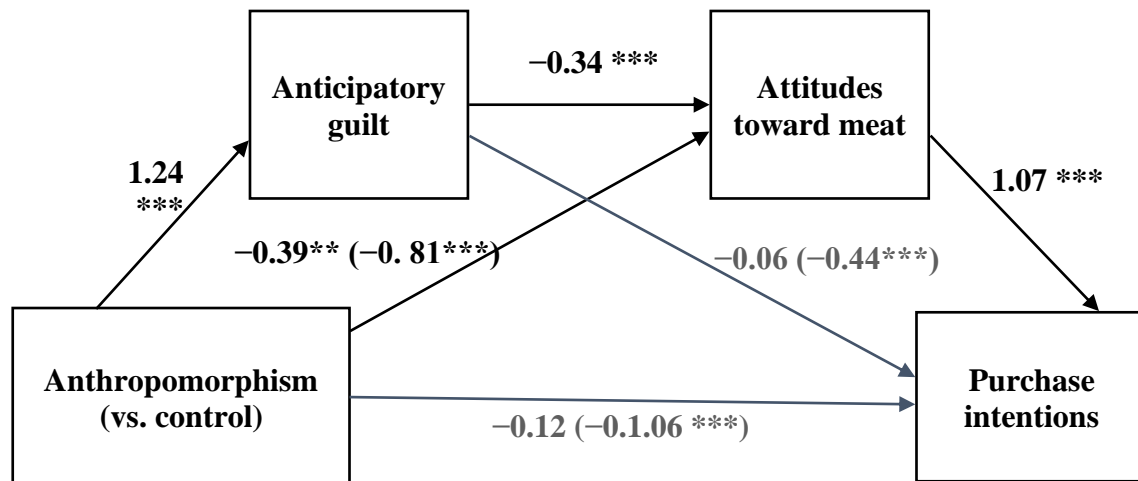
Note. Significant pathways are in bold text.

Table 5. Two phases of the serial mediation through anticipatory guilt and attitudes toward meat to purchase intentions in Study 3c.

<i>Phases</i>	β	<i>SE</i>	<i>95% CI</i>
Anthropomorphism → Anticipatory guilt → Attitudes toward meat	-0.42	0.12	[-0.69, -0.22]
Anticipatory guilt → Attitudes toward meat → Purchase intentions	-0.38	0.04	[-0.46, -0.29]

Note. Significant pathways are in bold text.

Figure 5. Model testing the negative effect of anthropomorphism (vs. control) on purchase intentions through anticipatory guilt and attitudes toward meat in Study 3c (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounted for 67% of the variance in purchase intentions ($R^2 = 0.67$).



8.3. Discussion

Replicating Study 3a with the friendship metaphor applied to staff-animal interactions instead of animal-animal interactions, Study 3c shows that the negative effect of anthropomorphism on consumers' attitudes toward meat (supporting H₁) and purchase intentions (supporting H₂) is mediated by increased feelings of anticipatory guilt (supporting H₃). However, anticipatory guilt feelings only partially mediated the negative effect of exposure to anthropomorphism on attitudes toward meat in the current study, which suggests that there might be other psychological mechanisms contributing to consumers' attitudes change. Implicit references to cuteness could remain present in this study due to playful human-animal interaction detailed in the vignette (Steinnes, 2017). Moreover, empathic concern and disgust could have been induced by anthropomorphism and contributed to reducing positive attitudes toward meat consumption (e.g., Hartmann & Siegrist, 2018; Kunst & Hohle, 2016; Niemyjska et al., 2018; Signal & Taylor, 2007).

9. General discussion

Taken together, these results show that anthropomorphizing meat animals (pigs) through human-animal or animal-animal friendship can alter omnivorous consumers' attitudes toward (pork) meat consumption and lead to lower intentions to patronize a (pork) meat restaurant or to buy (pork) meat products. Moreover, our results indicate that the negative effect of anthropomorphism on these attitudes is mediated by increased feelings of anticipatory guilt experienced when consumers consider eating (pork) meat. It is worth noting though, that these results do not extend beyond pork meat, as they failed to replicate with beef meat.

The current article thus complements the literature by adding feelings of guilt to cuteness response (Zickfeld et al., 2018) and empathic concern toward animals (Niemyjska et al., 2018) as mediators of the negative effect of anthropomorphism (or humanization) on meat consumption. Further studies can also explore how those psychological factors may correlate or interact with each other, and be moderated by participants' individual dispositions to anthropomorphize animals (Niemyjska et al., 2018) or display general dissociation tendencies (Kunst & Hohle, 2016).

Through the friendship metaphor, this article also documents the effect of the weak form of anthropomorphism on attitudes (Chandler & Schwarz, 2010; Epley et al., 2007; Lakoff & Johnson, 1980). When meat animals are friends, whom one can play with, seek comfort from and share both a mutual love and concern for welfare with, eating meat can be automatically understood and experienced as harming friends (or friendly beings). This leads to feelings of guilt (Baumeister et al., 1994; Keller, 1994) and, in turn, discourages meat consumption. Our findings suggest that, by anthropomorphizing meat animals, the friendship metaphor thus contributes to re-framing the human-animal divide that revolves around dehumanization (Bastian et al., 2012a; Haslam & Loughnan, 2014) and reminds people that calling something food is a moral act in itself (Liao & Meskin, 2018; see also Feinberg et al., 2019).

Additionally, we might speculate that our findings illustrate that metaphors, as weak forms of anthropomorphism, can succeed where stronger forms of anthropomorphism might have failed. For instance, Piazza and Loughnan's (2016) manipulation of mind attribution did not influence the moral standing of meat animals, possibly because consumers are so accustomed to eating these animals, that they lack motivation to engage in reasoning

against it, which renders their knowledge of animals' humanlike traits futile. By relying on the experiential system (Epstein, Pacini, Denes-Raj, & Heier, 1996; Lakoff & Johnson, 2003; Oullier & Basso, 2010), metaphors have heuristic value (Cornelissen, 2004). More specifically, here, we suggest that the "Animals are Friends" metaphor has affect heuristic value (Slovic, Finucane, Peters, & MacGregor, 2007). It provides a mental shortcut through which affective experience (guilt feelings attached to friendship; Keller, 1994), rather than knowledge and reasoning (mind attribution), plays a leading role in judgments and decision-making (eating meat). The current research thus has valuable implications for organizations, driven by animal welfare advocacy, that promote the reduction of meat intake. In tandem with spreading scientific knowledge about how sentient and intelligent meat animals are, organizations may be well advised to consider anthropomorphizing meat animals through the "Animals are Friends" metaphor. This metaphor could help craft a communication strategy to challenge carnism (Monteiro et al., 2017), speciesism (Caviola et al., 2018) and the traditional human-animal divide (Adams, 2018; Bastian et al., 2012a), and, hence, facilitate animal protection, reduce meat consumption and, incidentally, promote a more sustainable plant-based diet worldwide (Springmann et al., 2018).

On a concluding note, the friendship metaphor illustrates the use of a new (or novel) metaphor rather than a conventional one. Conventional metaphors existing in our culture (e.g., Time is Money or Love is A Journey) structure our conceptual system by highlighting and coherently organizing certain aspects of our experience (Lakoff & Johnson, 1980; Landau, Meier, & Keefer, 2010). As discussed, new metaphors such as "Animals are Friends" function in a similar way but give new meaning and understanding to our past experience and current activities, guiding our future actions to fit the new metaphorical

associations. Given their “power to create a new reality” (Lakoff & Johnson, 1980, p. 146), new metaphors are frequently used by marketers (Basso et al., 2014; Hirschman, 2007) and activists (Bouillé, Basso, & Robert-Demontrond, 2016) to cultivate positive or negative emotions (e.g., anger) respectively toward corporations (Gopaldas, 2014). In this perspective, this study finds that the metaphor “Animals are Friends” used by vegan and vegetarian activists evokes guilt feelings against meat consumption in the marketplace.

10. Perspectives and limitations

While our empirical findings demonstrate that anthropomorphizing meat animals reduces intentions to patronize a meat restaurant or to buy meat products, they come with limitations that could serve as a basis for future research.

First of all, in light of our results, it appears that one cannot expect anthropomorphism through the friendship metaphor to be applicable to all types of meat animals. Unexpectedly, as found and discussed in Study 3b, the effects of this metaphor are largely attenuated for cows, even though it works on pigs, as illustrated through five studies (Studies 1a, 1b, 2, 3a and 3c). Future research could investigate whether the “Animals are Friends” metaphor has a significant impact on consumers’ attitudes when it comes to meat animals other than pigs, such as poultry and fish, even though people tend to attribute less mental capacities (for pain, pleasure, affection, etc.) to these non-mammals than mammals (Kupsala, Vinnari, Jokinen & Räsänen, 2016). It could also be explored whether, as aforementioned, pre-existing (positive or negative) stereotypes about these animals (mammals or non-mammals) interact with the effects of anthropomorphism. Additionally, another metaphor “Animals are Family” could be more suitable than the friendship

metaphor to anthropomorphize certain animals in some cultures (Amiot & Bastian, 2017; Belk, 1996; Gray & Young, 2011; Hirschman, 1994). Using more subtle forms of anthropomorphism by simply calling the restaurant or company “Mr. Piggy’s” or “Mr. Moo’s” could also further document weak forms of anthropomorphism.

Second, the present research measured attitudes and behavioural intentions rather than actual behaviour. It would be worthwhile to test in field experiments (involving for instance restaurants or cafés) whether the less favourable attitudes toward meat-eating and the anticipatory guilt feelings experienced after exposure to the friendship metaphor would translate into corresponding meal or snack choices. It could also be interesting to test whether the effects of this metaphor could be extended to attitudes and behaviours toward non-food animal products. The consumption of leather and fur may indeed be considered an immoral act of cruelty against animals that could be associated with feelings of guilt but also of disgust and anger (Rosenfeld & Burrow, 2017).

Last, these studies were conducted with English-speaking participants living in the United States who seem to be more likely to humanize animals than other cultures. For instance, research documents that US students perceived animals as more intelligent than did Japanese students (Nakajima, Arimitsu & Lattal, 2002) and that the negative effect of cuteness on willingness to consume meat consistently observed among US participants was not observed in a Norwegian sample (Zickfeld, Kunst & Hohle, 2018). Furthermore, food choice is a complicated behaviour highly intertwined with culture (Köster, 2009; Rozin, Fischler, Imada, Sarubin, & Wrzesniewski, 1999), and metaphors and metaphorical thinking are also fundamentally grounded in culturally specific practices (Kövecses, 1995, 2004). More research in other sociocultural contexts is therefore needed. Recent studies in

Chinese and French cultural contexts suggest that cognitive dissonance in response to the meat paradox seems to generalize across cultures (Tian, Hilton, & Becker, 2016), which paves the way for cross-cultural investigations into the metaphorical framing of the human-animal divide.

11. Conclusion

To our knowledge, this is the first set of studies assessing the extent to which weak forms of anthropomorphism can affect meat consumption. We have provided evidence that exposure to the metaphor “Animals are Friends”, applied to human-animal or animal-animal interactions, generates moral (guilt) feelings in meat consumers, which negatively influences their attitudes toward meat consumption and their behavioural intentions to eat meat.

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Authors' contributions

Both authors contributed equally to this work.

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Appendix A: Stimuli

Appendix A1: Stimuli used in Study 1a

Meat condition	Non-meat condition
<p>HOME ABOUT US WHAT WE OFFER RESERVATIONS EVENTS F.A.Q</p> <div>  </div> <h1>Mr. Piggy's Café</h1>  <p><i>Welcome to Mr. Piggy's Café. We offer a unique café experience where customers can play with our cute piglets whilst enjoying a hot drink and any of our famous breakfast specials, such as the smoked bacon rolls!</i></p>	<p>HOME ABOUT US WHAT WE OFFER RESERVATIONS EVENTS F.A.Q</p> <div>  </div> <h1>Mr. Piggy's Café</h1>  <p><i>Welcome to Mr. Piggy's Café. We offer a unique café experience where customers can play with our cute piglets whilst enjoying a hot drink and any of our famous breakfast specials, such as the baked egg rolls!</i></p>



ABOUT US

The concept of pet café, such as cat café and dog café, is gaining popularity across the world, and we are proud to be the first piglet themed café in North America!



Piglets are like dogs. They love to play lots of interactive games such as fetch. So try tossing a stick to see if our piglets will retrieve it. Piglets also enjoy pushing balls around with their noses. Try giving them a big bouncy ball to push around their pens or around the yard of our café! You'll love it!



WHAT WE OFFER

- *As if piglets weren't enough, we offer a selection of teas, coffees and hand-baked pastries.*
- *We also feature a number of breakfast specials including our pork sausages and our famous smoked bacon rolls.*

VANILLA LATTE



SMOKED BACON ROLLS



WHAT WE OFFER

- *As if piglets weren't enough, we offer a selection of teas, coffees and hand-baked pastries.*
- *We also feature a number of breakfast specials including our spinach omelette and our famous baked egg rolls.*

VANILLA LATTE










BAKED EGG ROLLS


Appendix A2: Stimuli used in Study 1b

Introduction	
<p>HOME ABOUT US WHAT WE OFFER RESERVATIONS EVENTS F.A.Q</p>  <h3>From Farm to Fork</h3> <p>Our motto is Farm to Fork because we take fresh meat seriously. Our goal is to serve high quality free-range meat, and to share the enjoyment of eating great pork dishes.</p>	
Anthropomorphism condition	Control condition
<p>HOME ABOUT US WHAT WE OFFER RESERVATIONS EVENTS F.A.Q</p>  <h3>What makes our meat so unique?</h3> <p>Our meat is unique because our team entertains our farm pigs, which keeps them in good emotional and physical health! Pigs love to play the games that man's best friends, dogs, enjoy too. They like interactive games such as fetch. As soon as they see our team member with a Frisbee, they are ready to run and retrieve it. They also enjoy pushing a big bouncy ball around the green yard with their noses, which allows them to be active all day long!</p>	<p>HOME ABOUT US WHAT WE OFFER RESERVATIONS EVENTS F.A.Q</p>  <h3>What makes our meat so unique?</h3> <p>Our meat is unique because our farm pigs grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm pigs are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!</p>






Appendix A3: Stimuli used in Study 2

<p>Introduction</p>		
<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p>  <p>About Us</p> <p>Mr. Piggy's produces a wide range of meat products made to customer specifications and our boneless pork chops are among our customers' all-time favorites.</p>		
<p>Human-animal friendship condition</p>	<p>Animal-animal friendship condition</p>	<p>Control condition</p>
<p>HOME ABOUT US <u>OUR PRACTICES</u> PRODUCTS RECIPES WHERE TO BUY</p>  <p>What Makes Our Pork Chops So Tasty?</p> <p>Healthy pigs are delicious, nutritious pigs. Our team entertains our farm pigs, which keeps them in good emotional and physical health! Pigs love to play the games that man's best friends, dogs, enjoy too. They like interactive games such as fetch. As soon as they see our team member with a Frisbee, they are ready to run and retrieve it. They also enjoy pushing a big bouncy ball around the green yard with their noses, which allows them to be active all day long!</p> 	<p>HOME ABOUT US <u>OUR PRACTICES</u> PRODUCTS RECIPES WHERE TO BUY</p>  <p>What Makes Our Pork Chops So Tasty?</p> <p>Healthy pigs are delicious, nutritious pigs. Our farm pigs play games with each other, which keeps them in good emotional and physical health! Pigs are social animals, so they need each other to feel well just as we need friends. They require other pigs as companions with whom to eat, sleep, play and sort out group dynamics. They always enjoy pushing a big bouncy ball together around the green yard with their noses, which allows them to be active all day long!</p> 	<p>HOME ABOUT US <u>OUR PRACTICES</u> PRODUCTS RECIPES WHERE TO BUY</p>  <p>What Makes Our Pork Chops So Tasty?</p> <p>Healthy pigs are delicious, nutritious pigs. Our farm pigs grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm pigs are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!</p> 

Appendix A4: Stimuli used in Study 3a

Introduction	
<p style="text-align: center;">HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p style="text-align: center;">☰</p> <div style="text-align: center;">  </div> <h2 style="text-align: center;">About Us</h2> <p style="text-align: center;">Mr. Piggy's produces a wide range of meat products made to customer specifications and our boneless pork chops are among our customers' all-time favorites.</p>	
Anthropomorphism condition	Control condition
<p style="text-align: center;">HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p style="text-align: center;">☰</p> <div style="text-align: center;">  </div> <h3 style="text-align: center;">What Makes Our Pork Chops So Tasty?</h3> <p>Healthy pigs are delicious, nutritious pigs. Our farm pigs play games with each other, which keeps them in good emotional and physical health! Pigs are social animals, so they need each other to feel well just as we need friends. They require other pigs as companions with whom to eat, sleep, play and sort out group dynamics. They always enjoy pushing a big bouncy ball together around the green yard with their noses, which allows them to be active all day long!</p> <div style="text-align: center;">  </div>	<p style="text-align: center;">HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p style="text-align: center;">☰</p> <div style="text-align: center;">  </div> <h3 style="text-align: center;">What Makes Our Pork Chops So Tasty?</h3> <p>Healthy pigs are delicious, nutritious pigs. Our farm pigs grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm pigs are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!</p> <div style="text-align: center;">  </div>

Appendix A5: Stimuli used in Study 3b

Introduction	
<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>≡</p>  <h3>About Us</h3> <p>Mr. Moo's produces a wide range of meat products made to customer specifications and our beef steaks are among our customers' all-time favorites.</p>	
Anthropomorphism condition	Control condition
<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>≡</p>  <h3>What Makes Our Beef Steaks So Tasty?</h3> <p>Healthy cows are delicious, nutritious cows. Our farm cows play games with each other, which keeps them in good emotional and physical health! Cows are social animals, so they need each other to feel well just as we need friends. They require other cows as companions with whom to eat, sleep, play and sort out group dynamics. They always enjoy chasing and head-butting around the green yard adjacent to their shelter, which allows them to be active all day long!</p> 	<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>≡</p>  <h3>What Makes Our Beef Steaks So Tasty?</h3> <p>Healthy cows are delicious, nutritious cows. Our farm cows grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm cows are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!</p> 

Appendix B: Complementary data analyses

In Studies 1b-3c, the control condition indicates that animals grow in a “free-range environment”, are “reared to the highest welfare standards” and have “free access to a green yard”. Such description might have primed organic or ecological aspects (although not explicitly mentioned), which could result in higher liking of meat products.

Indeed, even though research with US participants showed that an organic label did not lead to more positive evaluation of product taste or higher purchase intentions in between-subjects experiments (Ellison, Duff, Wang, & White, 2016; Schuldt & Hannahan, 2013), Napolitano and colleagues (2010) demonstrated in a within-subjects experiment that Italian consumers rated organic beef more positively than conventional beef both before and after actually tasting it.

Thus, the purpose of the couple of studies reported below in Appendix B1 and B2 was twofold. First, a manipulation check tested whether there was a significant difference in terms of perception of the “organic” attribute in pork meat between anthropomorphism and control conditions. Second, in order to rule out the potential confounding effect of organic and ecological attributes on attitudes toward meat and intentions to buy meat, a follow-up study tested whether the negative impact of anthropomorphism (vs. control) on meat consumption could be replicated when the meat products were explicitly described as “organic” in both conditions.

Appendix B1: Manipulation check for organic and ecological attributes

As explained in the manipulation check for anthropomorphism (reported in Study 2), after completing items measuring anthropomorphic beliefs, participants were also required to indicate on a two-item Likert scale whether: “The pork produced by ‘Mr. Piggy’s’ is organic” and “The pork produced by ‘Mr. Piggy’s’ is ecological” (1 = “strongly disagree” to 7 = “strongly agree”).

The two items were highly correlated (Cronbach’s $\alpha = 0.73$) and thus averaged. A one-way ANOVA revealed significant differences in terms of perception of the organic attribute in meat products between the three conditions ($F(2, 171) = 6.96, p = 0.001, \eta^2 = 0.08$).

Bonferroni-corrected post-hoc *t*-tests showed that consumers rated the pork as significantly more organic in the control condition ($M = 5.44, SD = 1.05$) as compared to the animal-animal condition ($M = 4.69, SD = 1.34, p = 0.003, d = 0.63$) and the human-animal condition ($M = 4.76, SD = 1.24, p = 0.009, d = 0.59$). The difference between the two anthropomorphism conditions was not significant ($p > 0.999, d = 0.06$).

One-sample *t*-tests showed that, in all three conditions, consumers’ perceptions of the organic attribute in pork meat were significantly higher than the midpoint (= 4.00) of the scale (control, $t(60) = 10.70, p < 0.001$; animal-animal, $t(57) = 3.92, p < 0.001$; human-animal, $t(54) = 4.57, p < 0.001$).

On one hand, these results show that, in both anthropomorphism conditions (human-animal friendship and animal-animal friendship), pork products were rated significantly higher than the midpoint of the two-item Likert scale measuring the perception of the organic

attribute-in meat, which indicates that these products were not perceived as conventional (i.e. non-organic) meat. On the other hand, the differences in terms of perception of the organic attribute in pork meat between anthropomorphism and control conditions reveal a potential confounding effect of organic and ecological attributes on attitudes toward meat and intentions to buy meat in our studies. In order to rule out this potential confounding effect, we conducted a replication study (see Appendix B2). In this study, the meat products were explicitly described as “organic” in both control and anthropomorphism conditions.

Appendix B2: Follow-up study controlling for organic attribute

1. Material and methods

Participants . This follow-up study was a two-group between-subjects design. A target sample size of 64 participants per condition was determined with an estimated effect size of $d = 0.50$, an alpha level of 0.05 and a desired power of 0.80. One hundred and sixty participants from the United States who had not participated in the previous studies were recruited online through Amazon's Mechanical Turk and completed this study in exchange for \$0.30. Of those, 37 were excluded for the following reasons: failed manipulation check ($n = 6$), did not answer with care and diligence ($n = 10$), dietary practices: vegan, vegetarian, fish only omnivore and do not eat pork for religious or other reasons ($n = 21$); leaving 123 participants (Female = 71; $M_{\text{age}} = 40.55$ $SD_{\text{age}} = 12.98$).

Procedure and measures. Instructions and procedure were similar to Study 2 except that we included only two conditions: human-animal friendship ($N = 61$) vs. control ($N = 62$), to which participants were randomly assigned. We also specified “organic” in two sentences which were presented identically across conditions: “Mr. Piggy’s produces a wide range of *organic* [emphasis added] meat products made to customer specifications...” and “What Makes Our *Organic* [emphasis added] Pork Chops So Tasty?” (see Appendix B3 for all materials used in this study).

2. Results

Attitudes toward meat. The items used to measure consumers' attitudes toward meat were highly correlated (Cronbach's $\alpha = 0.79$) and were thus averaged. As predicted, an

independent samples *t*-test revealed that consumers had less favourable attitudes toward meat in the anthropomorphism condition ($M = 5.36, SD = 1.37$) (vs. control; $M = 6.13, SD = 0.98$), $t(121) = -3.58, p < 0.001, d = -0.65$.

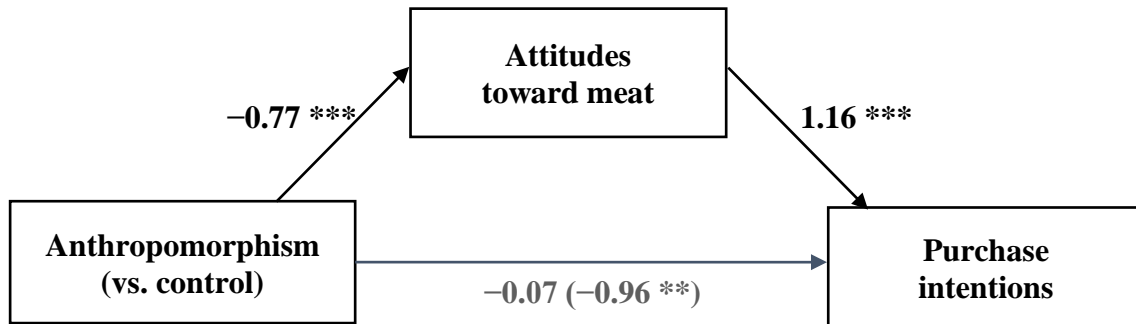
Purchase intentions. Likewise, an independent samples *t*-test indicated that purchase intentions were significantly lower in the anthropomorphism condition ($M = 4.64, SD = 2.10$) (vs. control; $M = 5.60, SD = 1.45$), $t(121) = -2.95, p = 0.004, d = -0.53$.

Mediation analysis. We then conducted a mediation analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2013) to test whether consumers' attitudes toward meat mediated the effect of anthropomorphism on their purchase intentions. We dummy coded the conditions as follows: 0 = control, 1 = anthropomorphism, and we entered attitudes toward meat as potential mediator and purchase intentions as dependent variable. A bias-corrected bootstrap analysis with 5,000 samples indicated that the indirect effect was negative and significant ($\beta = -0.89, SE = 0.24, 95\% CI = [-1.35, -0.42]$), whereas the direct effect was not significant ($\beta = -0.07, SE = 0.22, 95\% CI = [-0.51, 0.37], p = 0.754$), showing that the negative effect of anthropomorphism on purchase intentions was fully mediated by attitudes toward meat (see Figure B1). The model accounted for 61% of the variance in intentions to patronize the restaurant ($R^2 = 0.61$).


The negative effect of exposure to anthropomorphism on attitudes toward meat (H₁) and purchase intentions (H₂) remained significant when we controlled for the potential confounding effect of organic attribute on meat consumption. In other words, these results suggest that the negative effect of anthropomorphism (vs. control) on consumers' attitudes

and behavioural intentions toward meat consumption is not due to a confounding effect of organic or ecological attributes in our studies.

Figure B1. Mediation model showing that anthropomorphism (vs. control) leads to less favourable attitudes toward meat which in turn leads to decreased purchase intentions in the follow-up study reported in Appendix B2 (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounted for 61% of the variance in intentions to patronize the restaurant ($R^2 = 0.61$).



Appendix B3: Stimuli used in the follow-up study reported in Appendix B2

Introduction	
<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>MR. PIGGY'S FARM TO FORK</p> <h3>About Us</h3> <p>Mr. Piggy's produces a wide range of organic meat products made to customer specifications and our boneless pork chops are among our customers' all-time favorites.</p>	
Anthropomorphism condition	Control condition
<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>MR. PIGGY'S FARM TO FORK</p> <h3>What Makes Our Organic Pork Chops So Tasty?</h3> <p>Healthy pigs are delicious, nutritious pigs. Our farm pigs grow in a free-range natural environment, which keeps them in good emotional and physical health! Born and living outdoors for their whole lives, our farm pigs are reared to the highest welfare standards. Free access to a green yard adjacent to their shelter provides them with more room and a continuous supply of fresh air, spring water and nutritious feed. It also allows them to be active all day long!</p> 	<p>HOME ABOUT US OUR PRACTICES PRODUCTS RECIPES WHERE TO BUY</p> <p>MR. PIGGY'S FARM TO FORK</p> <h3>What Makes Our Organic Pork Chops So Tasty?</h3> <p>Healthy pigs are delicious, nutritious pigs. Our team entertains our farm pigs, which keeps them in good emotional and physical health! Pigs love to play the games that man's best friends, dogs, enjoy too. They like interactive games such as fetch. As soon as they see our team member with a Frisbee, they are ready to run and retrieve it. They also enjoy pushing a big bouncy ball around the green yard with their noses, which allows them to be active all day long!</p> 

Chapter 5

Would You Eat Pork When Pigs Have Family or Friends? Cultural Differences in Response to Anthropomorphic Metaphors

Abstract

Previous research shows that the anthropomorphic metaphor “Animals are Friends” discourages meat consumption by inducing anticipatory guilt among US omnivores. Considering cultural factors like Confucian familism, we extend this line of research to China and test an alternative metaphor “Animals are Family” in addition to the friendship metaphor. We hypothesize that Chinese omnivores are more likely to be influenced by the family metaphor than the friendship metaphor as familism plays a crucial role in Chinese culture since ancient times. In line with our expectations, a preregistered experiment demonstrates strong evidence that exposure to the family metaphor decreases Chinese omnivores’ intentions to purchase meat, but finds no evidence for the effectiveness of the friendship metaphor among Chinese participants. Another preregistered study successfully replicates the negative effect of the friendship metaphor on US omnivores’ intentions to purchase meat, while the evidence for the effectiveness of the family metaphor is rather weak among US participants. Those findings provide support to the source resonance hypothesis, i.e., people who perceive the source concept in a metaphor differently respond to the same metaphor in different ways. Illustrated with the case of meat consumption,

these studies also highlight the necessity of taking cultural differences into account when designing behaviour-change interventions.

Keywords

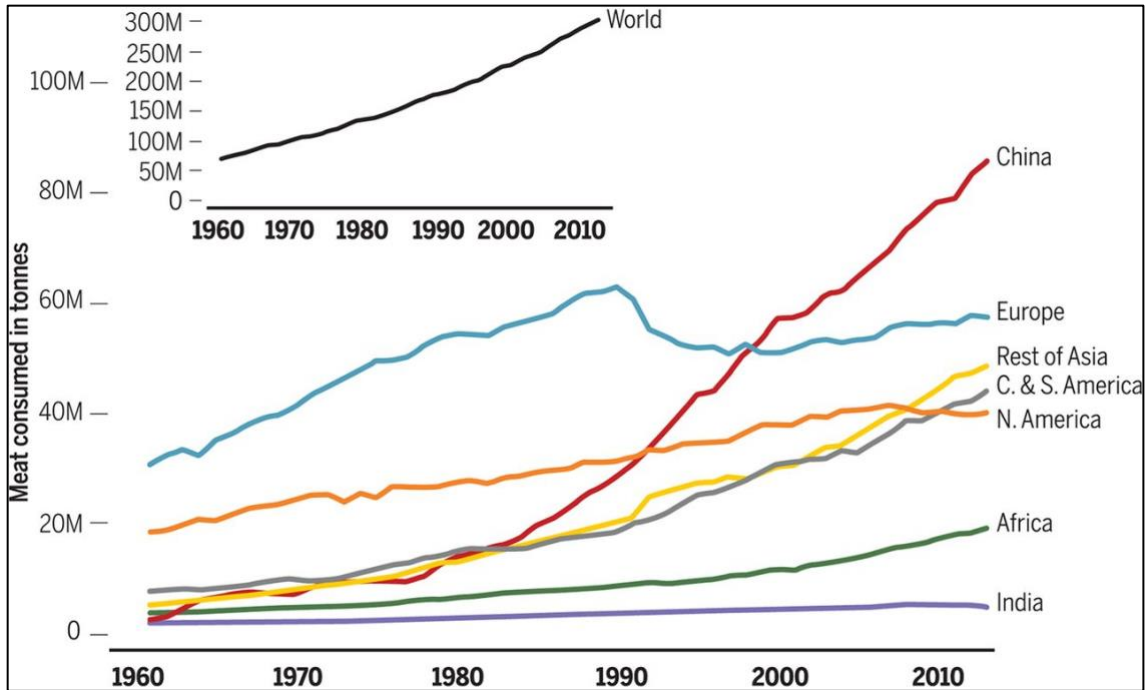
Meat consumption; Conceptual metaphor; Anthropomorphism; Source resonance; Cultural difference

1. Introduction

Scientific evidence has accumulated that excessive consumption of meat increases the risk of multiple health issues and contributes to key environmental problems such as global warming and water scarcity (Godfray et al., 2018; González, Marquès, Nadal, & Domingo, 2020; Richi et al., 2015). A variety of interventions for meat reduction have thus been studied in the past decade, many of which involve raising concerns about animal welfare and triggering cognitive dissonance (Kwasny, Dobernig, & Riefler, 2022; Rothgerber, 2020). In particular, anthropomorphizing meat animals through metaphors is found to be an effective strategy. Wang and Basso (2019) demonstrated in a set of experiments that exposure to the anthropomorphic metaphor “Animals are Friends” led to less positive attitudes towards meat and lower intentions to consume meat, and those effects were mediated by an increased level of guilt about eating meat. Similarly, Kim and Yoon (2021) showed that the friendship metaphor increased the likelihood of choosing non-meat dishes over meat dishes among consumers who had a low commitment to meat-eating, and made other consumers more likely to choose healthier meat dishes over less healthy but tastier meat dishes, as the excuse of eating meat for health reasons alleviated their guilt feelings. Nevertheless, both studies were conducted in the Western world, which calls into question if this strategy will be useful in other socio-cultural contexts. After all, the over-consumption of meat is a global issue. It is estimated from food balance sheets that meat consumption has ceased to increase lately in many high-income Western countries, even though remains large in amount. Meanwhile, meat consumption has been soaring in middle-income countries such as China for over thirty years, possibly driven by rapidly rising average incomes (Godfray et al., 2018, see also Figure 1). Therefore, it is timely and

meaningful to develop interventions that could cut down meat consumption in those countries.

Figure 1. Global trends in meat consumption (Godfray et al., 2018, p. 1).



To this end, the current research will explore if anthropomorphizing meat animals via metaphors could reduce meat consumption in China as well. Apart from the metaphor “Animals are Friends”, we propose that another anthropomorphic metaphor, “Animals are Family”, may have a stronger impact on Chinese people. The rationale behind this proposition will be laid out in the next two sections, and two preregistered experimental studies on Chinese and US omnivores, respectively, will be reported and discussed afterwards.

2. Metaphorical framing and source resonance

Metaphors are deeply embedded in our cognitive structure, allowing us to make sense of one concept (i.e., the target domain) in terms of an ostensibly unrelated concept (i.e., the source domain) (Lakoff & Johnson, 1999). The cross-domain metaphorical mappings not only give us a very specific way of thinking about the target, but also a way of acting towards it (Lakoff & Johnson 1980). This central claim of the conceptual metaphor theory (CMT) is backed up by a growing body of empirical research (Casasanto & Bottini, 2014; Landau, Meier, & Keefer, 2010). Early CMT research is focused on the conventional metaphors existing in our minds (e.g., “Affection is Warmth”, “Good is Up”) and reveals how they shape attention, memory, person perception, and other higher cognitive processes “even in contexts where linguistic expressions of the relevant metaphors are not made salient” (Landau et al., 2010, p. 1048). More recent studies, however, pay increasing attention to the novel metaphors used in public communication, and show that “the activation of different conceptual metaphors for the same target differentially influences target processing in line with the respective source concepts” (Landau, Robinson, & Meier, 2014, p. 9). For instance, investors became more likely to think that a price trend would continue when it was metaphorically framed as the volitional movement of a living agent (e.g., “This afternoon the Nasdaq started climbing upwards”), as compared to the unintentional movement of an inanimate object (e.g., “This afternoon the Nasdaq was swept upward”) (Morris, Sheldon, Ames, & Young, 2007). Exposure to the “Crime is A Beast” metaphor made respondents recommend more crime solutions about “capture/enforce/punish” (e.g., instituting harsher penalties, building more jails), while exposure to the “Crime is A Virus” metaphor led to more recommendations around

“diagnose/treat/inoculate” (e.g., fixing the economy, improving education) (Thibodeau & Boroditsky, 2011). Recalling past conflicts between romantic partners resulted in lower relationship satisfaction among participants who had been primed with the “Love is An Unity” metaphor (e.g., “my better half”), but not those primed with the “Love is A Journey” metaphor (e.g., “look how far we’ve come”), as people tended to expect ups and downs in a “journey” (Lee & Schwarz, 2014). This line of research is known as either “the alternate source strategy” (Landau et al., 2010) or the effects of metaphoric/metaphorical framing (Landau, Sullivan, & Greenberg, 2009; Hauser & Schwarz, 2015).

Since metaphorical thinking involves importing knowledge and experience from a source domain to a target domain, researchers move a step further and speculate that individual differences in perception of the source domain may modulate people’s responses to the same metaphor, i.e., the source resonance hypothesis (Landau, Zhong, & Swanson, 2018). In other words, the effects of the same conceptual metaphor may be enhanced or undermined because of individuals’ pre-existing experiences and opinions associated with the source concept. To test this hypothesis, Landau, Arndt, and Cameron (2018) assessed participants’ fear of enemy combatants before exposing them to a message about the relationship between UV exposure and skin cancer. The message either metaphorically framed sun exposure as an enemy confrontation or literally framed it as a major health risk. As predicted, among participants prone to fearing enemies, the “Sun is An Enemy” metaphor generated more concerns about skin cancer than the literal message. For participants unafraid of enemies, the metaphorical framing made them worry less about skin cancer than the literal framing. In the same vein, Spina, Arndt, Landau, and Cameron (2018) showed that exposure to the “Body is A Family” metaphor increased intentions to

receive a smear test only among Latina women high in familism endorsement. Brown, Keefer, Sacco, and Bermond (2019) found that metaphorically framing immigration as an infectious disease provoked stronger anti-immigration attitudes, especially among germ-averse individuals.

The present research integrates the alternate source strategy and the source resonance hypothesis, setting out to test if people from two cultures (Chinese and US) may be influenced by two alternate metaphors (“Animals are Family” and “Animals are Friends”) differently due to different cultural beliefs and practices encompassing the source and the target.

3. Potential cultural differences in response to the family and the friendship metaphors

People cherish family and friends all over the world. However, metaphorically associating meat animals like pigs with family and friends may not be equally doable in every culture. While the “Animals are Friends” metaphor shows robust effects of discouraging pork consumption among US omnivores, we do not expect it to hinder Chinese omnivores from eating pork. The friendship metaphor describes pigs as cute, prosocial, clever and energetic, which conflicts with how Chinese people perceive pigs in every sense. In China, “pig invokes an image of being dirty, smelly, fat and stupid, such as ‘to live a life even worse than a pig’ (to live a very poor and bad life), ‘as stupid as a pig’, or with regard to someone’s home ‘as filthy as a pigpen’ ” (Wang & Dowker, 2008, p. 227). While negative idioms about pigs also exist in English (e.g., “fat as pig”, “cast pearls before a swine”), many influential literature and media works in the English-speaking world have

anthropomorphized pigs in a positive way, such as *The Three Little Pigs*, *Charlotte's Web*, *Babe*, and *Peppa Pig*. This phenomenon is largely missing in Chinese culture. The most famous anthropomorphic pig figure in China is Pigsy (“猪八戒”) from the novel *Journey to The West*, where Pigsy was portrayed as ugly, lazy, lustful and greedy, on top of being a fool (Wu, 2017; Zhou, 1994). Previous research on US omnivores revealed that the discouraging effects of the friendship metaphor did not extend to beef consumption, presumably due to its incongruency with US people's cultural image of cows (Wang & Basso, 2019). We reckon that it could fail in China for a similar reason.

Alternatively, we suspect that the metaphor “Animals are Family” could discourage Chinese omnivores' pork consumption, because this metaphor is compatible with Chinese people's prior beliefs (e.g., in *Journey to The West*, Pigsy always wanted to quit the journey, go home and rebound with his wife), and more importantly, because familism is a core value in Chinese culture (Fei, 1992; Slote & De Vos, 1998). As the pioneering Chinese anthropologist Fei Xiaotong points out in his comparative cultural research, Chinese and US families differ substantially in their functions and roles in constructing society. While the family is a basic unit in every society, family life in the US concentrates on the affective interactions between family members, and the family is independent of other types of social groups (Fei, 1947). By contrast, traditional Chinese families have more political, economic, and religious functions. In the vast rural areas of China, family bonds have been used to build larger social groups to organize all the political, economic, and religious activities since ancient days, i.e., individuals interact with the broader world through the medium of the family, and family bonds are at the pivot of almost every aspect of their social life (Fei, 1992). This vital role of the family is reflected in and reinforced by

Confucianism, a traditional philosophy shaping Chinese people's thoughts and actions for thousands of years (Slote & De Vos, 1998). Confucius regards a harmonious family as the prototype of a good society, and believes that filial piety and brotherly respect are the roots of humanity (“孝悌也者，其为仁之本与”). Although the structure of Chinese society has changed dramatically during modernization, Confucian familism adapts and still prevails in today's China, even among the younger generations and in the industrialized urban areas (Siu-Kai, 1981; Yan, 2018; Yeh & Bedford, 2019). The concept of family is perceived as essential to what make one a “human” in Chinese culture, which affords the family metaphor an opportunity to modify Chinese people's habitual practices like eating meat. On the other hand, more recent quantitative evidence from consumer research supports that US people endorse familism less strongly than Chinese people (Horn & Merritt, 2004), indicating that the impact of the family metaphor may be weaker among US omnivores.

4. The current research

Based on the cultural differences elaborated above, we reason that the family metaphor is more likely to change Chinese omnivores' attitudes and behaviours, while the friendship metaphor would work better on US omnivores. Our main outcome variables are inferred tastiness of meat and intentions to purchase meat, adapted from Wang and Basso (2019). Formally, we propose two pairs of differentiated hypotheses for the Chinese and the US samples:

H_{1a}: Exposure to anthropomorphism through the family metaphor, but not the friendship metaphor, leads Chinese omnivores to consider meat as less tasty.

H_{1b}: Exposure to anthropomorphism through the friendship metaphor, but not the family metaphor, leads US omnivores to consider meat as less tasty.

H_{2a}: Exposure to anthropomorphism through the family metaphor, but not the friendship metaphor, lowers Chinese omnivores' intentions to purchase meat.

H_{2b}: Exposure to anthropomorphism through the friendship metaphor, but not the family metaphor, lowers US omnivores' intentions to purchase meat.

Besides, anticipatory guilt is shown as an important psychological drive for meat reduction in past studies on the friendship metaphor (Wang & Basso, 2019; Kim & Yoon, 2021), and we expect it to underlie the effects of the family metaphor as well. Therefore, we have two additional hypotheses constant across the two samples:

H₃: The negative effect of anthropomorphism on the inferred tastiness of meat is mediated by increased anticipatory guilt.

H₄: The negative effect of anthropomorphism on purchase intentions is mediated by increased anticipatory guilt.

5. Study 1: Chinese omnivores

5.1 Methods

Participants. An *a priori* power analysis was conducted in G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) to determine the target sample size. With an estimated effect size of $f = 0.22$, i.e., the weakest significant effect observed in Wang and Basso (2019), $\alpha = 0.05$ and power = 0.95, the minimum sample size needed for a one-way analysis of variance (ANOVA) with three groups is $N = 324$. We built the experiment on *www.wjx.cn*, a Chinese online survey platform, and used their participant-recruitment service to collect data from mainland China. Applying the preregistered exclusion criteria, we collected 373 valid answers in total (Female = 182, Male = 191; $M_{\text{age}} = 33.4$, $SD_{\text{age}} = 8.6$).

Procedure and materials. After giving informed consent, participants were first presented with a web page introducing a pork brand “Mr. Piggy’s” (“小猪先生”), and then randomly assigned to one of the three conditions (control vs. family vs. friendship) where they were given further information about the production process of this brand. In the control condition ($n = 116$), participants read that the farm pigs were raised in a free-range environment. The vignette in the family condition ($n = 129$) depicted how the farm pigs grew up with their families while in the friendship condition ($n = 128$) it described how pigs played games with each other like humans would do with their friends. The web page materials were adapted from Wang and Basso (2019) and were balanced across conditions (see Appendix for the stimuli).

Subsequently, participants were asked to infer the tastiness of the featured pork products on a 7-point scale: “How tasty do you think the pork produced by Mr. Piggy’s would be?”

(1 = “not tasty at all” to 7 = “very tasty”). On a separate page, they were required to indicate their intentions to buy those pork products: “If Mr. Piggy’s pork products are available in your local market or supermarket, how likely would you be to purchase them?” (1 = “not at all likely” to 7 = “very likely”).

In addition, we measured the potential mediator anticipatory guilt. Participants were instructed to imagine eating the pork produced by Mr. Piggy’s and to rate how strongly they would feel “guilty”, along with three filler items “responsible”, “happy” and “surprised” on a 7-point scale (1 = “not at all” to 7 = “very strongly”). The four items were presented in random order.

Last, participants were required to complete a manipulation check question and those who failed to answer this question correctly were automatically excluded from the dataset by the platform. Information concerning dietary practice (Piazza & Loughnan, 2016) was collected afterwards, along with demographic data (gender and birth year) and a seriousness check question. At the end of the survey, participants were thanked and invited to make comments (optional) on the study.

5.2 Results

Inferred tastiness. A one-way ANOVA revealed no significant differences in inferred tastiness of meat across the three conditions ($F(2, 370) = 2.05, p = 0.130, \eta^2 = 0.011$; Control: $M = 6.16, SD = 0.77$; Family: $M = 5.93, SD = 0.99$; Friendship: $M = 6.02, SD = 0.94$), providing no evidence for H_{1a}.

Purchase intentions. A one-way ANOVA indicated that participants' intentions to purchase meat were significantly different across conditions ($F(2, 370) = 4.16, p = 0.016, \eta^2 = 0.022$). As predicted by H_{2a}, Tukey-Kramer post-hoc *t*-tests showed that purchase intentions were significantly lower in the family condition as compared to the control condition ($M_{\text{diff}} = -0.42, SE = 0.15, p = 0.012, 95\% CI = [-0.77, -0.08]$), while the difference between the friendship condition and the control condition was not significant ($M_{\text{diff}} = -0.19, SE = 0.15, p = 0.392, 95\% CI = [-0.54, 0.15]$; Control: $M = 5.97, SD = 0.87$; Family: $M = 5.55, SD = 1.25$; Friendship : $M = 5.78, SD = 1.27$).

Anticipatory guilt. In contrast with our H₃ and H₄, no significant differences were found in anticipatory guilt across conditions ($F(2, 370) = 1.08, p = 0.342, \eta^2 = 0.006$; Control: $M = 1.84, SD = 1.36$; Family: $M = 1.95, SD = 1.35$; Friendship: $M = 2.11, SD = 1.56$), which meant that guilt could not possibly mediate the effects of metaphors on other outcome variables. Nevertheless, we still conducted the mediation analyses as preregistered, and the models were detailed in Appendix Figures A7 and A8.

6. Study 2: US omnivores

6.1 Methods

Participants. We built the experiment on *www.qualtrics.com*, and recruited US participants through Amazon's Mechanical Turk (MTurk). Based on the same power analysis as in Study 1, we set the minimum target sample size at $N = 324$, and collected 518 valid answers (Female = 199, Male = 317, Other = 2; $M_{\text{age}} = 39.9, SD_{\text{age}} = 11.3$).

Procedure and materials. The study design was exactly the same as Study 1, in which we randomly assigned participants to one of the three conditions (control: $n = 194$; family: $n = 161$; friendship: $n = 163$) and provided them with different information about a pork brand “*Mr. Piggy’s*”. The stimulus texts and questions were the English equivalents of the Chinese version.

6.2 Results

Inferred tastiness. A one-way ANOVA revealed no significant differences in inferred tastiness of meat across the three conditions ($F(2, 515) = 0.36, p = 0.699, \eta^2 = 0.001$; Control: $M = 6.07, SD = 0.86$; Family: $M = 6.10, SD = 1.01$; Friendship: $M = 6.01, SD = 0.99$), providing no evidence for H_{1b}.

Purchase intentions. A one-way ANOVA indicated that participants’ intentions to purchase meat were significantly different across conditions, $F(2, 515) = 6.82, p = 0.001, \eta^2 = 0.026$. As predicted by H_{2b}, Tukey-Kramer post-hoc t -tests showed that purchase intentions were significantly lower in the friendship condition as compared to the control condition ($M_{\text{diff}} = -0.57, SE = 0.16, p = 0.001, 95\% CI = [-0.94, -0.21]$), while the difference between the family condition and the control condition was not significant ($M_{\text{diff}} = -0.29, SE = 0.16, p = 0.150, 95\% CI = [-0.66, 0.08]$; Control: $M = 5.82, SD = 1.12$; Family: $M = 5.53, SD = 1.55$; Friendship : $M = 5.25, SD = 1.72$).

Anticipatory guilt. Likewise, a one-way ANOVA yielded significant differences in anticipatory guilt across conditions ($F(2, 515) = 6.88, p = 0.001, \eta^2 = 0.026$). Tukey-Kramer post-hoc t -tests further demonstrated that participants anticipated themselves to feel significantly more guilty about eating meat in the friendship condition as compared to

the control condition ($M_{\text{diff}} = 0.79$, $SE = 0.22$, $p = 0.001$, $95\% CI = [0.28, 1.29]$), while participants' feelings of guilt in the family condition was not significantly higher than the control condition ($M_{\text{diff}} = 0.47$, $SE = 0.22$, $p = 0.073$, $95\% CI = [-0.03, 0.98]$); Control: $M = 2.49$, $SD = 1.76$; Family: $M = 2.96$, $SD = 2.10$; Friendship : $M = 3.28$, $SD = 2.23$).

Mediation analysis. To test H₄, we conducted a mediation analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2017). The mediation model included experimental conditions as the multi-categorical independent variable (indicator coding; Hayes & Preacher, 2014), anticipatory guilt as the mediator, and purchase intentions as the dependent variable. A bias-corrected bootstrap analysis with 5000 samples revealed a significant indirect effect of the friendship metaphor (vs. control) on purchase intentions through anticipatory guilt ($\beta = -0.20$, $SE = 0.07$, $95\% CI [-0.35, -0.09]$), as well as a significant direct effect ($\beta = -0.37$, $SE = 0.15$, $95\% CI [-0.66, -0.08]$), suggesting a partial mediation. In the meantime, the indirect pathway of the family metaphor (vs. control) on purchase intentions through anticipatory guilt was also significant, but had a smaller effect size than the friendship metaphor ($\beta = -0.12$, $SE = 0.06$, $95\% CI [-0.25, -0.02]$), and the direct pathway was not significant ($\beta = -0.17$, $SE = 0.15$, $95\% CI [-0.46, 0.12]$). The model accounted for 15% of the variance in purchase intentions ($R^2 = 0.15$, see Appendix Figure A10 for the full model details). It should be noted that the effects of the family metaphor on anticipatory guilt became significant in the mediation analysis because correction for multiple comparisons was not available.

7. Discussion and conclusions

Inspired by the source resonance hypothesis in the CMT, this research showcases how cultural traditions modulate the effects of anthropomorphic metaphors on meat consumption. Across two online experiments, we demonstrated that Chinese omnivores had lower intentions to buy meat after exposure to the “Animals are Family” metaphor, but not the “Animals are Friends” metaphor, whilst US omnivores’ purchase intentions were discouraged by the friendship metaphor more strongly than the family metaphor. These studies are theoretically innovative in that they have investigated the source resonance hypothesis from a cross-cultural perspective. Previous evidence for source resonance was mostly found in Western countries and was focused on the moderation role of individual-level differences. Our research enriches this literature by offering the first piece of indicative evidence that cultural-level differences regarding the source concept (and its compatibility with the target concept) could enhance or undermine the effects of metaphorical framing as well. Practically, our findings provide convenience for policymakers and organizations aiming to develop targeted metaphorical interventions - they may be able to bypass the costly and time-consuming procedure of obtaining individual-level information, and instead, improve intervention effectiveness by factoring in the shared cultural values in the target group.

In the nuanced field of meat reduction, a recent review also warns that little is known about what kind of interventions would be effective outside “industrialized countries located across North America and Europe” (Kwasny et al., 2022, p. 3). In an effort to fill in this gap, the current research identifies the family metaphor as a promising strategy to decrease meat consumption among Chinese omnivores. Furthermore, Confucian familism is

influential not only in China but also in its neighbouring countries such as Vietnam, South Korea, and Japan (Lee, 2018; Slote & De Vos, 1998). Hence, the family metaphor has the potential to change meat-eating habits in those areas too.

Although the effects on behavioural intentions support our respective hypotheses, some unexpected results point to the limitations of our work and avenues for future research. In both countries, inferred tastiness did not vary across conditions, which is inconsistent with previous research (Wang & Basso, 2019). We suspect this might be due to the fact that we did not measure inferred tastiness together with inferred enjoyment¹² (see Appendix Part 5 and Table A1 for further discussions). This inconsistency alerts us that even a tiny adjustment in the measurement method can produce psychological differences. Moreover, whereas increased anticipatory guilt mediated the effects of anthropomorphic metaphors on US omnivores' meat purchase intentions, it was not the case for Chinese omnivores. Chinese omnivores' feelings of guilt stayed at a low level equably in all conditions, implying that other psychological mechanisms were at play. One possible explanation is that China, like many other Eastern Asian countries, has a shame culture rather than a guilt culture (Benedict, 1946; Wong & Tsai, 2007). Shame and guilt are both negative feelings about one's own transgressive actions and are often interchangeable in everyday language, but conceptually, shame entails being evaluated negatively by others, while guilt is concentrated in self-evaluation (Ausubel, 1955; Smith, Webster, Parrott, & Eyre, 2002). Individuals from a shame culture are more likely to feel bad about their wrongdoings in the presence of others, as compared to, say, filling in a survey alone. Future researchers

¹² We dropped the item for inferred enjoyment because all the available Chinese translations of it were criticized for sounding "unnatural and Westernized" in a focus-group pre-test with native Chinese speakers and English-Chinese bilinguals.

could create some interpersonal scenarios for Chinese omnivores and see if their affective responses to the family metaphor become more pronounced.

Another limitation of the current research is that we did not include an explicit measurement of familism. The metaphor “Animals are Family” has been chosen on account of the documented prevalence of familism in Chinese society (Fei, 1992; Whyte, 2020; Yan, 2021). To better investigate the role it plays, we should have measured familism in both samples, testing whether Chinese participants score higher than US participants on average, and whether individual-level differences in familism endorsement moderate the effects of the family metaphor. Unfortunately, we could not find an available familism scale that properly characterizes Chinese familism. Historically, familism has been studied as an extension of the East-West collectivism vs. individualism dichotomy (Gaines et al., 1997; Schwartz et al., 2010). In consequence, the measurements in previous literature always create an uncalled-for tension between the family and the individual, operationalizing familism as unconditional obedience to senior family members or sacrifice for the family. For instance, the widely-used familism scale from Steidel and Contreras (2003) consists of items like “The family should control the behaviour of children younger than 18”, “Children should obey their parents without question even if they believe they are wrong”, and “A person should always support members of the extended family, for example, aunts, uncles, and in-laws, if they are in need even if it is a big sacrifice”. Such controversial items are also common in Yang’s (2004) Chinese familism scale (e.g., “Individuals should avoid doing things of which their families disapprove”, “Individuals should sacrifice themselves to safeguard the overall interests of the family”), arguably because this Taiwanese psychologist was trained in US universities

in the 1960s¹³. We doubt if people in mainland China would feel comfortable with this Western conceptualization of familism. As mentioned earlier in section 3, Chinese familism emphasizes the harmony between one's self-fulfilment and family prosperity (Chen & Fan, 2010), and believes in the primacy of family interactions over other social activities. This is well-reflected in a quote from the Confucian classic *Great Learning*: “Since ancient times, those who want to bring enlightenment to the world, must first govern their country; to govern their country, they must first manage their family; to manage their family, they must first cultivate themselves” (“古之欲明明德于天下者，先治其国；欲治其国者，先齐其家；欲齐其家者，先修其身”). We hope that future researchers will develop new localized familism scales for non-Western societies, so that this cultural value could be examined with more depth and accuracy.

¹³ Yang's (2004) scale has other problems too. One example is that many of its items stress an obsession with reproduction, such as “It is a blessing to have many children and grandchildren”, “A big family full of children and grandchildren is the ideal family form”, and “In order to continue the family line, a guy should have at least one son”. This traditional mindset has been largely interrupted in mainland China due to the one-child policy as well as improvements in women's education. Even after the repeal of anti-natalist policies, China's fertility rate keeps declining and hit a record low in 2022 (<https://www.reuters.com/world/china/births-china-slide-10-hit-their-lowest-record-2023-10-12/>). Chinese people still cherish family, but no longer seem to want a lot of offspring.

To conclude, there is evidence that Chinese and US omnivores are influenced by the family and friendship metaphors differently, in a way that looks consistent with their cultural traditions. While the specific socio-psychological mechanisms are still pending, those contrasting patterns have practical implications for policymakers and organizations - they should always try to understand the target groups' cultural characteristics when designing metaphor-related interventions, and should not expect successful interventions to work in a new socio-cultural context without any adaptations.

Open Practices

Both studies in this research have been preregistered, including all the hypotheses, experimental procedures, materials, and analyses. We report all measures, manipulations, and exclusions in these studies. The preregistrations and data will be made available at <https://osf.io/tgsdh/> upon the publication of the article. During the review process, the preregistrations can be accessed via the following anonymous links:

https://osf.io/bnyas/?view_only=593dd50a2e9f4483a57da42a12e72f76

https://osf.io/hcagw/?view_only=313f7bfd8dab4d48b1ced9250e852ae1

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Methodological Detail Appendix

1. All stimuli used in the two experiments

Please note that the stimulus texts were equivalent in the English and the Chinese versions, which had been checked by two English-Chinese bilinguals. A popular pork dish in each culture was displayed alongside the text to stimulate participants' appetite.

1.1. Study 1

Figure A1. Stimulus in the control condition of Study 1.



Figure A2. Stimulus in the family condition of Study 1.



Figure A3. Stimulus in the family condition of Study 1.



1.2. Study 2

Figure A4. Stimulus in the control condition of Study 2.

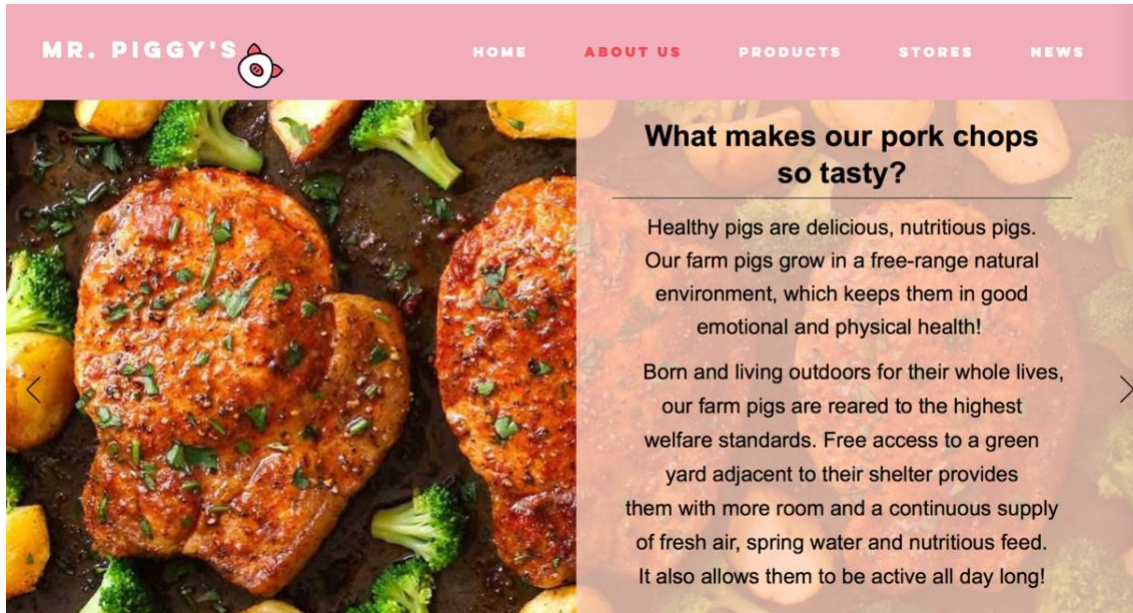


Figure A5. Stimulus in the family condition of Study 2.

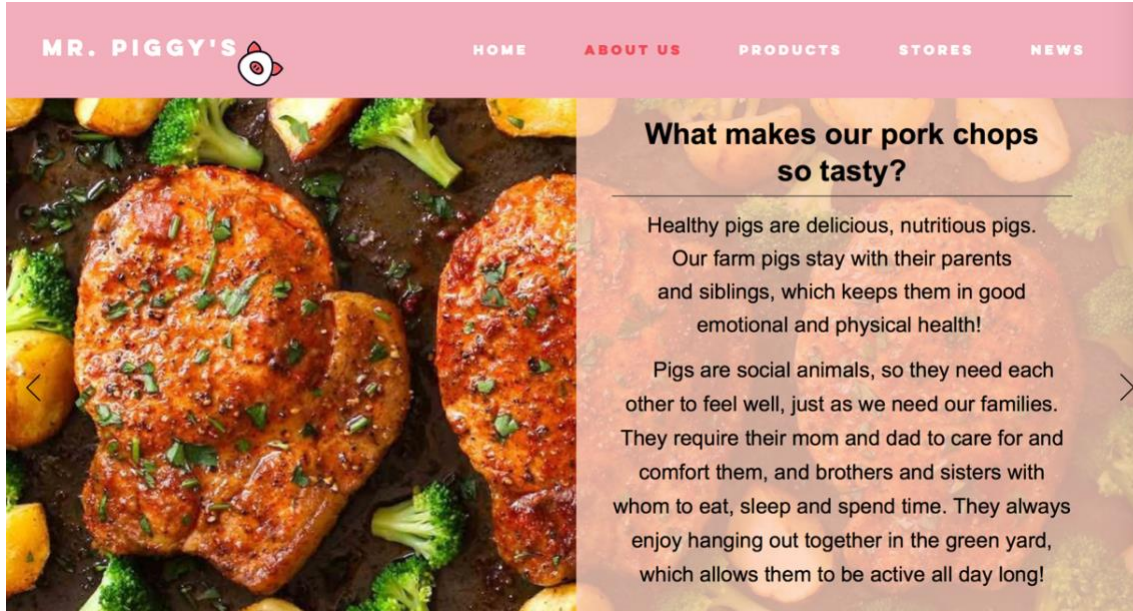
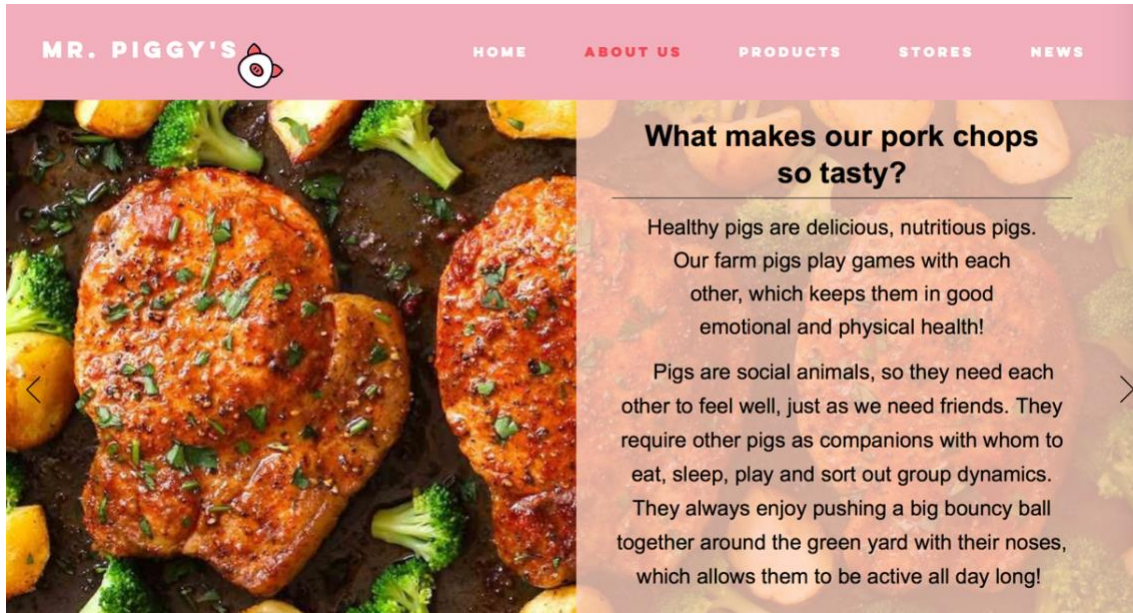


Figure A6. Stimulus in the family condition of Study 2.



2. Exclusion criteria and pertinent questions

2.1. Manipulation check

We manipulated exposure to anthropomorphic metaphors, and the manipulation would be successful as long as the participants read the textual stimuli carefully. Therefore, our manipulation check was just an attention check question - “According to the advertisement, how does Mr. Piggy’s keep their farm pigs in good health?” (1) “Their pigs grow in a free-range natural environment”; (2) “Their pigs are accompanied by parents and siblings”; (3) “Their pigs play games with each other like friends”; (4) “Their pigs are provided with professional medical care”; (5) “Their pigs listen to music and solve puzzles”; (6) “Their pigs live in houses with heat and moisture control”; (7) “Their pigs are given antibiotic-free feed”. The presentation order of the seven options were randomized. Participants who failed to answer this question correctly (i.e., participants who did not choose option (1) in the control condition, who did not choose option (2) in the family condition, and who did not choose option (3) in the friendship condition) were excluded from the data analysis.

2.2. Other criteria

The exclusion criteria had been fully preregistered before the studies were carried out. All the related questions were asked at the end of the survey in an independent page so as not to confound the experimental results.

Participants who were under the age of twenty-two (i.e., whose birth year was later than 1998 in Study 1, and 1999 in Study 2) were excluded. We used this age filter in the Chinese study because Chinese people typically start grocery shopping after finishing their

education at the age of twenty-two. Although Americans seem to start grocery shopping from a slightly younger age (at around eighteen), we decided to stick to twenty-two in case the cross-cultural comparison could be confounded by other age-related potential factors. Participants who answered the birth year question with an unconvincing year or unrecognizable numbers were also removed.

Participants who are vegan, vegetarian, fish-only omnivores, and/or do not eat pork for religious reasons were excluded.

Participants who answer “I have not taken part seriously, please throw my data away” to the seriousness check question were excluded. The seriousness check question was: “It would be very helpful if you could tell us at this point whether you have taken part in this study seriously, so that we can use your answers for our scientific analysis, or you were just clicking through without reading the instructions and survey questions? Please answer honestly - you will receive the payment regardless of your answer.” The default answer was “I have not taken part seriously, please throw my data away” and the other option was “I have taken part seriously”.

3. Additional details about data collection and sample

3.1. Study 1 data collection

An *a priori* power analysis yielded that the minimum sample size needed for a three-group one-way ANOVA is $N = 324$, with an estimated effect size of $f = 0.22$, $\alpha = 0.05$ and power = 0.95. We decided to oversample by around 25% at the beginning to ensure that there would be enough participants after applying the exclusion criteria. There were 422 participants who completed our study and each of them was paid three Chinese Yuan. Based on the preregistered criteria, we eliminated participants who were under the age of twenty-two ($n = 38$), who were vegan, vegetarian, fish-only omnivores, and/or did not eat pork for religious reasons ($n = 8$), and who failed the seriousness check ($n = 3$), leaving 373 valid answers.

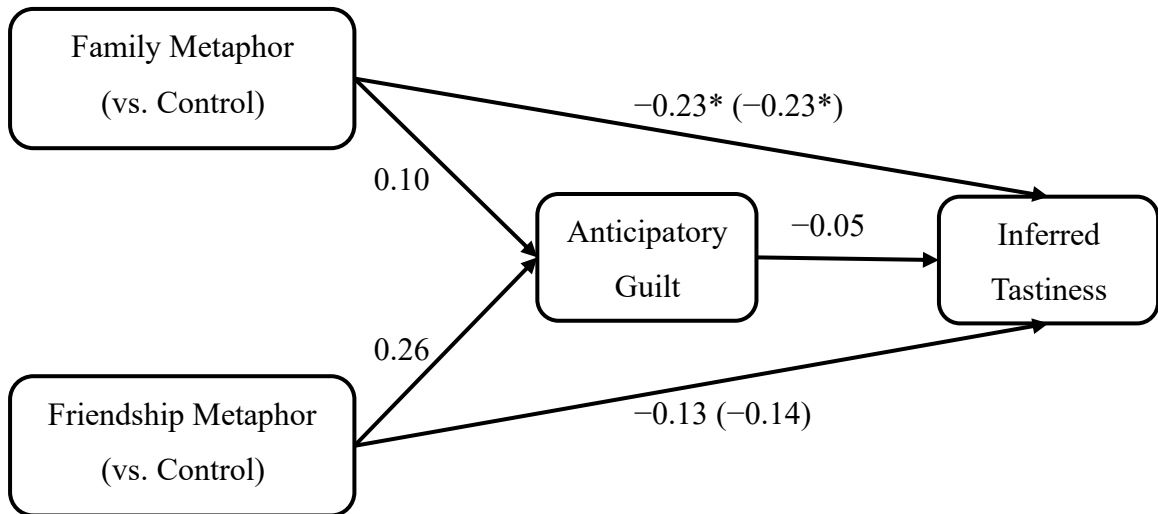
3.2. Study 2 data collection

Based on the same power analysis as in Study 1, we set the minimum target sample size at $N = 324$, but decided to oversample by 85% this time because MTurk did not recommend automatically filtering careless participants who answered the manipulation check question wrongly, and we had to exclude them manually afterwards. We thus collected 600 participants in our first attempt, hoping to get enough valid answers for a well-powered analysis. Unfortunately, there were only 245 valid answers when all the preregistered exclusion criteria were applied, suggesting a need to extend the data collection. After consulting MTurk, we targeted participants with a high reputation (i.e., MTurk workers with at least a 95% approval rating and more than 5000 HITs completed) in the second attempt, and collected 407 new answers.

After excluding those who failed the manipulation check ($n = 362$), who were under the age of twenty-two ($n = 3$), and who were vegan, vegetarian, fish-only omnivores, and/or did not eat pork for religious reasons ($n = 114$), and who failed the seriousness question ($n = 10$), we finally got 518 valid answers from the two rounds of data collection. All participants were paid fifty cents for completing the study.

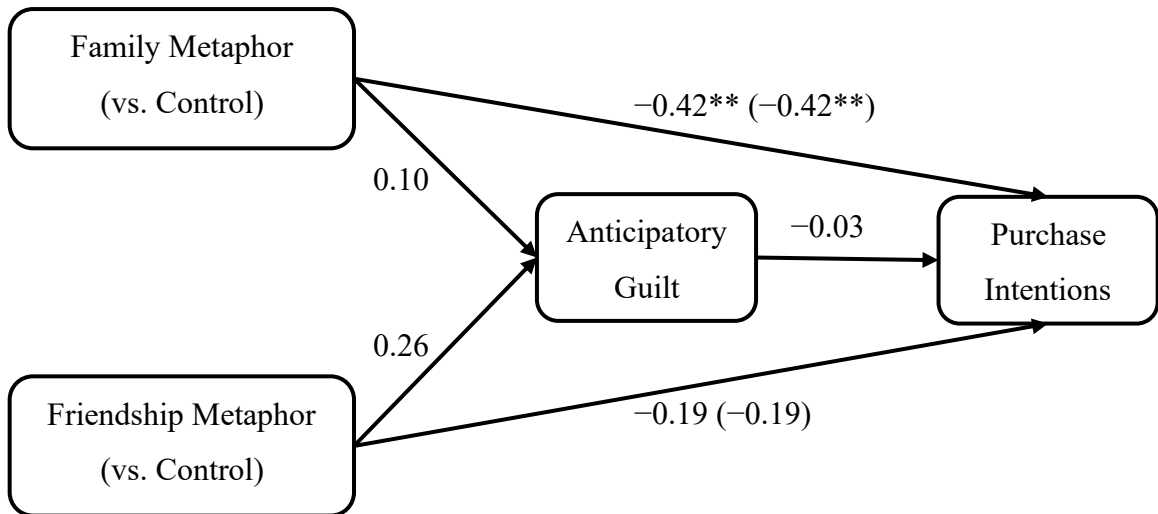
4. Further mediation analyses for H₃ and H₄

Figure A7. The mediation model testing H₃ in Study 1.



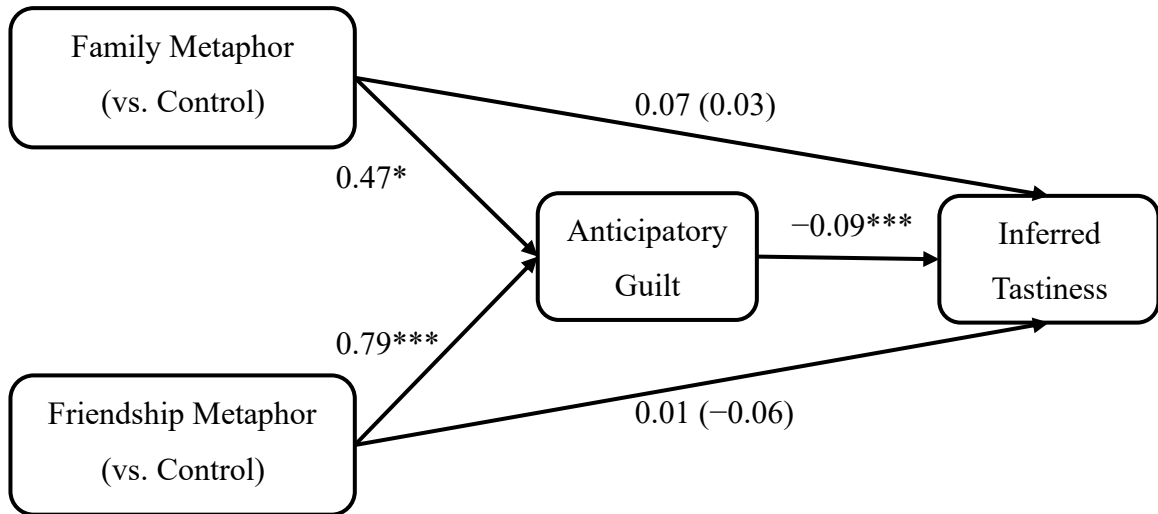
Note. The mediation analysis shows that the total effect of the family metaphor on the inferred tastiness of meat is significant and negative ($p = 0.045$) among Chinese omnivores when we do not correct for multiple comparisons, while anticipatory guilt does not mediate this effect. Unstandardized linear regression coefficients are presented (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounts for 2% of the variance in inferred tastiness ($R^2 = 0.02$).

Figure A8. The mediation model testing H4 in Study 1.



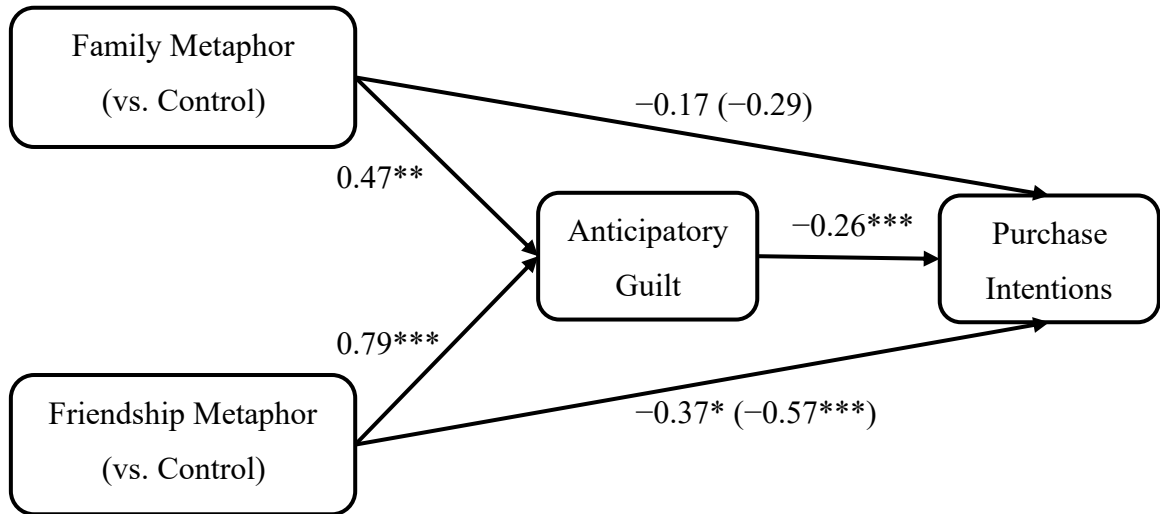
Note. The mediation analysis shows that the total effect of the family metaphor on meat purchase intentions is significant and negative ($p = 0.004$) among Chinese omnivores, while anticipatory guilt does not mediate this effect. Unstandardized linear regression coefficients are presented ($*p < 0.05$, $**p < 0.01$, $***p < 0.001$). The model accounts for 2% of the variance in purchase intentions ($R^2 = 0.02$).

Figure A9. The mediation model testing H₃ in Study 2.



Note. The mediation analysis shows that the total effects of the metaphors on the inferred tastiness of meat are not significant among US omnivores (Family: $p = 0.788$; Friendship: $p = 0.553$). Although the indirect pathways through anticipatory guilt are significant, we should not regard them as mediation effects given that the total effects are absent. Unstandardized linear regression coefficients are presented (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounts for 4% of the variance in inferred tastiness ($R^2 = 0.04$).

Figure A10. The mediation model testing H4 in Study 2.



Note. The mediation analysis shows that the total effect of the friendship metaphor on meat purchase intentions is significant and negative ($p = 0.0003$) among US omnivores, and anticipatory guilt partially mediates this effect. Unstandardized linear regression coefficients are presented (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The model accounts for 15% of the variance in purchase intentions ($R^2 = 0.15$).

5. Reanalysis of the data from Wang and Basso's (2019)

To explore why our outcomes around inferred tastiness were at odds with Wang and Basso's (2019) findings, we reanalysed the open data from that original paper and treated inferred tastiness and inferred enjoyment as separate variables. Interestingly, the effect of the friendship metaphor on inferred tastiness was still significant in every study on pork consumption, but always much weaker than that on inferred enjoyment. In this sense, the observed effect on inferred tastiness might be a spillover from inferred enjoyment. When participants read a single question for tastiness, they might simply make inferences according to presumed physical properties of meat, which were probably immune to metaphorical framing. However, when the questions for tastiness and enjoyment were presented side by side, participants' answers to them could be synchronized to some extent. Those who enjoyed meat-eating less after exposure to anthropomorphic metaphors would also rate meat as less tasty. This explanation is highly speculative and requires further experiments to confirm.

Table A1. The effects of the friendship metaphor on inferred tastiness and inferred enjoyment based on the data from Wang and Basso (2019).

	Inferred tastiness			Inferred enjoyment		
	η^2	F	p	η^2	F	p
Study 1b	0.045	5.45	0.021	0.106	13.62	0.0003
Study 2	0.128	11.69	< 0.0001	0.160	15.11	< 0.0001
Study 3a	0.037	4.19	0.043	0.094	11.28	0.001
Study 3c	0.050	8.75	0.004	0.143	27.46	< 0.0001

Note. We do not reanalyse the data from Studies 1a and 3b because the evaluation target in those studies is different from that in the current research, i.e., participants are not asked to evaluate pork products.

Chapter 6

A Take-Home Message: Workplace Food Waste Interventions Influence Household Pro-environmental Behaviours

Abstract

Previous research on food waste interventions has mostly focused on micro-level factors related to the individuals, and largely neglected macro-level contextual factors such as work-to-home spillovers. Inspired by the multi-level framework, we present a case study of how macro-level workplace campaigns could decrease food waste in staff cafeterias, compete with micro-level factors like environmental identity, and further stimulate some employees' food saving efforts at home. The workplace interventions combined smart bins with fortnightly informational feedback trialled in three staff cafeterias of a large hotel chain in Macau, China. Actual food waste data and self-reported behaviour consistently show that the staff cafeteria receiving environmental framing with anthropomorphic cues had more reductions in food waste behaviours. A key determinant of self-reported food saving efforts at home was efforts to reduce food waste at work, which predicted beyond and above environmental identity and provided evidence for positive contextual spillover effects.

Keywords

Food waste; Behavioural intervention; Multi-level framework; Environmental framing; Anthropomorphism; Contextual spillover¹⁴

¹⁴ This chapter is a published paper: Wang, F., Shreedhar, G., Galizzi, M. M., & Mourato, S. (2022). A take-home message: workplace food waste interventions influence household pro-environmental behaviors. *Resources, Conservation & Recycling Advances*, 15, 200106.

1. Introduction

Reducing food waste is key to improving the environmental sustainability of food systems and enhancing food security across the world. For example, in the wake of how Covid-19 disrupted food systems, President Xi Jinping launched the “Clean Plate Campaign” to tackle consumer food waste in China. Apart from signifying the importance of food waste as a national issue, it reflected the growing recognition that a significant amount of food waste comes from consumers’ leftovers (Makov et al., 2020). The UNEP food index estimates around 931 million tonnes of food waste was generated in 2019, 61% of which came from households, 26% from food service, and 13% from retail (United Nations Environment Programme, 2021). There is much interest, therefore, in raising consumer awareness of saving food, and reduce wasteful consumer behaviour.

There is an emerging literature on how behavioural interventions including informational and physical nudges can change consumer food choices (Garnett, Marteau, Sandbrook, Pilling, & Balmford, 2020; Mehrabi, 2020; Reisch et al., 2020; West et al., 2014). While similar efforts have been made to reduce consumer food waste, many scholars have called for more evidence on intervention effectiveness (Kallbekken & Sælen, 2013; Liu, Gomez-Minambres & Qi, 2022; Richardson, Prescott & Ellison, 2021; Stöckli, Niklaus & Dorn, 2018). There is, in particular, little evidence on whether food waste interventions could lead to behavioural changes in and beyond the immediate context (Clot, Giusta & Jewell, 2021).

The purpose of this article is to explore whether macro-level interventions implemented in staff cafeterias can help reduce food waste in the workplace and further facilitate pro-

environmental behaviours in the household. To carry out the study, we collaborated with Winnow, a business specializing in measuring food waste through smart technologies, and Melco, a large hotel-casino chain in the hospitality sector in Macau, China.

Three staff cafeterias in different Melco hotels received smart bins and fortnightly informational feedback on the amount of food they wasted. We varied the type of feedback each site received to investigate if it can be communicated more effectively in some ways: feedback in site A solely illustrated how much food was wasted, whereas we framed feedback with environmental information without and with anthropomorphic cues (e.g., where the food icons had faces) in sites B and C respectively. In addition to actual food waste data, we collected an online survey of staff after the interventions were trialled. This combination of metrics enabled us to examine if actual food waste data corresponded with self-reported levels of effort to save food at work, and if there were any unintended impacts on efforts to reduce waste at home. The survey, importantly, also allowed us to identify micro-level psychological determinants (e.g., environmental identity, motivations, and beliefs) for saving food at work and home to analyse how they might interact with the macro-level contextual spillover effects.

The remaining parts of section 1 will present brief literature reviews about informational feedback interventions with environmental framing and anthropomorphic cues, as well as behavioural spillover effects in the context of food waste, to explain the rationale of our interventions and our study design. The data collection and the statistical methodology will then be outlined in section 2, followed by the results in section 3. We will conclude with a discussion of the results, the limitations, and the implications for future research in section 4.

1.1. Informational feedback, environmental framing and anthropomorphic cues

Informational feedback is a widely used intervention proven to be useful in many other waste reduction contexts (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Schultz, Oskamp, & Mainieri, 1995). The large hotel-casino chain, Melco, required us to provide food waste feedback to all sites involved as the basis of our collaboration. Since we did not have a control site that received no feedback at all, we were unable to examine if feedback itself could effectively reduce waste behaviours. Alternatively, we decided to investigate if other techniques from psychological and behavioural research may enhance the effectiveness of informational feedback.

The first technique we selected is environmental framing. Framing is a nudging technique which draws attention to a specific attribute, motivation or consequence from a given course of action. The impact of “goal framing” where the goal of an action or behaviour is made salient (Levin, Schneider & Gaeth, 1998), has been used to motivate pro-environmental actions and spillover effects across related domains like energy conservation and food choice. Past research typically compares the effectiveness of environmental framing versus monetary framing by drawing attention to the environmental or monetary goals of conservation actions (e.g., reducing emissions or increasing financial savings) (Chen & Jai, 2018; Shreedhar & Galizzi, 2021; Steinhorst & Klöckner, 2018; Wolstenholme, Poortinga, & Whitmarsh, 2020). In the food waste domain, Chen and Jai (2018) found that environmental messages (e.g., “Reduce Waste for a Sustainable Future”) led to more positive consumer attitudes towards preventing food waste in the restaurant than threat-focused monetary messages (e.g., “We Charge \$5 per pound for Food Waste”), even though the effect on behavioural intentions was no significant. On the other hand, van

der Werf and colleagues' (2021) curb-side collection-cum-information intervention emphasized that saving waste can save money (although they did not compare the impact of this framing with other framings): they found a significant (29%) reduction in avoidable food waste compared to a no-intervention control group, suggesting that monetary framing may sometimes be beneficial in food waste interventions.

Nonetheless, research also shows that people can judge a pro-environmental and profit-making organization more negatively than a company that pursued profit only (Makov & Newman, 2016), a consideration particularly relevant in our setting. Recall that we were trialling interventions in the workplace cafeterias of a large hotel-casino chain, where guests often wasted food at all-you-can-eat buffets. Furthermore, workers do not pay for their meals in staff cafeterias, so any savings from food waste reduction would not directly financially benefit them, but the company. At least in this specific scenario, monetary framing is likely to do more harm than good, so we chose to focus on the environmental impact of food waste only.

The second technique we chose is anthropomorphism. Anthropomorphism is defined as attributing human-like characteristics to non-human objects (Epley, Waytz, & Cacioppo, 2007). Past studies have found that anthropomorphic cues, such as facial expressions, can induce affective responses and make humans cherish the objects more (Chandler & Schwarz, 2010). Anthropomorphic cues have been unintentionally used alongside environmental framing by both pro-environmental activists and scientists (e.g., Dolnicar, Juvan, & Grün, 2020), indicating good compatibility between the two techniques. Indeed, previous research shows that anthropomorphic cues boost pro-environmental behaviours like waste-sorting (Ahn, Kim, & Aggarwal, 2014) and that anthropomorphism increases

consumers' intentions to buy misshapen food products (Cooremans & Geuens, 2019; Shao, Jeong, Jang, & Xu, 2020).

Despite the wide range of studies on environmental framing and anthropomorphism in other domains like energy and food choices, there is no empirical research on whether they could jointly improve the effectiveness of informational feedback in reducing workplace food waste. To fill in this gap, we set out to test the following hypotheses in the current paper:

Hypothesis 1a: Environmental framing of food waste feedback leads to a greater reduction in food waste at work (compared to feedback framed with food waste only).

Hypothesis 1b: Environmental framing of food waste feedback with anthropomorphic cues leads to a greater reduction in food waste at work (compared to feedback framed with food waste only).

1.2. Contextual spillovers and food waste behaviours

There has been a growing interest in “behavioural spillovers” in both policy and academic research in recent years (e.g., Truelove et al., 2014; Dolan and Galizzi, 2015). “Spillovers” refer to the idea that the adoption of one behaviour causes the adoption of additional, seemingly unrelated behaviours (Galizzi & Whitmarsh, 2019; Sintov, Geislar & White, 2019). In many cases, the initial behaviour change arises from a behavioural intervention (although this may not be the case, e.g., in Maki et al., 2019). From a practical perspective, the possibility of behavioural spillovers is attractive because it enables us to change behaviours in a cost-effective manner by picking interventions that usher in the greatest

effects on all desirable behaviours. From an academic perspective, spillover effects are intriguing because they shed new light on the dynamic process of behaviours change, by drawing attention to the relationships between behaviours within and between contexts like the workplace and the home, with implications about how we can scale shifts to more sustainable lifestyles (Nilsson, Bergquist, & Schultz, 2017).

Contextual behavioural spillovers occur when interventions aiming to change behaviour in one context (e.g., workplace) influence behaviour in another context (e.g., home). The evidence of contextual spillovers is scarce for consumer food behaviours (Verfuërth, Jones, Gregory-Smith, & Oates, 2019). Previous studies predominantly investigate food waste behaviours within one context, either in residential households (Roe et al., 2022; van der Werf, Seabrook, & Gilliland, 2021; Graham-Rowe et al., 2014; Visschers et al., 2016), workplaces, university halls, or cafeterias (Kallbekken & Sælen, 2013; Lim et al., 2021; Liu et al., 2022; Richardson et al., 2021; Sebbane & Costa, 2018).

Recently, Boulet, Hoek, and Raven (2021) proposed a multi-level theoretical framework after having comprehensively reviewed past papers on household food waste behaviours over the past two decades. The framework organizes the factors that are likely to influence consumer food waste behaviours into three levels: the micro-level focusing on the individuals, the meso-level considering the household environment and interactions between family members, and the macro-level concerning physical contexts (e.g., workplaces, schools, and supermarkets) and social networks (e.g., colleagues, friends, and neighbours) external to the household. They found that the research field was heavily skewed towards micro-level factors targeting individual attitudes and awareness, and paid barely any attention to the macro-level factors such as contextual spillovers (Boulet et al.,

2021). Only a very small number of researchers pioneeringly studied the spillover effects from school to home. Namely, Boulet, Grant, Hoek, and Raven (2022) showed that school-based educational events on food saving led to a reduction in avoidable food waste in the participating Australian schools, motivated students to change their food-related behaviours at home, and further inspired their parents to reflect on household food waste. Nevertheless, no studies so far, to the best of our knowledge, have empirically explored the possible effects of workplace food waste interventions on household food waste behaviours. Formal education at school means to have an impact “beyond the school gate” (Duvall, & Zint, 2007). Informal learning in the workplace, though often underestimated, is a no less effective route for knowledge acquisition and habit formation, especially in collectivist cultures where workers are more willing to engage in collaborative group activities (Kim, S., & McLean, 2014). Therefore, it is worthwhile to examine if workplace campaigns may influence household food waste behaviours as well. Our hypothesis for this work-to-home spillover is formally stated below:

Hypothesis 2: Efforts to reduce food waste at work are positively associated with efforts to reduce food waste at home (i.e., there are positive contextual spillover effects).

Inspired by Boulet, Hoek, and Raven’s (2021) multi-level framework, we will analyse, on an exploratory basis, how macro-level contextual spillover effects may interact with the micro-level factors such as environmental identity. This is the first study to investigate if environmental framing and anthropomorphism facilitate contextual spillovers in food waste behaviours, relying on both real-time automatically recorded data of food waste, and self-reported survey data on food saving actions.

Besides, we will also explore if the spillovers extend to other waste reduction behaviours at home (e.g., sorting waste and using less plastic packaging). There is very little research on whether interventions targeting food waste would influence other pro-environmental behaviours. Ek & Miliute-Plepiene (2018) exploited the staggered implementation of a curb-side food waste collection system (either using different containers, multi-compartment bins or different-coloured bags) from 2006 to 2015 in 290 Swedish municipalities. They used a difference-in-differences design and found a short-lived positive spillover onto sorting of packaging waste. Miliute-Plepiene & Plepys (2015) also find a spillover from food waste collection onto packaging using survey data in one Swedish municipality. Our exploratory analyses would add to this literature and provide a new contextual angle to it.

2. Materials and methods

2.1. Research design

Our research consisted of two stages. Firstly, we installed smart bins (i.e., the Winnow Sense (WS) system) to automatically measure food waste in three staff cafeterias of a hotel chain based in Macau, China,, and implemented fortnightly feedback interventions. The WS system had the advantage of minimizing the measurement errors associated with manual weighing, and therefore enabled us to estimate food waste reduction more accurately. Secondly, we surveyed the workers who had been exposed to our interventions to examine if the workplace campaign also stimulated efforts to reduce food waste, as well as other pro-environmental behaviours, at home.

2.2. Procedure

2.2.1. Step 1: Framed informational feedback interventions on food waste at work and automatically recorded food waste weight data

To investigate if environmental framing and anthropomorphic cues could improve the effectiveness of food waste feedback (Hypotheses 1a and 1b), we conducted a quasi-experimental field study in three staff cafeterias in Macau between the end of 2020 and the 2021 summer. The outcome variable was grams of food waste per meal per day, automatically captured by the WS system. We collected the food waste data from 21/12/2020 to 23/05/2021, and the informational feedback campaign ran between 09/02/2021 and 19/04/2021 in sites B & C, and between 09/03/2021 and 19/04/2021 in site A. The study covered 1,536,610 meals in total over the four-month trial period.

We had seven weeks of data before any feedback posters were introduced, and we also tracked changes in food waste data for five further weeks after the posters were removed. To measure the effects of environmental framing and anthropomorphism in the workplace, we employed a difference-in-differences (DID) design where, in all the cafeterias, we gave fortnightly feedback on the reduction of food waste, and introduced environmental framing and anthropomorphic cues into the feedback in some of the sites. The study design is summarized in Figure 1. Basically, in control site A, we planned to provide food waste feedback in rounds 1-5, but only managed to do so in rounds 3-5, as there was a one-month delay in installing the WS system in site A due to logistical difficulties. In treatment site B, food waste feedback was given for all 5 rounds, while additional posters about the environmental benefits of reducing food waste were added in rounds 3-5. The same food

waste feedback and environmental messages were given to treatment site C with the only difference that images (e.g., food, trees, and the globe) were anthropomorphized (see Figures 2-3 for exemplar posters).

Figure 1. The detailed design of the field study.

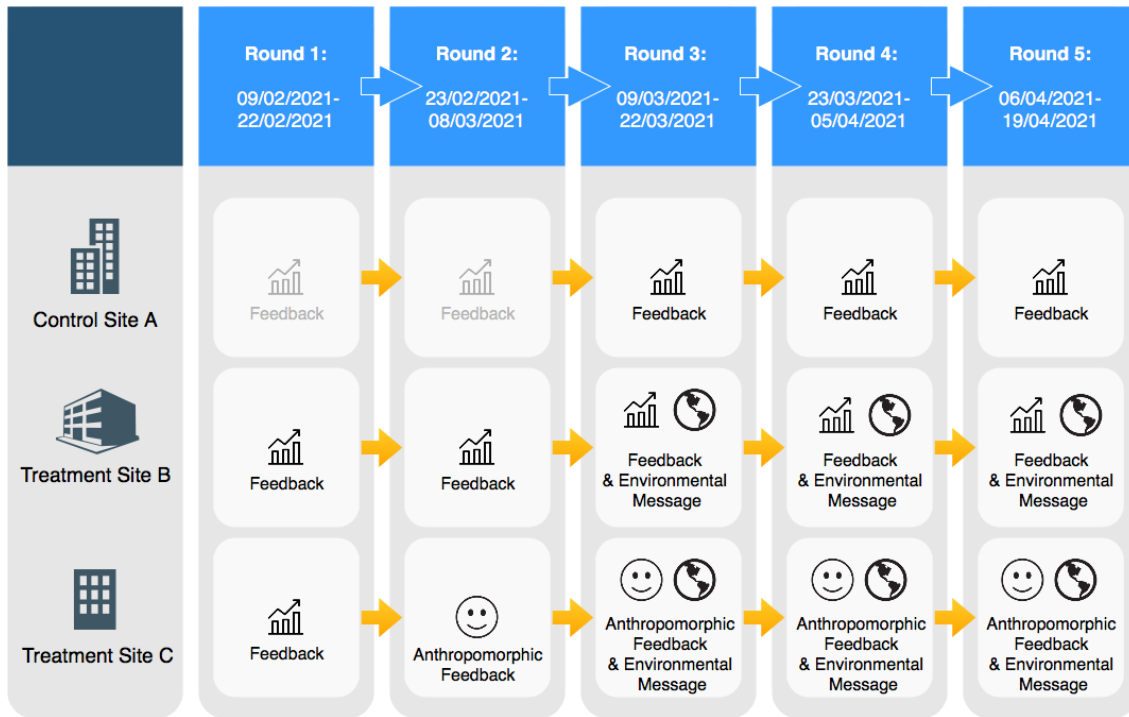


Figure 2. Exemplar posters: Round 1 on-site implementations.

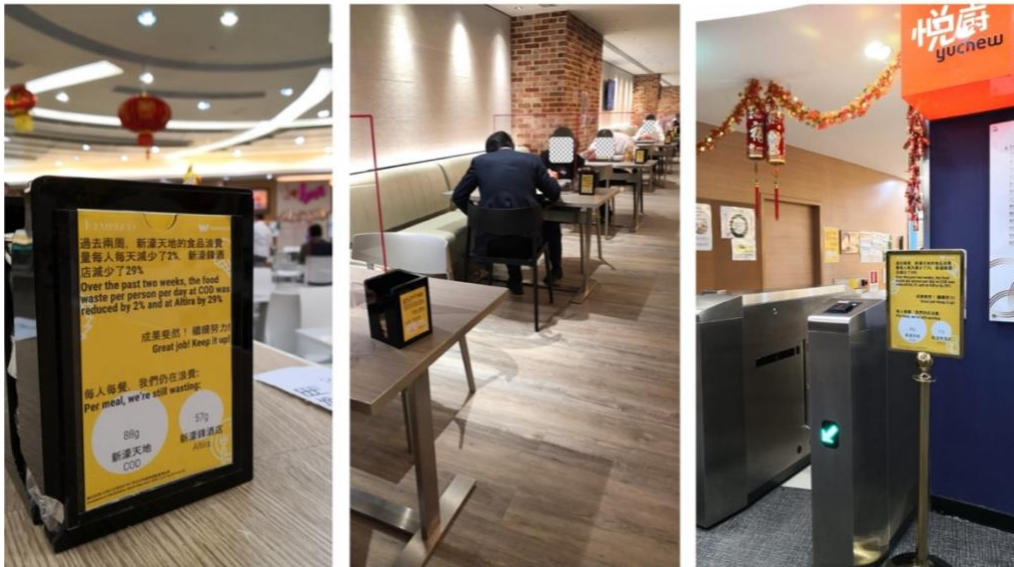
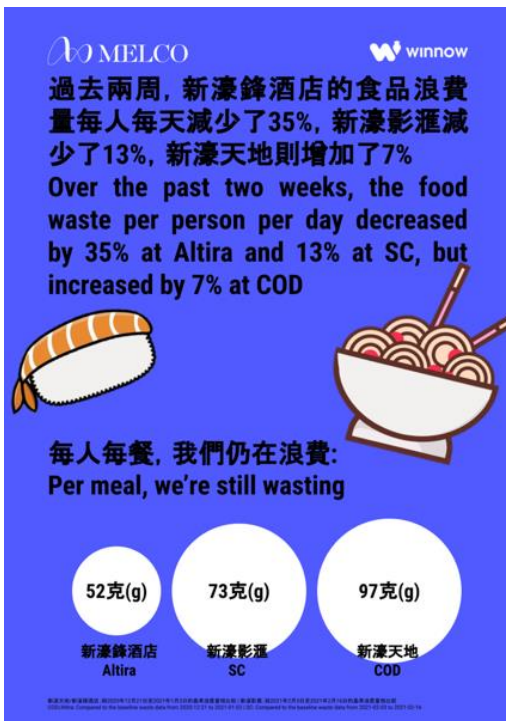
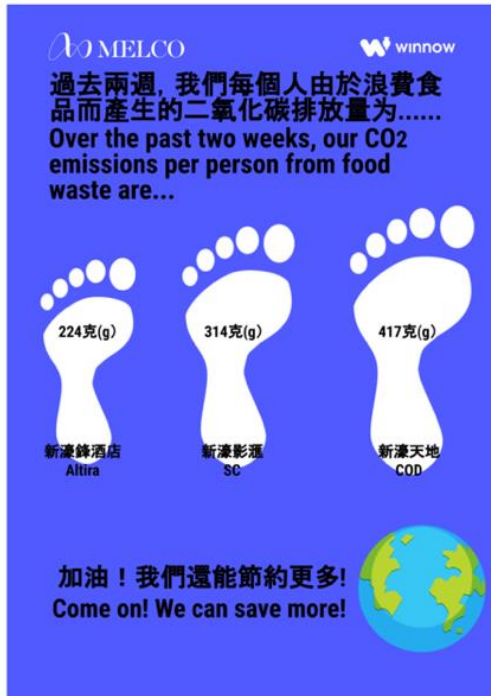


Figure 3. Exemplar posters: Round 3.

Control site A:



Treatment site B:



Treatment site C:



2.2.2. Step 2: Survey of workers on food waste behaviours at work and home

To investigate if there were spillovers from work to home (Hypothesis 2), we relied on an online survey with employees from all sites after the food waste campaign ended. The survey was built on *Qualtrics* and distributed via QR codes from 26/04/2021 to 10/05/2021. In each survey, the questions and responses were available in both Traditional Chinese and English, which were developed by native Chinese and English speakers. We piloted the survey with a small group of on-site teams to ensure comprehension amongst the workers.

After collecting the consent and information on which site the respondent worked at, the survey began with a question on their memory of the workplace food waste campaign (Recall_waste_work: “Have you seen a campaign in your workplace about reducing food waste?” 1 = “Never” to 5 = “Always”). We included this to check if the workers noticed our interventions and if their memory of the interventions would influence food saving behaviours. Thereafter, the workers’ efforts to reduce food waste at work and home were measured with multiple questions, which would be the main independent and dependent variables in our analyses. The workers’ efforts to reduce food waste at work were measured on two 5-point Likert scales: “Have you done any of the following in the past 4 months?” Action_waste_work: “Tried to reduce food waste at work” and Talk_waste_work: “Had a conversation with work colleagues about food waste” (1 = “Never” to 5 = “Always”).

Likewise, we measured efforts to reduce food waste at home by asking if the respondent had talked about or acted upon saving food at home during the study period (Action_waste_home: “Tried to reduce food waste at home”; Talk_waste_home: “Had a conversation with friends/family about food waste”), and if they conducted two specific

household food waste saving actions (Specific_action1_home: “Threw away less food”; Specific_action2_home: “Used leftover food for meals or cooking”; 1 = “Never” to 5 = “Always”). Given that past studies have noted spillover effects on other household waste-reducing behaviours unrelated to food (e.g. in van der Werf et al., 2021), we also added two measurements for plastic usage and waste sorting at home (Other_action1_home: “Used less plastic packaging”; Other_action2_home: “Sorted your waste before disposing it”; 1 = “Never” to 5 = “Always”).

In addition to these variables, we measured a set of micro-level psychological factors. Specifically, we measured self-reported environmental identity, compensatory beliefs, and catalysing beliefs¹⁵ using previously validated psychological scales because they have the potential to influence food waste behaviours and contextual spillovers (Capstick et al., 2019; Hope et al., 2018; Verfuierth et al., 2019; Whitmarsh & O’Neill, 2010). We also measured different motivations to reduce food waste to better understand “why” people save food based on the past literature and the pre-survey pilot (Hebrok & Boks, 2017; Thyberg & Tonjes, 2016; Visschers, Wickli, & Siegrist, 2016).¹⁶ Finally, we recorded

¹⁵ We included the measurements for compensatory beliefs (e.g., “The environmental impact of wasting food at home can be made up for by saving food at work”) and catalysing beliefs (e.g., “Doing something positive for the environment in my everyday life makes me want to do other similar things”) to explore if they could moderate the contextual spillover effects. For example, among the workers who are high in compensatory beliefs and low in catalysing beliefs, efforts to reduce food waste at work may be negatively associated with efforts at home. Unfortunately, we did not detect any significant moderation effects, so they were just kept in the regression models as covariates.

¹⁶ Apart from the variables reported, the survey also contained an experimental manipulation towards the end, where the participants were asked to read a poster similar to the environmental message that we gave them in the last round of the food waste campaign. We randomly assigned participants to one of three posters - the control poster which focused on the total amount of food saved, the environmental poster which highlighted the total CO₂ emissions saved out of food waste reduction, or the anthropomorphic poster which showed information about the CO₂ emissions saved along with smiling trees and earth. However, the variables analysed in the current paper (except for the socio-demographic data) were collected before the experimental stimuli and they were thus not influenced by it.

socio-demographic characteristics like age, gender, and income at the end of the survey (see Appendix Table A1 for details of those psychological measurements).

In total, we collected 1,253 survey responses, of which 1,198 were valid. Responses were invalidated if the respondent filled in the survey more than one time ($n = 27$), or if the time spent on the experimental stimuli page or the whole survey was 3 SDs higher than the average ($n = 28$). We kept responses from workers in all sites (rather than just the treatment sites) since all sites received food waste feedback, and employees across sites could have taken different efforts to reduce their waste. We allowed people to skip questions in the survey if they wished so.

2.3. Data analysis

For the field study, we used DID regression to compare changes in food waste (rather than levels) to eliminate the influence of unobserved fixed factors specific to the three cafeterias which can impact food waste (e.g., canteen size and layout). The DID model is specified below:

$$\begin{aligned}
 \text{grams_per_cover}_{it} &= \alpha_i + \beta_1 \text{TreatmentB}_i \times \text{During_campaign}_t + \beta_2 \text{TreatmentC}_i \times \text{During_campaign}_t \\
 &+ \beta_3 \text{TreatmentB}_i \times \text{After_campaign}_t + \beta_4 \text{TreatmentC}_i \times \text{After_campaign}_t + \gamma_t + \varepsilon_{it}
 \end{aligned}
 \tag{1}$$

In the equation, β_1 and β_2 are the DID estimators of the treatment effects of the two types of environmental messages in sites B and C, respectively, during the food waste campaign; and β_3 and β_4 estimate if the treatment effects carried over after the campaign ended in sites B and C, respectively. α_i denotes the site fixed effects. γ_t denotes the

time-varying variables, including 2 dummies for **During_campaign** and **After_campaign** (**Before_campaign** omitted), 6 dummies for the days of the week (Sunday omitted), and 5 monthly dummies (Jan to May 2021, Dec 2020 omitted). Research shows that people's dietary practices differ across weekends and weekdays (Thompson, Larkin, & Brown, 1986). Moreover, the company initiated a Green Monday campaign on 11/01/2021 and provided more vegetarian options every Monday since then. There were also several festival seasons in our study period (e.g., Christmas 25/12/2020, New Year 01/01/2021, Spring Festival from 11/02/2021 to 26/02/2021, Ching Ming Festival 04/04/2021, Labor Day 01/05/2021), and the cafeterias had special menus on some festival dates. Those menu changes could influence the weight of food waste. Therefore, we introduced the dummy variables for days of the week and months into the model to control for those issues.

For the survey study, we checked the consistency between actual and self-reported data by investigating the cross-site differences in self-reported efforts to reduce food waste at work. More importantly, we conducted multiple linear regressions to examine work-to-home spillovers. Our main outcome variable - efforts to reduce food waste at home (**Efforts_waste_home**) - was the composite score of its four items since the reliability of the scale was satisfactory (Cronbach's $\alpha = 0.68$). Our main independent variables were workers' memory of the workplace food waste campaign (**Recall_waste_work**) and efforts to reduce food waste at work. However, the two items of efforts to reduce food waste at work were not highly correlated ($r = 0.33$), and thus treated as separate variables: **Talk_waste_work** and **Action_waste_work**. We also replicated the analysis on the four items of the outcome variable separately as robustness tests. Other covariates included in the regression model are detailed in Appendix Table A1. In addition, we used two other

pro-environmental actions at home as the outcome variables to test if work-to-home contextual spillovers could also happen between different environmental behaviours.¹⁷

3. Results and Discussions

3.1. Direct effects on food waste at work: automatically recorded waste weight from Step 1 (field)

We started with simply plotting the outcome by site to see the trends. Figure 4 shows food waste in control site A gradually increased throughout the study period and increased more rapidly after we removed the last round of feedback. In treatment site B, food waste remained at the same level before and during the campaign period and increased slightly after the posters were removed. In contrast, food waste in treatment site C exhibited a reduction during the campaign period and kept decreasing after the posters were removed.

The DID regression revealed a marginally significant reduction in food waste in site B ($\beta_1 = -8.92$, $SE = 4.65$, $z = -1.92$, $p = 0.055$, $95\% CI = [-18.05, 0.20]$), and a significant reduction in site C ($\beta_2 = -17.49$, $SE = 4.65$, $z = -3.76$, $p < 0.001$, $95\% CI = [-26.61, -8.37]$) during the food waste campaign as compared to control site A. These results suggest that exposure to environmental messages, especially those with anthropomorphic cues, was associated with a significant decrease in food waste behaviours in the workplace. Moreover, those differences in food waste reduction continued even after the campaign ($\beta_3 = -42.80$,

¹⁷ Except for our main outcome variable efforts to reduce food waste at home, the outcome variables in our analyses were all measured with a single question on a 5-point Likert scale. Although it is a common practice to treat Likert scales as continuous, those variables could alternatively be treated as ordinal. Therefore, besides the multiple linear regression models reported in the main text, we ran ordered logistic regression models for each of those variables as a further robustness check. The results of the logistic regression models did not differ from the linear regression results in any substantial ways and are presented in Appendix Tables A2-A4.

$SE = 5.10, z = -8.39, p < 0.001, 95\% CI = [-52.83, -32.77]$; $\beta_4 = -66.33, SE = 5.10, z = -13.00, p < 0.001, 95\% CI = [-75.36, -56.30]$), implying a long-term effect of those interventions. Therefore, changes in actual food waste data, provide relatively weak evidence for Hypothesis 1a regarding the positive effect of environmental framing. Hypothesis 1b on the positive effect of environmental framing with anthropomorphic cues is strongly supported. Apart from running the DID regression using the fixed effects model to control for any time-invariant site-specific characteristics, we conducted robustness tests using the OLS model and the random-effects model. The results did not differ substantially across models (see Table 1).

Figure 4. Average food waste per meal across sites (in grams).

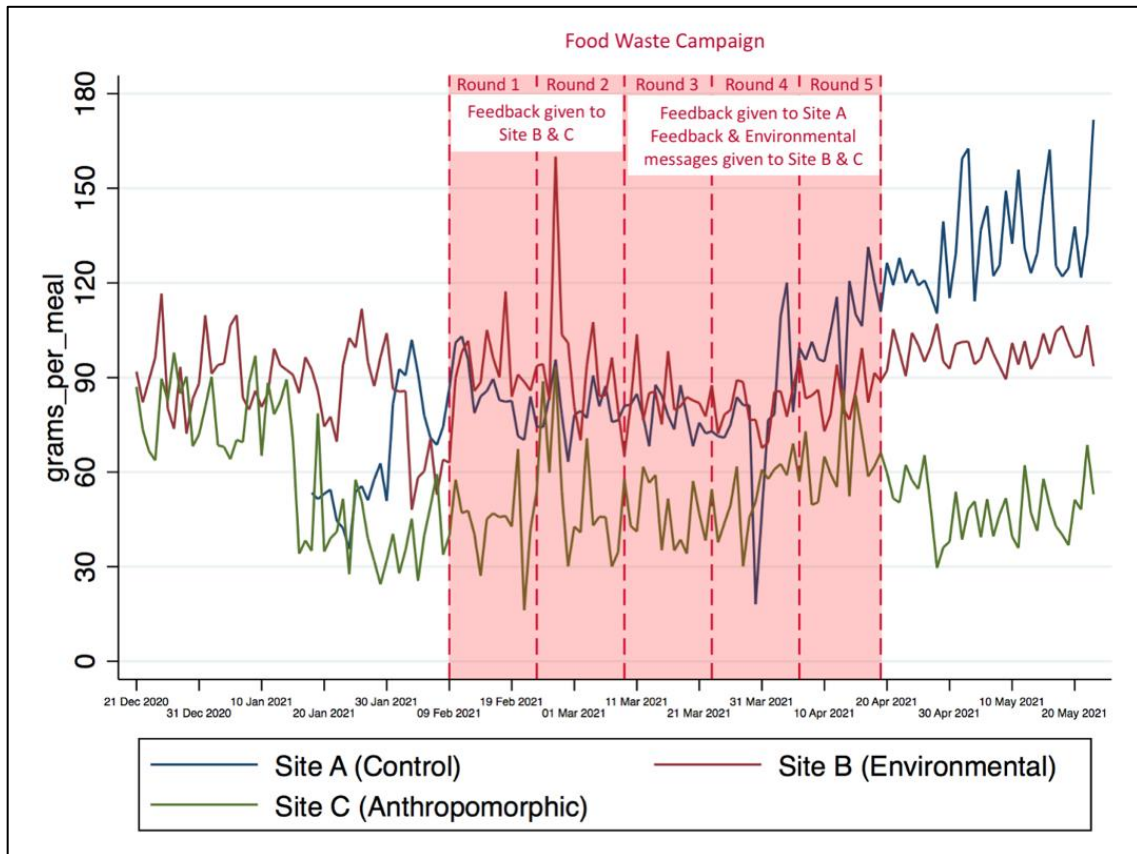


Figure 5. The marginal effects of the food waste campaign across sites (estimated by the random-effects model).

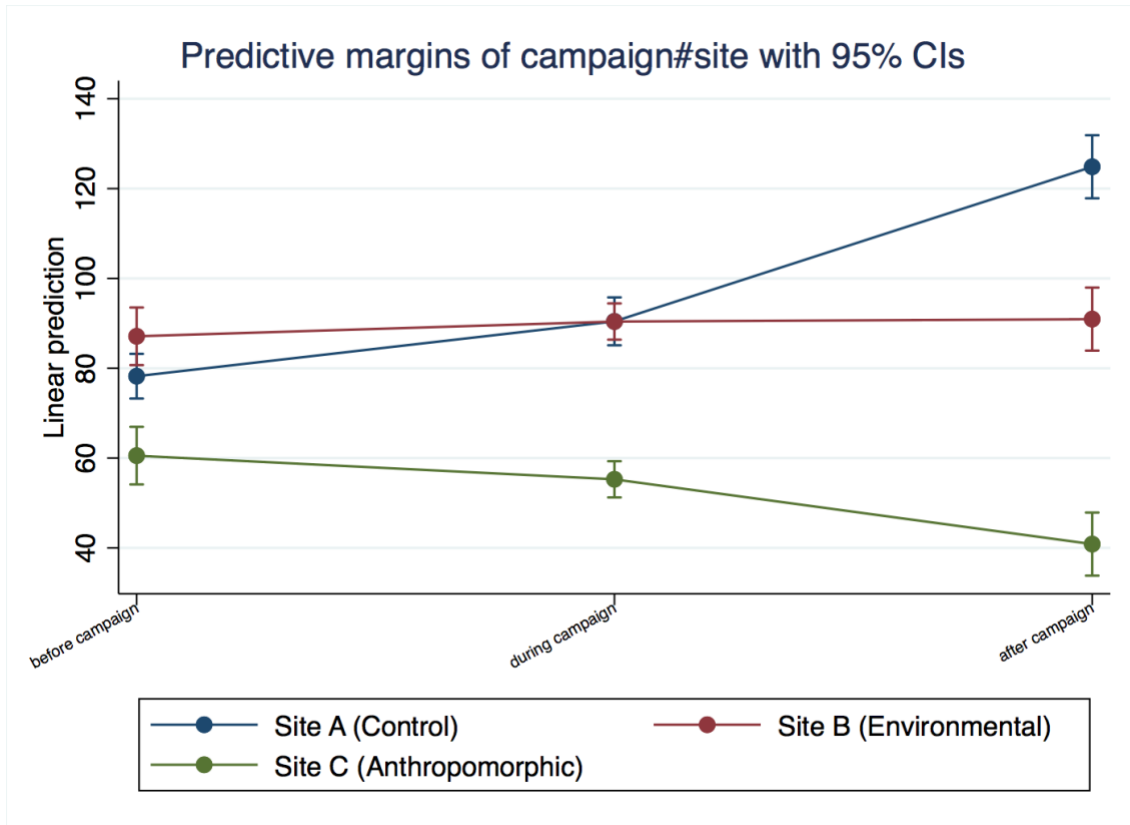


Table 1. Difference-in-differences models testing the direct effects on food waste at work (automatically recorded field data).

	(1) Ordinary Least Squares	(2) Random effects	(3) Fixed effects
Site B (Environmental)	8.887* (4.899)	8.887** (3.544)	
Site C (Anthropomorphic)	-17.68*** (5.139)	-17.68*** (3.544)	
During campaign	12.21*** (4.097)	12.21*** (3.949)	12.21*** (3.949)
After campaign	46.63*** (4.540)	46.63*** (4.999)	46.63*** (4.999)
Treatment B (Site B)×During campaign	-8.925 (5.759)	-8.925* (4.653)	-8.925* (4.653)
Treatment B (Site B)×After campaign	-42.80*** (5.615)	-42.80*** (5.102)	-42.80*** (5.102)
Treatment C (Site C)×During campaign	-17.49*** (5.921)	-17.49*** (4.653)	-17.49*** (4.653)
Treatment C (Site C)×After campaign	-66.33*** (5.995)	-66.33*** (5.102)	-66.33*** (5.102)
Monday	0.156 (2.644)	0.156 (2.726)	0.156 (2.726)
Tuesday	-0.364 (2.903)	-0.364 (2.728)	-0.364 (2.728)
Wednesday	-0.0509 (2.835)	-0.0509 (2.738)	-0.0509 (2.738)
Thursday	0.440 (2.764)	0.440 (2.725)	0.440 (2.725)
Friday	1.477 (3.015)	1.477 (2.722)	1.477 (2.722)
Saturday	2.071 (2.759)	2.071 (2.718)	2.071 (2.718)
January	-13.40*** (3.923)	-13.40*** (3.722)	-13.40*** (3.722)
February	-12.49** (5.538)	-12.49*** (4.449)	-12.49*** (4.449)
March	-19.00*** (6.118)	-19.00*** (5.085)	-19.00*** (5.085)
April	-5.541 (6.378)	-5.541 (5.365)	-5.541 (5.365)
May	-1.147 (6.782)	-1.147 (6.270)	-1.147 (6.270)
Constant	87.84*** (6.168)	87.84*** (4.930)	84.71*** (3.859)
Observations	433	433	433
<i>R-squared</i>	0.711		0.481

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.2. Discussion of methodological limitations in Step 1

While the results offer strong evidence that exposure to environmental framing with anthropomorphic cues is positively associated with food waste reduction, there are some caveats to interpreting our results as “causal”.

First, causal inference from difference-in-differences estimates rests on the assumption that all three cafeterias would have similar trends in food waste in the pre-treatment period i.e., there would have had to be parallel trends. Unfortunately, we were unable to empirically verify this for a comparable timeframe because we only had three weeks of data from all the sites before the treatment.

Second, there were unavoidable differences in the menus and preparation procedures across sites and in different seasons, which were outside the control of consumers but could influence room for food waste weight reduction (e.g., the proportion of inedible waste such as bones and fruit peels). The potential seasonal differences in reducible food waste made it even harder to make causal inferences, because even if we observed parallel trends in food waste across sites before the treatment for a longer time, those trends might be due to the fact that the menus did not allow for too much variation in food waste per meal from December to February, which may or may not be the case from March to May.

Finally, the cafeterias were located at three hotels run by the same hotel-chain, and the company informed us at the beginning of the study that a small number of maintenance workers might sometimes go to different sites to fix emergency issues. Although they later assured us all workers including the maintenance team were entitled to eat only at one worksite cafeteria so that they were unlikely to see more than one versions of posters, we

cannot rule out the possibility that some maintenance workers entered the cafeteria of a different worksite by chance (not for eating) and see the posters there, or that they ran into a friend at work and became aware of different versions of posters in conversations. That verbal exchange between. These instances should be rare, if they occurred at all; but they could potentially confound our effects.

3.3. Direct effects on food waste behaviours at work: self-reported behaviours from Step 2 (survey)

Consistent with the actual food waste data, the self-reported survey data confirmed that workers from treatment site C had taken significantly more food-saving actions at work than those from control site A (Action_waste_work: $\beta = 0.41$, $SE = 0.08$, $t = 5.32$, $p < 0.001$, $95\% CI = [0.26, 0.55]$), and this held even controlling for age, gender, education, income, motivations to save food, and environmental identity (see Table 2). Workers from treatment site B also reported more actions at work than those at site A, but the difference was not statistically significant (Action_waste_work: $\beta = 0.05$, $SE = 0.06$, $t = 0.93$, $p = 0.351$, $95\% CI = [-0.06, 0.17]$). Therefore, results from analyzing self-reported food waste data, do not support Hypothesis 1a on environmental framing but support Hypothesis 1b on environmental framing with anthropomorphic cues. It is worth mentioning that the dummy variable for site C, which represents the intervention combining environmental framing and anthropomorphism, predicted food waste reducing actions at work beyond and above most micro-level factors including environmental identity.

We also tested the cross-site differences in Talk_waste_work and Recall_waste_work, as they could validate our manipulations as active treatments and were indirect indicators of

intervention effectiveness. Workers from treatment site C also talked with their colleagues about food waste more often than those from control site A, even though the difference failed to reach statistical significance ($\beta = 0.14$, $SE = 0.14$, $t = 1.03$, $p = 0.304$, $95\% CI = [-0.13, 0.41]$). To our surprise, workers from treatment site B reported a lower frequency of having conversations about food waste than those from control site A. The effect was marginally significant ($\beta = -0.13$, $SE = 0.07$, $t = -1.93$, $p = 0.054$, $95\% CI = [-0.260, 0.002]$), but disappeared when controlling for age, gender, education, income, motivations to save food, and environmental identity (see Table 2).

Moreover, workers from treatment site C also recalled seeing the workplace campaign more often than those from control site A ($\beta = 0.26$, $SE = 0.14$, $t = 1.93$, $p = 0.054$, $95\% CI = [-0.004, 0.532]$), whereas workers from treatment site B remembered it less well ($\beta = -0.13$, $SE = 0.07$, $t = -1.77$, $p = 0.076$, $95\% CI = [-0.27, 0.01]$). The results did not change when controlling for age, gender, education, income, motivations to save food, and environmental identity (see Table 2). It should be noted that only 4.6% of the participants answered “Never” to this question, suggesting that the majority of participants saw our interventions.

Table 2. Linear regression models testing the direct effects on behaviours at work (survey).

	(1)	(2)	(3)	(4)	(5)	(6)
	Action_waste_ work	Action_waste_ work	Talk_waste_ work	Talk_waste_ work	Recall_waste_ work	Recall_waste_ work
Site B	0.0539 (0.0577)	0.0356 (0.0536)	-0.129* (0.0668)	-0.0620 (0.0629)	-0.129* (0.0727)	-0.135* (0.0694)
Site C	0.405*** (0.0762)	0.394*** (0.0746)	0.141 (0.138)	0.166 (0.124)	0.264* (0.137)	0.226* (0.133)
Environmental_identity		0.0818* (0.0449)		0.328*** (0.0509)		0.118** (0.0582)
Motivation_Saving money		0.0270 (0.0487)		0.0388 (0.0664)		0.0235 (0.0836)
Motivation_Saving resources		0.141** (0.0565)		0.107 (0.0740)		0.0670 (0.0769)
Motivation_National security		0.0995* (0.0581)		0.0534 (0.0588)		-0.0270 (0.0647)
Motivation_Fairness		0.0361 (0.0474)		0.101* (0.0537)		0.102* (0.0606)
Motivation_Global warming		-0.124*** (0.0446)		0.00325 (0.0530)		-0.0647 (0.0682)
Motivation_Traditional virtue		-3.81e-05 (0.0442)		0.0731 (0.0551)		-0.0373 (0.0663)
Motivation_Organizational culture		0.0640 (0.0516)		0.153** (0.0701)		0.144* (0.0762)
Motivation_Personal principles		0.168*** (0.0623)		-0.112 (0.0838)		0.298*** (0.0885)
Age		0.000357 (0.00279)		0.0121*** (0.00343)		0.00976*** (0.00374)
Female		-0.0126 (0.0485)		0.0120 (0.0594)		0.0178 (0.0655)
Education		0.0890*** (0.0211)		-0.0381 (0.0281)		0.0938*** (0.0302)
Income		-0.0124 (0.0180)		-0.0429* (0.0222)		-0.0246 (0.0239)
Constant	4.316*** (0.0487)	1.931*** (0.316)	3.207*** (0.0547)	-0.131 (0.368)	3.829*** (0.0597)	0.562 (0.359)
Observations	1,191	1,145	1,192	1,146	1,191	1,145
<i>R-squared</i>	0.013	0.136	0.006	0.191	0.009	0.121

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.4. Spillover effects on food waste behaviours at home: self-reported food saving efforts

A multiple linear regression showed that memory of the campaign and efforts to reduce food waste at work were all positively and significantly associated with efforts to reduce food waste at home (Recall_waste_work: $\beta = 0.06$, $SE = 0.02$, $t = 3.38$, $p = 0.001$, $95\% CI = [0.03, 0.10]$; Talk_waste_work: $\beta = 0.26$, $SE = 0.02$, $t = 14.42$, $p < 0.001$, $95\% CI = [0.23, 0.30]$; Action_waste_work: $\beta = 0.40$, $SE = 0.02$, $t = 17.57$, $p < 0.001$, $95\% CI = [0.36, 0.45]$). The effects of efforts to reduce food waste at work remained significant even controlling for site fixed effects, age, gender, education, income, motivations to save food, environmental identity, catalysing beliefs, and compensatory beliefs, while the effect of memory became marginally significant (see Table 3). Additional analyses on the four items for Efforts_waste_home yielded similar results (see Table 3). We thus found robust evidence that there were positive spillovers from workplace campaigns onto efforts to reduce food waste at home, lending support to Hypothesis 2. Environmental identity (e.g., “I think of myself as an environmentally-friendly person”) was also positively associated with efforts to reduce food waste at home ($\beta = 0.15$, $SE = 0.03$, $t = 5.03$, $p < 0.001$, $95\% CI = [0.09, 0.21]$). Nevertheless, actions to reduce food waste at work, and talking about food waste with work colleagues, i.e., the contextual spillover factors, predicted household food saving efforts beyond and above all the micro-level factors including environmental identity.

To further investigate the interplay between the most salient macro- and micro-level factors, we conducted a path analysis using the PROCESS Model 4 macro for SPSS (Hayes, 2013). We entered the site dummies as the independent variables, Action_waste_work,

Talk_waste_work, and Environmental identity as the mediators, and Efforts_waste_home as the dependent variable. A bias-corrected bootstrap analysis with 5000 samples indicated no significant direct pathways (site C \rightarrow Efforts_waste_home: $\beta = -0.05$, $SE = 0.06$, 95% $CI = [-0.17, 0.08]$; site B \rightarrow Efforts_waste_home: $\beta = -0.04$, $SE = 0.03$, 95% $CI = [-0.10, 0.03]$), so we just present all the indirect pathways in Figure 6. For treatment site C, the only significant indirect pathway was through Action_waste_work ($\beta = 0.17$, $SE = 0.03$, 95% $CI = [0.10, 0.23]$), which confirmed a positive spillover from workplace interventions to household food saving efforts. The insignificant pathway through Talk_waste_work was positive ($\beta = 0.03$, $SE = 0.03$, 95% $CI = [-0.03, 0.10]$), while the insignificant pathway through environmental identity was negative ($\beta = -0.01$, $SE = 0.02$, 95% $CI = [-0.04, 0.02]$). For treatment site B, the only positive pathway through Action_waste_work was not significant ($\beta = 0.02$, $SE = 0.02$, 95% $CI = [-0.02, 0.07]$). On the other hand, the pathways through Talk_waste_work ($\beta = -0.03$, $SE = 0.02$, 95% $CI = [-0.065, -0.001]$) and Environmental identity ($\beta = -0.02$, $SE = 0.01$, 95% $CI = [-0.038, -0.001]$) were both negative and significant. It was theoretically unlikely that our interventions could undermine environmental identity in sites B and C, so we suspect that the observed differences in environmental identity pre-existed among those workers. When the workplace intervention was strong enough to significantly increase workplace food saving actions (as in site C), the macro-level contextual spillover effect overrode the effect of environmental identity. However, when the intervention had a relatively weak effect on actions at work (as in site B), the micro-level factor, environmental identity, determined how much effort people put into food saving at home.

Figure 6. Pathway analysis showing the interplay between the macro-level work-to-home spillover effects and the micro-level factor environmental identity.

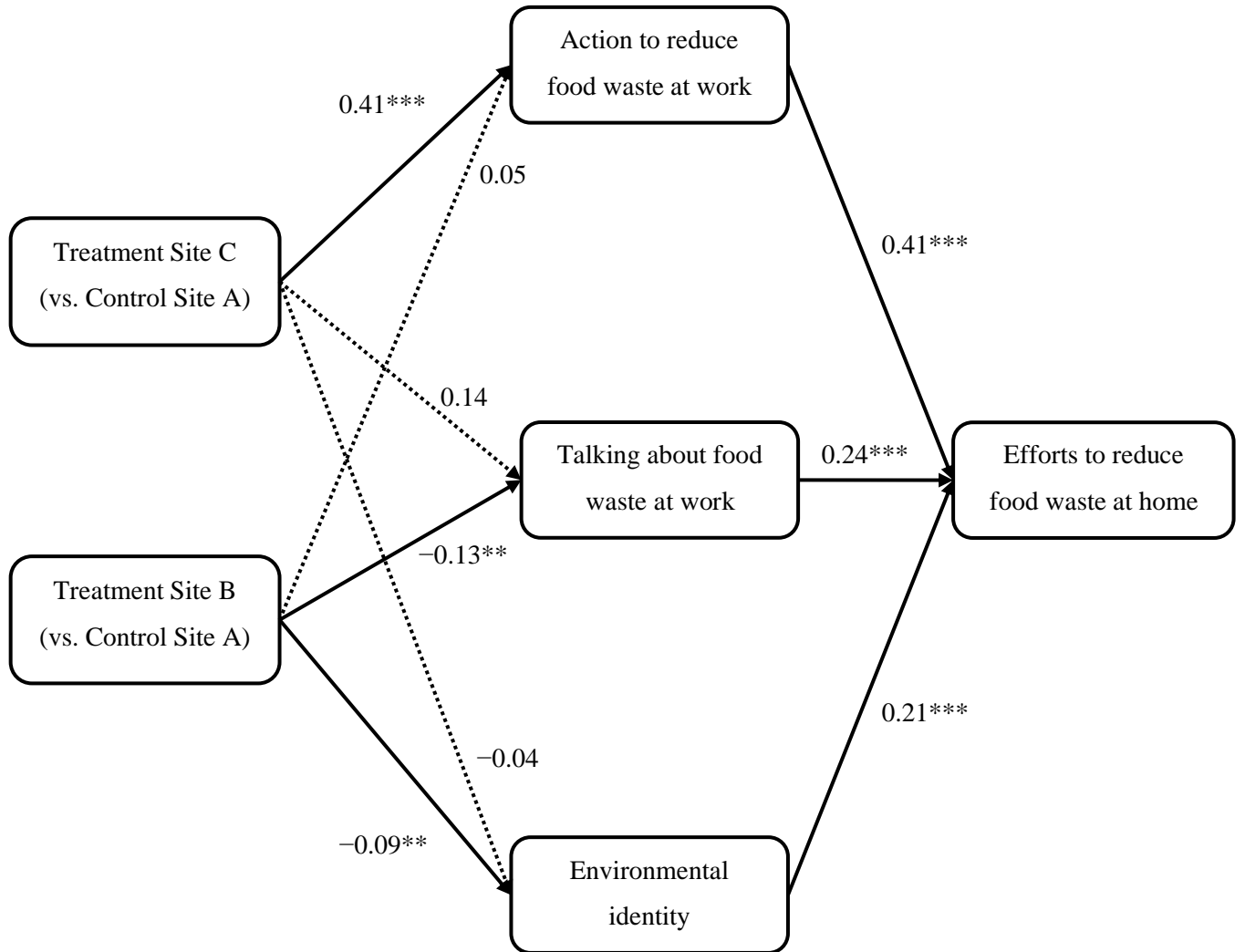


Table 3. Linear regression models testing spillover effects on food waste behaviours at home.

	(1)	(2)	(3)	(4)	(5)
	Efforts_waste_ home	Talk_waste_ home	Action_waste_ home	Specific_action1_ home	Specific_action2_ home
Recall_waste_work	0.0291* (0.0164)	0.00304 (0.0243)	-0.0176 (0.0188)	0.0903*** (0.0313)	0.0408 (0.0351)
Talk_waste_work	0.221*** (0.0191)	0.555*** (0.0309)	0.0422** (0.0202)	0.119*** (0.0357)	0.168*** (0.0397)
Action_waste_work	0.375*** (0.0229)	0.178*** (0.0299)	0.662*** (0.0405)	0.369*** (0.0420)	0.291*** (0.0432)
Site B	-0.0429 (0.0337)	-0.103** (0.0443)	-0.0166 (0.0400)	0.0322 (0.0652)	-0.0843 (0.0690)
Site C	-0.0579 (0.0653)	0.0492 (0.0950)	-0.0948 (0.0708)	-0.0739 (0.120)	-0.112 (0.140)
Environmental_identity	0.148*** (0.0295)	0.191*** (0.0441)	0.0824** (0.0372)	0.137** (0.0544)	0.183*** (0.0632)
Motivation_Saving money	0.0840** (0.0351)	0.0329 (0.0447)	0.159*** (0.0447)	0.0642 (0.0600)	0.0802 (0.0762)
Motivation_Saving resources	-0.0182 (0.0399)	-0.0154 (0.0585)	-0.0222 (0.0559)	0.0370 (0.0709)	-0.0720 (0.0817)
Motivation_National security	-0.00399 (0.0392)	-0.0349 (0.0531)	-0.0207 (0.0413)	-0.0208 (0.0682)	0.0605 (0.0839)
Motivation_Fairness	-0.0487 (0.0327)	-0.0176 (0.0453)	-0.0296 (0.0433)	-0.0667 (0.0567)	-0.0807 (0.0662)
Motivation_Global warming	0.0552* (0.0304)	0.0471 (0.0413)	0.0500 (0.0400)	-0.0446 (0.0557)	0.168*** (0.0621)
Motivation_Traditional virtue	0.0165 (0.0308)	-0.00711 (0.0448)	-0.00135 (0.0363)	0.107* (0.0592)	-0.0324 (0.0670)
Motivation_Organizational culture	-0.0342 (0.0421)	-0.0595 (0.0546)	-0.0302 (0.0523)	-0.0278 (0.0755)	-0.0195 (0.0838)
Motivation_Personal principles	0.0713 (0.0465)	0.0783 (0.0635)	0.0444 (0.0563)	0.00328 (0.0837)	0.159* (0.0922)
Catalysing_beliefs	0.0695* (0.0363)	0.0911* (0.0483)	0.0183 (0.0389)	0.134* (0.0716)	0.0344 (0.0682)
Compensatory_beliefs	-0.0316** (0.0129)	0.0107 (0.0178)	-0.0255* (0.0138)	-0.114*** (0.0243)	0.00258 (0.0281)
Age	-0.00190 (0.00180)	0.00117 (0.00241)	-0.00115 (0.00196)	-0.0124*** (0.00349)	0.00483 (0.00364)
Female	-0.00288 (0.0308)	0.117*** (0.0425)	-0.0254 (0.0357)	-0.0361 (0.0594)	-0.0674 (0.0656)
Education	-0.0141 (0.0152)	-0.0311 (0.0201)	0.0198 (0.0164)	-0.0356 (0.0290)	-0.00943 (0.0325)
Income	0.0112 (0.0119)	0.0156 (0.0166)	-0.0114 (0.0131)	0.0306 (0.0236)	0.00984 (0.0258)
Constant	0.0587 (0.181)	-0.429 (0.264)	0.407** (0.205)	0.950*** (0.355)	-0.693** (0.333)
Observations	1,144	1,144	1,144	1,144	1,144
<i>R-squared</i>	0.559	0.545	0.542	0.241	0.206

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.5. Spillover effects on other behaviours at home: self-reported pro-environmental actions

Exploratory analyses showed that efforts to reduce food waste at work were positively and significantly associated with both using less plastic packaging at home (Talk_waste_work: $\beta = 0.24$, $SE = 0.03$, $t = 8.91$, $p < 0.001$, $95\% CI = [0.19, 0.29]$; Action_waste_work: $\beta = 0.30$, $SE = 0.04$, $t = 8.22$, $p < 0.001$, $95\% CI = [0.23, 0.37]$), and sorting waste at home before disposing (Talk_waste_work: $\beta = 0.40$, $SE = 0.03$, $t = 11.95$, $p < 0.001$, $95\% CI = [0.34, 0.47]$; Action_waste_work: $\beta = 0.24$, $SE = 0.04$, $t = 6.19$, $p < 0.001$, $95\% CI = [0.17, 0.32]$). Those associations were statistically significant even controlling for site fixed effects, age, gender, education, income, motivations to save food, environmental identity, catalysing beliefs, and compensatory beliefs, supporting that the effects of workplace food waste campaigns could spill over onto other pro-environmental behaviours at home (see Table 4). The contextual spillover factors (Talk_waste_work, Action_waste_work) and the micro-level factor environmental identity were approximately equally strong this time.

Nevertheless, memory of the campaign had no significant effect on plastic usage ($\beta = 0.04$, $SE = 0.03$, $t = 1.54$, $p = 0.123$, $95\% CI = [-0.01, 0.09]$) and even a significant and negative effect on waste sorting ($\beta = -0.06$, $SE = 0.03$, $t = -2.02$, $p = 0.044$, $95\% CI = [-0.125, -0.002]$). These findings, together with the weak effects of memory on household food saving efforts reported in the last section, showed that the mere memory of campaigns could not effectively foster household pro-environmental behaviours. It was the efforts induced by workplace campaigns that could promote further actions at home.

Table 4. Linear regression models testing spillover effects on other waste-reducing behaviours at home.

	(1) Other_action1_home	(2) Other_action1_home	(3) Other_action2_home	(4) Other_action2_home
Recall_waste_work	0.0405 (0.0263)	0.0388 (0.0263)	-0.0635** (0.0314)	-0.0596* (0.0311)
Talk_waste_work	0.240*** (0.0269)	0.194*** (0.0298)	0.403*** (0.0337)	0.268*** (0.0357)
Action_waste_work	0.301*** (0.0365)	0.284*** (0.0382)	0.245*** (0.0395)	0.245*** (0.0397)
Site B		0.0507 (0.0518)		-0.00747 (0.0612)
Site C		0.141 (0.0962)		0.0463 (0.121)
Environmental_identity		0.304*** (0.0479)		0.510*** (0.0594)
Motivation_Saving money		0.0405 (0.0543)		0.000986 (0.0608)
Motivation_Saving resources		0.0131 (0.0668)		-0.116 (0.0745)
Motivation_National security		-0.102* (0.0598)		-0.0528 (0.0699)
Motivation_Fairness		-0.113** (0.0519)		0.0401 (0.0551)
Motivation_Global warming		0.152*** (0.0481)		0.0288 (0.0549)
Motivation_Traditional virtue		0.0777 (0.0490)		0.0358 (0.0621)
Motivation_Organizational culture		-0.0436 (0.0585)		0.0782 (0.0699)
Motivation_Personal principles		-0.116 (0.0733)		-0.126 (0.0853)
Catalysing_beliefs		-0.0327 (0.0523)		0.00459 (0.0687)
Compensatory_beliefs		-0.0249 (0.0204)		0.00980 (0.0252)
Age		0.00266 (0.00261)		-0.00138 (0.00341)
Female		0.0247 (0.0474)		-0.171*** (0.0576)
Education		0.00590 (0.0220)		-0.0659** (0.0270)
Income		-0.0173 (0.0182)		-0.123*** (0.0220)
Constant	1.508*** (0.154)	1.048*** (0.298)	1.438*** (0.161)	1.040*** (0.323)
Observations	1,195	1,144	1,195	1,144
<i>R-squared</i>	0.224	0.277	0.192	0.333

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.6. Discussion of methodological limitations in Step 2

Since we measured all the dependent and independent variables in a single survey, all the results we presented above were correlational in nature. Moreover, measuring attitudes and behaviours with cross-sectional survey could lead to the issue of common method variance, i.e., some variations in responses might have been caused by the measurement method itself (e.g., common scale anchors and formats, demand characteristics, and social desirability) rather than to the hypothesized associations between constructs (Bagozzi & Yi, 1990; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

To control for common method variance, we adopted several preventive remedies when designing the survey. Following Tourangeau, Rips, and Rasinski's (2000) suggestions, we selected measurements carefully, tried to make every question simple and concise, and provided verbal labels for each point of the response scales instead of using numerical scale values. We also held a focus-group interview with worker representatives from three sites to make sure that no survey items were ambiguous or difficult to understand. In addition, we added a lot of page-breaks to psychologically separate the measurement of the independent and dependent variables, and did not allow participants to go back to previous pages in case they tried to synchronize their answers to different questions.

To further check the effectiveness of those ex-ante remedies, we conducted a confirmatory factor analysis (CFA) by loading all the survey items for our main independent and dependent variables on the same factor (please see Appendix Table A5 for the model details). This is an improved version of Harman's single-factor test, one of the most commonly used ex-post techniques for detecting common method variance (Fuller,

Simmering, Atinc, Atinc, & Babin, 2016; Podsakoff et al., 2003). The CFA model demonstrated a poor goodness of fit ($\chi^2(2) = 915.29, p < 0.001$; $RMSEA = 0.17, p < 0.001$; $CFI = 0.75, TLI = 0.67$; $SRMR = 0.08$), suggesting that a single (common method) factor cannot account for all the variance in our independent and dependent variables, and that common method variance was not a concerning problem in the current study.

Nevertheless, this test result could not dismiss the possibility that low to moderate levels of common method variance existed in our data, which might have inflated some observed relationships between constructs, or deflated some theoretical relationships that should have been observed (Fuller et al., 2016; Podsakoff et al., 2003). For instance, the association between *Action_waste_work* and *Action_waste_home* might have been inflated given the high similarity between the two questions. However, this inflation should have been reduced when we used the composite score of four items as our dependent variable (i.e., the questions for *Specific_action1_home* and *Specific_action2_home* were asked in a very different way than that for *Action_waste_work*). On the other hand, compensatory and catalysing beliefs, in theory, should moderate the spillover effects from work to home, but we did not find any evidence for that. The potential moderation effects might have been deflated because participants became aware that compensatory beliefs were socially undesirable and that catalysing beliefs were desirable after answering so many questions about food waste behaviours at work and home.

4. General discussion and conclusion

Combining a quasi-experimental field study and an online survey of workers, the current research investigated if workplace food waste campaigns providing informational feedback with environmental framing and anthropomorphic cues could decrease food waste behaviours in staff cafeterias. In line with our expectations, there were significantly greater reductions in food waste in the treatment sites than in the control site. In accordance with earlier observations in energy conservation (e.g., Abrahamse et al., 2005), we found that a combination of multiple interventions achieved the best results in food waste reduction, such that the treatment site C which received the environmental feedback with anthropomorphism saw the most salient reduction in food waste during and after the campaign. Theoretically, this work takes forward past research on anthropomorphism and food consumption (Cooremans & Geuens, 2019; Shao, et al., 2020), and shows that anthropomorphism can reinforce the effects of environmental feedback in eliciting waste-reducing behaviours. Practically, our findings have implications for policy makers and organizations - they should consider promoting the combined use of anthropomorphism and environmental framing in public communication about food waste, and in large-scale food-saving interventions.

More importantly, we also explored if there were spillovers from workplace interventions onto household food saving efforts as well as other waste-reducing behaviours. Workers who put more effort into reducing food waste at work reported significantly more efforts to save food at home and a higher frequency of engaging in other pro-environmental practices, supporting a positive contextual spillover. These results extend the scarce literature on macro-level factors influencing consumer food waste, and offer the first piece

of empirical evidence of a positive work-to-home spillover. Nevertheless, this is by no means denying the importance of micro-level factors such as individuals' environmental identity. In fact, workers in our treatment sites happened to be lower in environmental identity, which diluted parts of the positive spillovers from workplace campaigns to household food savings. This interesting interplay emphasizes the necessity of taking a multi-level perspective when addressing the issue of consumer food waste, and holds valuable practical implications. It urges behavioural scientists and policymakers to factor in macro-level contextual spillover effects when designing and evaluating interventions, and to think carefully if some seemingly effective interventions could unintentionally discourage pro-environmental behaviours in a different context. Multi-level interventions that are likely to not only provoke immediate actions but also enhance environmental identity in the long run should be considered for their potential to facilitate resource-saving behaviours in multiple contexts. Other contextual spillovers, such as from the consumption realm to the production process, can also be studied to manage the complex issue of food waste.

Our study contributes to the evolving literature on behavioural spillover effects in various ways. Although interventions highlighting the environmental impact of food behaviours are widely advocated to achieve positive spillovers, there is limited evidence for this from real-world settings (Asensio & Delmas, 2015; Capstick et al., 2019; Lim et al., 2021; Maki et al., 2019; Nomura, John, & Cotterill, 2011; Wolstenholme et al., 2020). Several studies also note that environmental impacts are frequently ignored or underestimated by consumers (Camilleri, Larrick, Hossain, & Patino-Echeverri, 2019; Gil, 2020; Wolstenholme et al., 2020), which further calls into question if environmental framing can

effectively reduce food waste behaviours or promote positive spillovers. Beyond the domain of food waste, a meta-analysis of 77 studies on pro-environmental behavioural spillovers found evidence for positive spillovers only on behavioural intentions, but negative or no effects on actual behaviours (Maki et al., 2019). Our study merely observed weak or no evidence for the effectiveness of environmental framing alone, which echoes those concerns in the literature. However, we innovatively integrated anthropomorphic cues into environmental framing, and found that this combined intervention effectively promoted waste-reduction behaviours across contexts, pointing to positive spillover effects. Unlike many previous studies, our survey asked about concrete waste-reduction behaviours conducted in a recent past. Therefore, our study offers rare and valuable evidence for positive contextual spillovers on self-reported behaviours, rather than just behavioural intentions. Those promising findings also suggest that behavioural scientists do not have to discard interventions which demonstrate small size effects. Instead, we should embrace the possibility that a compatible combination of those interventions may stimulate behavioural changes and spillovers efficiently.

Moreover, contextual spillover is a relatively neglected aspect of behavioural spillover research. Most researchers only look at spillovers between different types of behaviours within one context, and the very few studies on spillovers between contexts typically focus on one type of behaviours (Andersson, Eriksson, & Von Borgstede, 2012; Littleford, Ryley, & Firth, 2014; Rashid, & Mohammad, 2011; Tudor, Barr, & Gilg, 2007). Our research investigates both spillovers across contexts (work-to-home) and across behavioural types (food saving, waste sorting and reducing plastic use), and thus provides a comprehensive perspective for future researchers studying behavioural spillover effects. Understanding

whether the impact of interventions spillover across contexts and behavioural types allows us to map the net effect of interventions and to pick those which provoke multiple sustainable behavioural changes across a variety of contexts (Maki et al., 2019; Galizzi & Whitmarsh, 2019). This is particularly informative for policy makers because it will allow them to cost-effectively induce positive social changes.

As a case study, our research has some unique strengths. Firstly, we combined actual and self-reported data to explore changes in food waste behaviours whereas many past studies on food waste interventions solely relied on self-reports or pictorial analyses of food waste (Reisch et al., 2020). This combination of metrics addresses a concern raised by several scholars, i.e., self-reported and observed food waste data do not necessarily match (Sebbane & Costa, 2018; Liu et al., 2022). In Step 1, we quantified actual food waste over 1,536,610 meals in three hotel staff cafeterias in Macau over four months using waste weight data measured via smart bins. In total, the three sites reduced approximately 9819.73 kilograms of food waste during the information campaign as compared to the baselines¹⁸, equivalent to 24,549 meals saved or 42.22 metric tons of reduction in CO₂ emissions. In step 2, we examined self-reported food saving behaviours at home amongst the same employees and find positive correlations between workplace food waste reduction efforts and food savings at home. Our results were consistent across the two phases, indicating good validity. That is to say, we did not detect strong discrepancies between observational and self-reported data, which were typically observed in other food waste studies (Sebbane & Costa, 2018). This could be due to that the employees in our study

¹⁸ Following the WS system provider's recommendation, we took two weeks of reliable data right after the system was installed in each site and calculated their average food waste per meal as the baseline amounts, which were 86.39 grams, 90.14 grams, and 79.72 grams for Site A, B, and C, respectively.

could read their own waste amount on the smart bins, and were given feedback on their collective performance fortnightly at work, so they were less likely to underestimate how much food they wasted.

Secondly, this study was conducted in an under-explored field setting in Macau, China. Most previous research on food waste interventions was carried out in American or European countries (Reisch et al., 2020), and smart bins and feedback were typically installed in residential households (Lim et al., 2021; Roe et al., 2022), rather than the workplace. Therefore, our Chinese sample and workplace setting provide valuable insights into food waste management on a global scale. The typical collectivist culture in China implies that Chinese workers are more likely to be influenced by the collective norms and organizational culture built up in workplace campaigns. The same campaign may not be as effective were it initiated in well-studied individualist societies, but would hopefully have similar impacts in the wide range of countries with collectivist cultures. Companies in collectivist countries also show greater interest in disclosing their environmental policy and disseminating environmental information (Cubilla-Montilla, Galindo-Villardón, Nieto-Librero, Vicente Galindo, & García-Sánchez, 2020), which makes extensive use of the workplace pro-environmental campaign possible. Besides, as a popular tourist destination famous for gambling, Macau is filled with luxury hotels, including the ones we collaborated with. It is interesting and encouraging to see that workers who witness indulgent consumption every day can still be stimulated to reduce their waste behaviours.

Nevertheless, the current study also has limitations. We have previously noted several potential problems specific to Step 1 or Step 2 that make us cautious about interpreting our results as “causal”, including the inability to empirically verify if there were parallel trends

in the pre-treatment periods, the differences between sites arising from factors like menu differences and food preparation techniques, and the issue of common method variance in cross-sectional surveys. More broadly across the two steps, our study was unable to check if an individual's self-reported behaviour matched his actual food waste behaviours because individual-level directly observed data on food waste at work and home was unavailable. In addition, we did not have a control group that received no feedback at all, so we were unable to shed light on whether the sites would have had a steeper increasing trend in food waste in the absence of any feedback, or indeed if there were any contextual spillovers caused by informational feedback only. Lastly, this study was conducted during a period when the Chinese government was lifting pandemic restrictions, leading to some uncertainty about how representative and generalizable these results would be at other times. Future studies can address these issues and examine the impact of such campaigns in conjunction with other nudges like reducing plate size.

To conclude, the present research demonstrates for the first time that food waste feedback obtained from smart bins and environmental footprint information combined with anthropomorphic cues jointly contribute to reducing food waste at work and can have a positive spillover effect on food saving behaviours at home. The findings help advance the emerging field of multi-level interventions in managing consumer food waste behaviours.

Statement of author contributions

GS, FW, MMG, SM conceptualized the study and designed the methodology. FW and GS analysed the data and interpreted the results, FW curated and managed the data, GS and FW wrote the original draft and MMG contributed to subsequent versions. GS supervised the project. All the feedback interventions were co-designed with Winnow and the project was jointly implemented by Winnow, Melco, and LSE.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1. Independent variables included in the regression models testing work-to-home spillovers.

Variable name	Description
Recall_waste_work	“Have you seen a campaign in your workplace about reducing food waste?” 1 = “Never” 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often”, 5 = “Always”
Talk_waste_work	“Have you done any of the following in the past 4 months?” - “Had a conversation with work colleagues about food waste?” 1 = “Never” 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often”, 5 = “Always”
Action_waste_work	“Have you done any of the following in the past 4 months?” - “Tried to reduce food waste at work?” 1 = “Never” 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often”, 5 = “Always”
Site dummies (Site B & Site C)	“Which site do you mainly work at?” 0 = [Site A], 1 = [Site B];, 2 = [Site C]
Catalysing beliefs	The mean of two items adapted from previous research (Capstick et al., 2019), Spearman-Brown $\rho = 0.63$ (Eisinga, Te Grotenhuis, & Pelzer, 2013): “Being environmentally friendly is not about taking small actions; it is a complete approach to life.” “Doing something positive for the environment in my everyday life makes me want to do other similar things.” 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Undecided”, 4 = “Agree”, 5 = “Strongly Agree”
Compensatory beliefs	The mean of two items adapted from previous research (Capstick et al., 2019), Spearman-Brown $\rho = 0.65$: “The environmental impact of wasting food at home can be made up for by saving food at work.” “It doesn’t matter how much energy I waste when I’m at work or out of the house, as long as I try to minimize my environmental impact at home.” 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Undecided”, 4 = “Agree”, 5 = “Strongly Agree”
Environmental identity	The mean of two items adapted from previous research (Whitmarsh & O’Neill, 2010); Spearman-Brown $\rho = 0.75$: “I think of myself as an environmentally-friendly person.” “I think of myself as someone who is very concerned with environmental issues.” 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Undecided”, 4 = “Agree”, 5 = “Strongly Agree”
Motivations to reduce food waste	“To what extent do you agree that the following reasons have motivated you to reduce food waste?” “Wasting food is a waste of money.” “Wasting food is a waste of resources like water and energy.” “Wasting food is a national security issue because food is difficult to secure and supply.” “Wasting food is unfair to those who do not have enough to eat.” “Wasting food causes global warming and climate change due to emissions from food.” “It is a Chinese traditional virtue to cherish food and reduce food waste.” “It is [the company]’s culture to cherish food and reduce food waste at work.” “It is in line with my personal principles to cherish food and reduce food waste.” 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Undecided”, 4 = “Agree”, 5 = “Strongly Agree”
Age	“Please indicate your age (please enter the number)”
Female	“Please indicate your gender” 0 = “Male”, 1 = “Female”
Education	“Please indicate your highest education level” 0 = “No school”, 1 = “Primary school”, 2 = “Junior high school”, 3 = “Senior high school”, 4 = “Junior college diploma”, 5 = “Bachelor degree”, 6 = “Master degree”, 7 = “Doctor degree”
Income	“Please indicate your personal monthly income (after taxes) in MOP” 1 = “<=10,000”, 2 = “10,001-15,000”, 3 = “15,001-20,000”, 4 = “20,001-25,000”, 5 = “25,001-30,000”, 6 = “>30,000”

Table A2. Ordered logistic regression models testing the direct effects on behaviours at work (survey).

	(1)	(2)	(3)	(4)	(5)	(6)
	Action_waste_ work	Action_waste_ work	Talk_waste_ work	Talk_waste_ work	Recall_waste_ work	Recall_waste_ work
Site B	0.0210 (0.126)	0.0327 (0.132)	-0.236** (0.116)	-0.109 (0.120)	-0.257** (0.118)	-0.270** (0.120)
Site C	1.006*** (0.260)	1.129*** (0.279)	0.253 (0.247)	0.343 (0.247)	0.521** (0.243)	0.551** (0.255)
Environmental_identity		0.318*** (0.114)		0.659*** (0.0996)		0.259*** (0.100)
Motivation_Saving money		0.0670 (0.127)		0.106 (0.138)		0.0473 (0.140)
Motivation_Saving resources		0.357*** (0.136)		0.207 (0.145)		0.158 (0.124)
Motivation_National security		0.198 (0.153)		0.104 (0.114)		-0.0404 (0.108)
Motivation_Fairness		0.0854 (0.118)		0.206* (0.108)		0.197* (0.101)
Motivation_Global warming		-0.337*** (0.124)		0.00861 (0.101)		-0.133 (0.115)
Motivation_Traditional virtue		0.00898 (0.114)		0.143 (0.106)		-0.0836 (0.110)
Motivation_Organizational culture		0.154 (0.122)		0.288** (0.139)		0.274** (0.132)
Motivation_Personal principles		0.511*** (0.148)		-0.168 (0.156)		0.530*** (0.155)
Age		-0.00127 (0.00672)		0.0236*** (0.00657)		0.0172*** (0.00657)
Female		-0.0201 (0.125)		0.0436 (0.114)		0.0242 (0.113)
Education		0.214*** (0.0555)		-0.0835 (0.0535)		0.164*** (0.0538)
Income		-0.0478 (0.0457)		-0.0807* (0.0426)		-0.0703* (0.0417)
/cut1	-4.301*** (0.280)	1.604** (0.734)	-2.781*** (0.143)	3.769*** (0.651)	-3.166*** (0.161)	2.661*** (0.628)
/cut2	-3.025*** (0.172)	2.987*** (0.716)	-1.256*** (0.107)	5.469*** (0.660)	-1.931*** (0.124)	3.997*** (0.625)
/cut3	-1.864*** (0.126)	4.304*** (0.731)	0.584*** (0.0998)	7.615*** (0.683)	-0.682*** (0.104)	5.380*** (0.636)
/cut4	-0.165 (0.104)	6.193*** (0.748)	1.859*** (0.115)	9.028*** (0.698)	0.615*** (0.102)	6.839*** (0.651)
Observations	1,191	1,145	1,192	1,146	1,191	1,145

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3. Ordered logistic regression models testing spillover effects on food waste behaviours at home.

	(1) Talk_waste_home	(2) Action_waste_home	(3) Specific_action1_home	(4) Specific_action2_home
Recall_waste_work	0.00556 (0.0672)	-0.0967 (0.0697)	0.170*** (0.0605)	0.0670 (0.0593)
Talk_waste_work	1.703*** (0.115)	0.184** (0.0749)	0.265*** (0.0703)	0.291*** (0.0713)
Action_waste_work	0.493*** (0.0839)	2.396*** (0.176)	0.741*** (0.0839)	0.494*** (0.0741)
Site B	-0.299** (0.128)	-0.129 (0.139)	0.0269 (0.120)	-0.0944 (0.117)
Site C	0.0440 (0.279)	-0.412 (0.276)	-0.119 (0.218)	-0.147 (0.234)
Environmental_identity	0.511*** (0.130)	0.276** (0.128)	0.338*** (0.105)	0.335*** (0.111)
Motivation_Saving money	0.0863 (0.128)	0.538*** (0.140)	0.112 (0.107)	0.163 (0.141)
Motivation_Saving resources	-0.0411 (0.168)	-0.145 (0.177)	0.0358 (0.126)	-0.150 (0.142)
Motivation_National security	-0.132 (0.168)	-0.0521 (0.149)	-0.0639 (0.120)	0.0712 (0.142)
Motivation_Fairness	-0.0778 (0.136)	-0.0184 (0.147)	-0.0774 (0.105)	-0.111 (0.112)
Motivation_Global warming	0.147 (0.123)	0.0838 (0.122)	-0.0763 (0.102)	0.295*** (0.108)
Motivation_Traditional virtue	0.00673 (0.127)	-0.0725 (0.118)	0.196** (0.0970)	-0.0286 (0.113)
Motivation_Organizational culture	-0.149 (0.152)	-0.0895 (0.160)	-0.0833 (0.136)	-0.0345 (0.148)
Motivation_Personal principles	0.209 (0.190)	0.231 (0.199)	0.0996 (0.156)	0.262* (0.156)
Catalysing_beliefs	0.236* (0.142)	0.0955 (0.155)	0.202 (0.126)	0.0858 (0.113)
Compensatory_beliefs	0.0209 (0.0515)	-0.0457 (0.0570)	-0.209*** (0.0495)	0.00686 (0.0495)
Age	0.00453 (0.00690)	-0.00540 (0.00713)	-0.0220*** (0.00634)	0.00536 (0.00629)
Female	0.298** (0.120)	-0.126 (0.131)	-0.122 (0.111)	-0.141 (0.110)
Education	-0.0717 (0.0574)	0.0204 (0.0582)	-0.0562 (0.0528)	-0.0444 (0.0574)
Income	0.0329 (0.0462)	-0.0430 (0.0479)	0.0241 (0.0438)	0.0369 (0.0446)
/cut1	6.039*** (0.752)	5.417*** (0.757)	1.794*** (0.682)	4.282*** (0.614)
/cut2	8.138*** (0.763)	8.127*** (0.759)	3.829*** (0.668)	5.728*** (0.621)
/cut3	11.29*** (0.799)	10.98*** (0.854)	5.052*** (0.683)	7.116*** (0.632)
/cut4	13.85*** (0.830)	13.88*** (0.940)	6.817*** (0.704)	8.607*** (0.644)
Observations	1,144	1,144	1,144	1,144

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4. Ordered logistic regression models testing spillover effects on other waste-reducing behaviours at home.

	(1)	(2)	(3)	(4)
	Other_action1_home	Other_action1_home	Other_action2_home	Other_action2_home
Recall_waste_work	0.109* (0.0622)	0.120* (0.0672)	-0.129** (0.0587)	-0.119* (0.0638)
Talk_waste_work	0.611*** (0.0691)	0.508*** (0.0780)	0.759*** (0.0702)	0.568*** (0.0784)
Action_waste_work	0.711*** (0.0815)	0.709*** (0.0926)	0.442*** (0.0712)	0.462*** (0.0787)
Site B		0.144 (0.123)		0.0466 (0.120)
Site C		0.366 (0.240)		0.202 (0.237)
Environmental_identity		0.793*** (0.121)		1.046*** (0.125)
Motivation_Saving money		0.111 (0.138)		0.0307 (0.123)
Motivation_Saving resources		0.0246 (0.173)		-0.236* (0.143)
Motivation_National security		-0.242 (0.150)		-0.113 (0.137)
Motivation_Fairness		-0.272** (0.127)		0.0885 (0.104)
Motivation_Global warming		0.347*** (0.116)		0.0355 (0.106)
Motivation_Traditional virtue		0.169 (0.121)		0.0689 (0.117)
Motivation_Organizational culture		-0.0817 (0.144)		0.183 (0.136)
Motivation_Personal principles		-0.258 (0.184)		-0.249 (0.167)
Catalysing_beliefs		-0.0808 (0.129)		-0.0168 (0.137)
Compensatory_beliefs		-0.0506 (0.0515)		0.00965 (0.0516)
Age		0.00487 (0.00644)		-0.00402 (0.00655)
Female		0.0659 (0.115)		-0.327*** (0.113)
Education		0.0223 (0.0540)		-0.117** (0.0524)
Income		-0.0362 (0.0437)		-0.237*** (0.0429)
/cut1	0.417 (0.393)	1.618** (0.791)	0.403 (0.296)	1.340** (0.670)
/cut2	2.684*** (0.342)	4.251*** (0.754)	2.188*** (0.299)	3.284*** (0.677)
/cut3	4.880*** (0.370)	6.539*** (0.773)	3.735*** (0.315)	5.058*** (0.683)
/cut4	6.979*** (0.405)	8.760*** (0.802)	5.089*** (0.330)	6.607*** (0.696)
Observations	1,195	1,144	1,195	1,144

Notes. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A5. Confirmatory factor analysis for common method variance.

	Common method factor	
	Standardized factor loading	Equation level goodness of fit (R^2)
Recall_waste_work	0.476	0.227
Talk_waste_work	0.631	0.398
Action_waste_work	0.697	0.485
Talk_waste_home	0.649	0.421
Action_waste_home	0.693	0.489
Specific_action1_home	0.559	0.312
Specific_action2_home	0.525	0.276
Other_action1_home	0.624	0.389
Other_action2_home	0.503	0.253

Chapter 7

Methodological Reflections

This chapter will discuss several overarching methodological issues relevant to the empirical studies presented in the current thesis. Apart from critically evaluating my own research practices, I hope some of the discussions could cast light on broader challenges in psychological and behavioural science.

1. Reflections on the replication crisis

Psychology is facing a replication crisis since the mid 2010s, in which many influential findings in top-tier journals are found difficult or impossible to replicate (Camerer et al., 2018; Open Science Collaboration, 2015). A range of landmark studies in embodied cognition have also come under scrutiny, and those involving priming effects (i.e., the effects of incidental exposure to bodily or semantic cues on social judgments and behaviours) often fail to replicate (Doyen, Klein, Pichon, & Cleeremans, 2012; Landy, & Goodwin, 2015; Lynott, Corker, Connell, & O'Brien, 2023). With this concern in mind, I have not adopted the priming technique for my own experiments, and have instead focused on the effects of metaphorical congruency (Chapters 2 and 3) and metaphorical framing (Chapters 4, 5, and 6). However, I did cite a few classic papers on embodied priming in the theoretical parts of my papers because they had conceptually inspired my studies and researchers are still debating on whether there are evidence for those effects. For instance,

a registered replication report from 17 independent labs (Wagenmakers et al., 2016) yielded no support for Strack, Martin, and Stepper's (1988) finding that inhibiting (vs. facilitating) facial muscles for smiling with a pen-in-mouth task led participants to perceive the given cartoons as less funny. On the contrary, Noah, Schul, and Mayo (2018) hypothesized that the replication failure could have arisen from a small difference in the protocol - participants were informed that they would be monitored by a video camera in all the replication studies but not in Strack and colleagues' (1988) original study. They further demonstrated with a preregistered experiment that the original effect was successfully replicated when there was no camera, and disappeared in presence of the camera. More recently, a well-powered multi-lab test across 19 countries (Coles et al., 2022) showed that people reported feeling happier when mimicking or voluntarily posing happy (vs. neutral) facial expressions, but the evidence was less conclusive when their facial expressions were manipulated unobtrusively via the pen-in-mouth task. Likewise, the effects of weight on judgment of importance (Ackerman, Nocera, & Bargh, 2010; Jostmann, Lakens, & Schubert, 2009) have met with both success and failure in replication (IJzerman, Padiotis, & Koole, 2013; Rabelo, Keller, Pilati, & Wicherts, 2015). A later attempt (Hauser & Schwarz, 2021) revealed that participants judged a heavier book as more important if the judgement was made during (but not after) the sensory experience, which suggested a short-lived effect of embodied priming.

Putting aside the controversies around individual effects or papers, it is widely recognized that a few general factors, including small sample sizes, high degrees of freedom in analysis and report, and a publication bias for significant results, have contributed to the replication crisis across social, developmental, clinical, and comparative psychology (Duncan, Engel,

Claessens, & Dowsett, 2014; Maxwell, 2004; Simmons, Nelson, & Simonsohn, 2011; Stevens, 2017; Tackett, Brandes, King, & Markon, 2019; Wicherts, Veldkamp, Augusteijn, Bakker, Van Aert, & Van Assen, 2016). In the following subsections, I will elaborate on why those methodological issues are important, how I tried to tackle them in my studies, and why I sometimes did not manage to fully address them.

1.1. Sample size and power

It was common for psychological studies conducted before the 2010s to have a very small sample size (Marszalek, Barber, Kohlhart, & Cooper, 2011). Many psychologists admitted that they determined the sample size based on rules of thumb or conventions in the field, which was typically around 20-30 participants per condition (Bakker, Hartgerink, Wicherts, & van der Maas, 2016). This conventional sample size requires an unrealistically large effect size to ensure adequate power. Consequently, a lot of published studies in psychology were severely underpowered (Bakker, Van Dijk, & Wicherts, 2012; Maxwell, 2004), which not only increases the false negative rate, but also decreases the likelihood that a statistically significant result reflects the true effect in the population (Button, Ioannidis, Mokrysz, Nosek, Flint, Robinson, & Munafò, 2013; Ioannidis, 2005).

To deal with this issue, I decided the minimum sample size needed for every experimental study by performing an *a priori* power analysis for the main effects that I planned to test in G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). A medium effect size ($d = 0.50$) would be used for estimation if the target effects were to be examined for the first time, while the weakest significant effect size observed would be adopted for all the replication studies. The desired power was set at 80% in Chapters 2 and 4 in compliance with Suresh

and Chandrashekara's (2012) recommendations, and at 95% in Chapters 3 and 5 because I suspected that the true effect sizes might be smaller in a different socio-cultural context (e.g., the linguistic metaphor "Healthy is Up" does not exist in the Chinese language and the "Animas are Friends" metaphor conflicts with the culture image of pigs in China, which could undermine the effects of those metaphorical interventions). There was no formal power analysis for the field experiment in Chapter 6, and we basically asked the collaborating companies to collect as much data as they could. Fortunately, the final sample seemed to be sufficiently large. Nevertheless, I did not take any of the mediation (or pathway) analyses into account when doing the power analyses, meaning that, strictly speaking, the structural equation models in my thesis were all exploratory. This compromise was made due to two practical constraints. First, the power analyses for structural equation models often involve Monte Carlo simulations (Jobst, Bader, & Moshagen, 2023; Schoemann, Boulton, & Short, 2017) and I could not find an easy way of conducting them back then. Second, a mediation analysis would only make sense if the main effects were significant. I had very limited research funding as a PhD student, and it was not cost-effective to spend extra money on an analysis that I may or may not be able to do.

On a side note, Brysbaert (2019) argues that G*Power sometimes underestimates the sample size needed for multiple comparisons as the post-hoc tests have not been considered. According to his analysis, a one-way ANOVA with three between-groups ($f = 0.20$, $\alpha = 0.05$, and power = 0.80) requires 230 participants per condition if the third condition is "similar to one of the other conditions," and 950 participants per condition if the third condition is "midway in-between the two other conditions" (Brysbaert, 2019, p. 10). I could

not afford such a huge data collection anyway, but would like to acknowledge that some of my research findings may still suffer from inadequate power in this sense.

1.2. Flexibility in data collection and analysis

High degrees of freedom in data collection and analysis can harm the replicability and reproducibility of scientific research (Simmons, Nelson, & Simonsohn, 2011; Wicherts, Veldkamp, Augusteijn, Bakker, Van Aert, & Van Assen, 2016). In an extreme instance, 70 neuroscience teams analysed the same fMRI dataset independently and submitted contrasting test results of the same hypotheses (Botvinik-Nezer et al., 2020). Simulation studies show that flexibility in (a) choosing among dependent variables, (b) choosing sample size, (c) using covariates, and (d) reporting subsets of experimental conditions can dramatically inflate the false positive rate (Simmons et al., 2011).

Registering the research plan in detail before data collection is a straightforward way of reducing undisclosed flexibilities (Shrout & Rodgers, 2018; Simmons, Nelson, & Simonsohn, 2021; van't Veer & Giner-Sorolla, 2016). Following this recommendation, I formally preregistered the whole research protocol (i.e., hypotheses, target sample size, exclusion criteria, experimental materials, procedure, and analysis plans) on *osf.io* for Chapters 3 and 5. However, I only realized the importance of Open Science (Vicente-Saez & Martinez-Fuentes, 2018) halfway through my PhD journey, so I did not make any pre-registrations for the earlier studies in Chapters 2 and 4. Within those unregistered studies, I have also tried to avoid questionable research practices (John, Loewenstein, & Prelec, 2012), e.g., I cleaned the data on the basis of predetermined criteria before testing any hypotheses, listed all the variables collected, reported all the experimental conditions,

provided the statistical results with and without covariates, and uploaded the datasets to *osf.io* upon publication of the papers. The field experiment in Chapter 6 underwent constant adjustments because of implementation problems, so we just briefly preregistered the survey part on *aspredicted.org*. Moving ahead, I will fully preregister my experiments whenever possible to strengthen the transparency of my research.

It is worth mentioning that preregistration is not a one-for-all solution to every questionable research practice (Chambers & Tzavella, 2022). Researchers may still preregister and report their studies selectively, or process the data differently from the preregistration (Pham & Oh, 2021). Claesen, Gomes, Tuerlinckx, and Vanpaemel (2021) investigated all 27 articles published with a Preregistered badge in *Psychological Science* between February 2015 and November 2017, and found that 24 of them contained undisclosed deviations from the preregistered plan. Van den Akker and colleagues (2023) assessed 459 published psychological studies which earned a Preregistration Challenge prize or a Preregistration badge, and revealed that more than half of them had omitted hypotheses ($N = 224$; 52%) or added hypotheses ($N = 227$; 57%). It seems that the field needs more endeavour from authors, editors, and reviewers to improve adherence to the preregistration and to guarantee proper disclosure of adjustments.

1.3. File drawer problem

Psychological and behavioural science is long known to have a file drawer problem (Francis, 2012; Franco, Malhotra, & Simonovits, 2014; Rosenthal, 1979), i.e., papers with significant results that perfectly confirm the hypotheses are more likely to be published, which motivates researchers to selectively report their studies or analyses and lock the non-

significant or non-confirming results in the “file drawer”. The excessively high proportion of positive results in psychological journals, the low replication success rates, and the peculiar prevalence of p -values just below 0.05 all suggest that selective reporting and p -hacking pervade the standard literature of psychology (Franco, Malhotra, & Simonovits, 2016; Masicampo & Lalande, 2012; Open Science Collaboration, 2015; Scheel, Schijen, & Lakens, 2021; Schneck, 2023; Simonsohn, Nelson, & Simmons, 2014).

Struggling within this system, I have occasionally omitted studies with non-significant or unexpected results for publication purposes too. For example, I investigated if empathic concerns and moral disgust mediated the effects of the metaphor “Animals are Friends” on US omnivores’ intentions to consume meat in two respective studies. Neither of them showed a significant mediation effect, which was inconsistent with previous literature (Bastian, Loughnan, Haslam, & Radke, 2012; Hamilton, 2006; Kunst & Hohle, 2016; Niemyjska, Cantarero, Byrka, & Bilewicz, 2018). However, I was unsure if empathy and disgust actually played no role, or if I failed to find any evidence because of overlooked problems in my experimental design (e.g., I might have selected an unsuitable scale or have not collected sufficient data due to a budget limit). I moved on to another psychological mechanism anticipatory guilt and luckily detected significant mediations across studies. As a student, I had always been taught that “prestigious” journals would prefer articles which had a nice and clean narrative, so it felt quite natural to leave out the mediators that did not work and stick to the significant effects of anticipatory guilt. After all, inconclusive null findings are not welcomed by most top-tier journals, and it often requires much larger sample sizes to gain strong evidence in favour of the null with Bayesian analyses (Brysbaert, 2019; Etz & Vandekerckhove, 2016). Students are prone to the feeling that they

should not “waste” funding of the lab (as well as their own effort) on potentially unpublishable studies.

Likewise, the survey study in Chapter 6 contained an experimental part, which we disclosed in a footnote without reporting the non-significant results. The experimental manipulation was similar to that of the field experiment (i.e., we randomly exposed participants to one of three posters - the control poster which only provided information about the total amount of food saved during the campaign, the environmental poster which highlighted the environmental impact of food waste reduction, or the anthropomorphic poster which showed smiling trees and a laughing globe together with the environmental message), and the dependent variables were intentions to reduce food waste at work and home in future. As one may expect, this one-off exposure would not be as effective as the long-term repetitive exposures during the field experiment, especially when part of the participants had been receiving the strongest intervention (anthropomorphic) for months. In addition, this experimental manipulation was placed after a long list of survey questions about past food-saving behaviours (we did not want responses to those questions to be contaminated), so participants could be tired or absent-minded at that point. All the co-authors of this paper, including myself, knew it was not an extremely good idea to do this experimental manipulation, but we somehow came to the agreement that it would not hurt to give it a try (we were worried if the field experiment would be criticized for not being a randomised control trial, which did happen later on). After data analysis, we also agreed not to bring reviewers attention to this failed online experiment, since it would make the paper even less likely to get published.

In retrospect, I have to admit that those practices were more problematic than I used to realize, but with limited time and resources and an environment where “an academic scientist’s professional success depends on publishing” (Nosek, Spies, & Motyl, 2012, p. 615), the temptation of going with the “conventions” was too hard to resist. We psychology students are learning through trial and error along with the discipline itself.

1.4. Unexplained protocol details

Due to the word-limit for a journal article, researchers do not always explain every factor they have taken into consideration in an experiment. For instance, the implicit association test (IAT) requires participants to respond with a right key and a left key, which may introduce a confounding factor caused by the metaphorical associations between right-left and valence (Casasanto, 2009). Consequently, classical IAT studies on vertical metaphors arranged the potentially positive category (e.g., “God”, “Rational”) on the left-hand side and the potentially negative category (e.g., “Devil”, “Emotional”) on the right-hand side in the congruent blocks, and vice versa in the incongruent blocks (Cian, Krishna, & Schwarz, 2015; Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007). Since most people are right-handed and implicitly endorse the metaphor “Good is Right, Bad is Left”, the abovementioned arrangement would allow the congruent blocks to be at odds with the right-left metaphor, and make the incongruent blocks consistent with it. With this design, the right-left metaphor is only likely to weaken the targeted IAT effect and make the test more stringent. The IAT studies in my Chapters 2 and 3 also followed this routine, i.e., assigning the “Healthy” label to the left and the “Unhealthy” label to the right in the congruent blocks, and swapping them in the incongruent blocks. A significant IAT effect was observed in both studies regardless of the possible attenuation, so we can be confident

that the metaphorical association between “Healthy” and “Up” is robust. However, this cautious strategy has never been talked about in published papers, and the logic may not be obvious to readers who are unfamiliar with this line of research. Although in our particular case, replication studies should be able to find a stronger effect if they used a different right-left arrangement, unexplained protocol details like that could also undermine replicability and create controversies.

One such example can be seen in the debates on the effects of physical warmth priming. Williams and Bargh (2008) demonstrated that participants who briefly held a cup of hot (vs. iced) coffee judged a target person to be “warmer” (e.g., more generous and caring), and that holding a hot (vs. cold) therapeutic pad made participants more likely to select a gift for friends than for themselves. Two independent labs found no evidence for these effects in multiple high-powered direct replications (Chabris, Heck, Mandart, Benjamin, & Simons, 2018; Lynott, Corker, Wortman, Connell, Donnellan, Lucas, & O’Brien, 2014). In a response commentary, Bargh and Melnikoff (2019) said that the original study “took steps to keep the coffee comfortably warm”, and Chabris and colleagues handed a “fresh, hot cup of coffee to passers-by who volunteered to take part in the study” (p. 208). They argued that this deviation may account for the replication failure as a piping hot coffee should not evoke the pleasant concept of warmth. While this consideration is arguably important from a theoretical perspective, it was never mentioned in the original paper that the temperature of the coffee had been carefully controlled. On top of that, it remains unclear whether the iced coffee in Williams and Bargh’s (2008) study was “unpleasantly” cold, which could introduce a confounding factor of valence. Indeed, Barbosa Escobar, Velasco, Motoki, Byrne, and Wang (2021) showed in a cross-country survey that people

associate 0°C and 10°C with negative-valenced, low-arousal emotions, 20°C with positive-valenced, low-to-medium-arousal emotions, 30°C with positive-valenced, high-arousal emotions, and 40°C with high-arousal and either positive- or negative-valenced emotions. There seems to be a more general mapping between comfortable (vs. uncomfortable) temperature and positive (vs. negative) emotions. Given that Williams and Bargh's (2008) original studies, as well as other direct or indirect successful replications (e.g., Inagaki & Eisenberger, 2013; Pijls, Galetzka, Groen, & Pruyn, 2021; Schilder, IJzerman, & Denissen, 2014), have relatively small cell sizes, I tend to consider the effects of physical warmth priming as unreliable, or hard to detect unless contrasted with an uncomfortable level of coldness (Hadi & Block, 2019). The replicability of psychological research is likely to be bettered if researchers can offer more precise descriptions of their experimental procedures and discuss the possible confounding effects more thoroughly.

2. Reflections on conducting online experiments

Influenced by the Covid-19 pandemic, our departmental behavioural science laboratories were closed for two years, and a series of travel restrictions further interrupted many of my research plans. Therefore, the majority of experiments in the current thesis were built online and collected data via crowdsourcing platforms. We recruited US participants from Amazon Mechanical Turk (MTurk), and Chinese participants through WJX or InsightWorks. While web-based studies have enabled us to access larger samples with lower costs and to implement randomizations in a double-blind manner (Reips, 2002; Ryan, Wilde, & Crist, 2013), the shortcomings of this approach are also notable.

2.1. Intention-behaviour gap

Online studies can measure attitudes and behavioural intentions, but hardly actual behaviours, which makes them less ideal for investigation of intervention effectiveness. Although the “attitude-intention-behaviour” chain suggested by the theory of planned behaviour (Ajzen, 1991; 2015) is plausible in some cases (Conner, Norman, & Bell, 2002; Fielding, McDonald, & Louis, 2008), discrepancies between attitudes/intentions and behaviours have been widely observed among research on healthy eating (de Ridder, Kroese, Evers, Adriaanse, & Gillebaart, 2017; Webb & Sheeran, 2006) and pro-environmental actions (Kennedy, Beckley, McFarlane, & Nadeau, 2009; Kollmuss & Agyeman, 2002). The online studies in this PhD thesis have merely offered evidence for the effectiveness of metaphorical interventions in altering consumer attitudes and behaviour intentions. Further lab or field research is needed to determine whether the “Healthy is Up” metaphor can increase behavioural compliance with the healthy eating guidelines, and whether the anthropomorphic metaphors will decrease the amount of meat people actually consume.

2.2. Data quality

Data quality is one of the major concerns for using crowdsourcing platforms (Goodman, Cryder, & Cheema, 2013; Peer, Vosgerau, & Acquisti, 2014). I adopted various quality control strategies in my online studies, such as adding a seriousness check at the end of each survey, inserting attention checks when there were long scales, adding a timer for the stimulus page to hinder participants from clicking through, and using a manipulation check after all the outcome measures to further evaluate if participants had read the stimulus page

carefully. Duplicate responses were prevented by the Unique Turker script (for US participants) or IP-based access control (for Chinese participants)¹⁹. However, those screening methods cannot guarantee the detection of every single careless response in the datasets. For example, participants might browse other webpages while waiting for the timer to end, and some might have picked the right answer to the manipulation check question randomly by chance. Those who wanted to earn a living by filling out surveys might take part in a study more than once by using different accounts or devices. It is almost certain that a small number of inattentive or dishonest participants could escape our filters, but the rate should have been largely reduced by the multiple quality control strategies.

Besides, my experience is that the data quality on MTurk seems to be declining over the years. The manipulation check question captured careless participants quite efficiently for the series of studies on “Animals are Friends/Family”. When I firstly conducted them in 2017, the proportion of participants who failed the manipulation check was typically around 5%-10%. The failure rate increased to 22%-45% when I replicated it for cultural comparisons in 2021²⁰. This observation is echoed by the empirical studies evaluating the data quality on MTurk at different time points. Early studies in 2016-2017 often found MTurkers to be more attentive than participants from traditional subject pools, such as

¹⁹ The Unique Turker script was also employed to block participants who had previously taken part in any of my studies. The Chinese panel companies were incapable of implementing such a filter, but the impact of non-naïve Chinese participants should not be severe, as I just collected three studies with WJX and one study with InsightWorks, all of which had different experimental designs.

²⁰ The failure rate was 45% in the first round of data collection, and 22% in the second round which only targeted high reputation MTurkers with a minimum 95% approval rating and more than 5000 HITs completed. Due to the lab's budget limit, as well as the relatively low probability of passing all the checks by chance (e.g., the manipulation check question had seven options and only one correct answer for each participant), I kept the data from the first round for analysis to ensure adequate power. The main effects were slightly stronger, but did not change in any substantial way when I merely analysed the data from the second round.

university students and professional marketing research panels (Hauser & Schwarz, 2016; Kees, Berry, Burton, & Sheehan, 2017; Ramsey, Thompson, McKenzie, & Rosenbaum, 2016). Evidence from a four-wave naturalistic experiment suggested that the data quality on MTurk decreased substantially during and after the summer of 2018, but could be corrected back to normal after multiple screening techniques were applied (Chmielewski & Kucker, 2020). More recently, Peer, Rothschild, Gordon, Evernden, and Damer (2022) demonstrated that the data quality on MTurk had become alarmingly low even with quality control filters. Some researchers suspect that those poor quality responses on MTurk were generated by web bots (Stokel-Walker, 2018; Webb & Tangney, 2022), which could be getting worse with the latest advances in artificial intelligence as AI-based bots can rapidly learn and adapt to our screening methods (Storozuk, Ashley, Delage, & Maloney, 2020; Veselovsky, Ribeiro, & West, 2023). Others showed evidence that the quality problems on MTurk were more strongly associated with fraudulent human users outside the US who utilized virtual private networks (VPNs) to mask their locations (Dennis, Goodson, & Pearson, 2020; Kennedy, Clifford, Burleigh, Waggoner, Jewell, & Winter, 2020; Moss, Rosenzweig, Jaffe, Gautam, Robinson, & Litman, 2021). Either way, I would not continue to collect data on MTurk in the foreseeable future unless the platform takes actions to tackle those problems. Several studies (Douglas, Ewell, & Brauer, 2023; Eyal, David, Andrew, Zak, & Ekaterina, 2021; Peer, et al., 2022) suggest that Prolific and CloudResearch have relatively high data quality at the moment, and thus could be better alternatives to MTurk. Nevertheless, those platforms are still likely to be hampered by similar or new quality issues as time goes by. The growing number of professional crowdsourcing workers could also bias the results of online psychological research, since experienced participants are

more likely to figure out the purpose of an experiment (Chandler, Paolacci, Peer, Mueller, & Ratliff, 2015; Newman, Bavik, Mount, & Shao, 2021). Psychologists may have to develop novel strategies to address those evolving threats to research validity and reliability.

2.3. Fair pay

Another recurrent concern is that online crowdsourcing workers are often underpaid (Gleibs, 2017; Hara, Adams, Milland, Savage, Callison-Burch, & Bigham, 2018; Moss, Rosenzweig, Robinson, Jaffe, & Litman, 2023; Woods, Velasco, Levitan, Wan, & Spence, 2015). My supervisor recommended fairly compensating MTurkers with an hourly rate of \$9, which was above the federal minimum wage in the US (i.e., \$7.25/h). We estimated the duration of each study by asking one or two native English-speaking friends to pre-test it, and then scale the payment accordingly. We paid all the participants who completed our studies even if they were found to be careless, as it was very uncommon for academic researchers to reject participant submissions (Hara et al., 2018; Litman & Robinson, 2020). This communal choice cared for MTurkers' wellbeing and was reasonable under certain circumstances, e.g., I once read in a participant's comment that she responded carefully to most questions but selected "I have not taken part seriously" by mistake. However, with the problem of bots and fraudulent users aggravating these days, some worry that academic researchers' reluctance to reject low-quality submissions may bring more harm than good (Edelman, Moss, & Rosenzweig, 2020).

Chinese research panel companies have a different policy - they would assess task duration and complexity, and then offer a quote for each valid answer they collect (researchers are required to specify exclusion criteria before data collection). The minimum hourly rate in

mainland China varies across regions, ranging from ¥12.5/h (Hunan) to ¥25.3/h (Beijing) in 2022²¹. The quotes I received from the panel companies were much higher than those standards, e.g., InsightWorks charged ¥10 per participant for an eight-minute implicit association test (i.e., ¥75/h), and WJX charged ¥3 per participant for a four-minute survey (i.e., ¥45/h). I am not sure what percentage of my payment would eventually go to the participants, but I suppose that those companies would comply with the law. In my view, the mode of only paying attentive participants who passed the quality control checks, but with a considerably higher hourly rate, might be fairer for both the participants and the researchers.

2.4. Representativeness

Due to budget constraints, I never utilized a national representative sample service. Therefore, the data I collected via online crowdsourcing platforms were fundamentally convenience samples. More representative than the traditional student samples though they are, the MTurk samples are found to be younger and more educated than the general US population (Jensen-Doss, Patel, Casline, Mora Ringle, & Timpano, 2022; Levay, Freese, & Druckman, 2016; Walters, Christakis, & Wright, 2018). Scientific research on the representativeness of Chinese online panels is lacking, but the companies' panel descriptions also suggest that there are larger proportions of young and educated people in their sample pools than the general Chinese population (see Figure 1 for illustrations). Online crowdsourcing workers need to be computer-literate, which may help explain why a similar sampling bias occurs across countries (Merz, Lace, & Eisenstein, 2020; Woods

²¹ <http://finance.people.com.cn/n1/2023/0408/c1004-32659762.html>

et al., 2015). I used to think that, while my samples might not be representative of the entire population of each country, they should at least capture some generalizable characteristics of US and Chinese younger netizens. The cross-cultural comparisons would thereby be narrowed down to these two comparable subgroups. I am less confident about this assumption after knowing that part of my US data (especially those collected in 2019-2020 and reported in Chapters 2) might have been contaminated by fraudulent VPN users who pretended to be in the US.

Figure 1. InsightWorks panel attributes (the gender and age distributions of the panel are presented in comparison with the general population and the netizen population of China).



Moreover, the cross-cultural comparisons in the current thesis were limited to US and Chinese participants partially because the former is the “default” sample in psychological science (Cheon, Melani, & Hong, 2020; Henrich, Heine, & Norenzayan, 2010) and my cultural background grants me better access to the latter. China and the US are often treated as typical representatives of Eastern and Western cultures in and outside the domain of food psychology (Markus & Kitayama, 1991; Morris & Peng, 1994; Pearcey & Zhan, 2018; Zhang & Seo, 2015). Nonetheless, this “East-West” dichotomy has been criticized for overgeneralization and oversimplification (Masuda, Batdorj, & Senzaki, 2020; Vignoles et al., 2016). Popular theoretical frameworks like holistic vs. analytic thinking style (Nisbett, Peng, Choi, & Norenzayan, 2001) and interdependent vs. independent self-construal (Markus & Kitayama, 1991; Singelis, 1994) have stimulated a mushrooming body of cross-cultural studies on East Asians and Europeans/North Americans, neglecting the considerable variations within each geographic region (e.g., Egri & Ralston, 2004; Talhelm et al., 2014) and leaving out the rest of the world (e.g., Africa, the Middle East, South Asia, and South America). This issue deserves more attention in the field of sustainable healthy diets in that food choice and eating habits vary sizably across cultures and regions (Anna, 2001; Gluck & Geliebter, 2002; Pollard et al., 2014), and that the underexamined Global South and tropical countries are more heavily affected by nutrition insecurity and climate change (Cline, 2007; Singer, 2018; Zurayk, 2020). It will require collaborations between researchers from different cultures to address this inequality of research focus and to design appropriate interventions for those underrepresented sociocultural groups.

3. Reflections on conducting field experiments

To enhance methodological diversity, I collaborated with other senior researchers and carried out a quasi-experimental longitudinal study on interventions to reduce food waste between December 2020 and May 2021. Our field partners included Winnow, a UK-based smart technology company specializing in food waste management, and Melco, one of the largest companies in the hospitality industry in Macau, China. As reported in Chapter 6, this project collected and modelled actual food waste weight data from 1,536,610 meals over four months and self-reported survey data from 1,198 workers who had received our interventions. It provided valuable evidence for the effectiveness of metaphorical intervention on changing real-world dietary behaviours.

Nonetheless, field experiments are associated with unique challenges and drawbacks, which I did not recognize until I managed this project. The industry pursues speed and efficiency, but cares less about casual inference or scientific rigor. Non-academic collaborators are not always convinced that various caution strategies should be adopted to rule out alternative explanations. The academia, on the other hand, has a tradition of prioritizing randomised control trials and marginalising the knowledge, perspectives and interests of implementation practitioners (Cornish & Gillespie, 2009; Hampton & Adams, 2018), which makes field experiments disadvantaged in the publication process. Before getting published in a new open-access journal *Resources, Conservation & Recycling Advances*, our paper had been desk rejected by four other high-impact journals, receiving comments like “we do not feel that the conclusions that can be drawn at this stage are novel enough to justify publication in [our journal]” or “we felt that [your paper] might not attract

substantial interest to researchers in relevant fields.” Frustrated by the repeated rejections, in the published article we kept silent about some minor confounding factors that we were aware but unable to eliminate:

- 1) Melco insisted on initiating a “Green Monday” campaign to promote plant-based diets in parallel with our food waste reduction interventions. They had prepared all the materials and trained the kitchen staff for it in advance, so it was impossible to cancel at the last minute. Since the “Green Monday” campaign was relevant to sustainable healthy diets, I asked if we could help design the informational posters for that project too, so that the two campaigns could be synchronized and that the effects of similar interventions on different dietary behaviours could be simultaneously examined. My request was turned down, as Melco preferred to use the same “Green Monday” posters for all sites as per their original design (see Figure 2) and did not plan to spend extra money on measuring diners’ food choices. It is suggested by past research that engaging in one pro-environmental behaviour could increase the likelihood of performing another, especially when those behaviours are seen to be similar (Maki, Carrico, Raimi, Truelove, Araujo, & Yeung, 2019; Margetts & Kashima, 2017). Thus, the overall food waste reduction during our project could have been amplified by the “Green Monday” campaign. However, the relative effect of environmental framing in comparison with pure food waste feedback might have been attenuated, given that diners at the control site had been exposed to the “Green Monday” environmental messages. The relative effect of anthropomorphic cues should be less interfered as the “Green Monday” posters did not involve anthropomorphism.

Figure 2. “Green Monday” posters.



- 2) Our feedback posters showed the food waste reduction rate of each site, which entailed social comparisons and might have heterogeneous impacts. The direction of the potential confounding effect is hard to predict. Underperforming groups were more strongly stimulated by comparative messages in some studies (Brent, Cook, & Olsen, 2015; Brent, Lott, Taylor, Cook, Rollins, & Stoddard, 2020), but discouraged by upward social comparisons in the others (Beshears, Choi, Laibson, Madrian, & Milkman, 2015; Callery, Goodwin, & Moncayo, 2021). We did not choose to provide site-specific feedback because we were afraid that it would create even more heterogeneity. Our collaborating companies were also keen on including the comparative element, as they knew that social comparisons were likely to boost the overall food waste reduction across sites.

- 3) The anthropomorphic cues used in our posters mostly conveyed positive emotions. In fact, we framed all the feedback messages with a positive tone, because Winnow let us know that, based on their prior experience, negative messages did not work very well and sometimes even backfired. We appreciated this pragmatic insight and integrated it into our intervention design. However, one may suspect that smiling and laughing faces would be perceived as more positive than verbal encouraging words, so that valence could have a slight confounding effect on our anthropomorphic intervention.

Trade-offs between internal and external validity commonly exist in field experiments (Matthay, Hagan, Gottlieb, Tan, Vlahov, Adler, & Glymour, 2020; Roe, & Just, 2009). I believe that researchers would become more willing to talk about them if the peer review system can be more tolerant to those imperfections. As Vankov, Bowers, and Munafò (2014) sensibly put, “scientists are human and will therefore respond (consciously or

unconsciously) to incentives” (p. 1037). Structural incentives for research integrity and transparency, rather than novel positive results and publication impact, may foster a healthier academic environment (Nosek et al., 2012; Smaldino & McElreath, 2016).

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Chapter 8

General Discussion & Conclusions

Across five papers, this thesis demonstrates that insights from the embodied cognition approach and the conceptual metaphor theory (CMT; Lakoff & Johnson, 1980, 1999) could pave the way towards more effective informational interventions. In Chapters 2 and 3, arranging food items in a healthy eating guideline in accordance with the metaphor “Healthy is Up” increased US people’s acceptance of the guideline, even though no such effect was observed among Chinese people. In Chapters 4, 5 and 6, anthropomorphic metaphors such as “Animals are Friends”, “Animals are Family”, and “The Earth is A Person” decreased meat eating intentions and food waste behaviours in multiple sociocultural contexts. The empirical results suggest that metaphors could complement current mainstream dietary interventions and become a promising tool for promoting sustainable healthy diets. In the following parts of this chapter, I will recap the main findings, evaluate the robustness of them, and discuss their implications in light of other competing theories, such as the rational choice paradigm and the analogy approach to metaphor.

1. Novelty, robustness, and potential moderators

Since the embodied cognition approach and the CMT are underrepresented in past research on sustainable healthy diets, several major findings of this thesis are rather novel to this nuanced field.

For instance, Chapter 2 offers experimental evidence for the mental association between healthiness and verticality for the first time. The results are published in *Appetite*, a leading journal in food psychology (Wang & Basso, 2021) and have been conceptually replicated by another independent lab - Manippa, Ferracci, Pietroni, and Brancucci (2022) found that consumers indicated a stronger desire for high-calorie unhealthy food products when they were displayed at the bottom of the screen, whereas low-calorie healthy food products were liked more when depicted at the top of the screen. Taken together with the finding in Chapter 2 that an upward-looking angle increased the perceived healthiness of a juice product, the “Healthy is Up” metaphor seems to have the potential to improve healthy food package design, virtual advertising, and supermarket shelf arrangement in practice.

Chapter 4, which is also published in *Appetite* (Wang & Basso, 2019), is among the earliest studies establishing the effects of anthropomorphism on meat consumption. This paper has inspired several conceptual replications and extensions in other international journals such as *Journal of Consumer Psychology* (Kim & Yoon, 2021; Schroll, 2022) and *Foods* (Choueiki, Geuens, & Vermeir, 2021). Those replication studies mostly found anthropomorphism effective in decreasing unsustainable and unhealthy dietary practices, and sometimes detect interesting boundary conditions. Complementary to our findings that the “Animals are Friends” metaphor discouraged pork consumption but not beef consumption, Choueiki and colleagues (2021) revealed that anthropomorphic messages emphasizing cows’ capacity to feel pain decreased beef purchase intentions more effectively than anthropomorphic messages about their social abilities. Schobin, Haefner, and León (2022) showed that anthropomorphic graphical representations of animals reduced consumers’ preference for beef and chicken over vegetables, but had no significant

impact on fish preference. Similarly, Kim and Yoon (2021) demonstrated that the effects of anthropomorphism were attenuated when a healthy meat option was provided alongside tasty meat and vegetarian dishes, such that exposure to the friendship metaphor only led consumers to avoid meat dishes when they had a low commitment to eating meat in daily life. Consumers who were highly committed to eating meat went for healthier meat dishes instead of less healthy but tastier meat dishes to justify meat consumption with its health benefits. More broadly, anthropomorphism was found to discourage the consumption of other foods like candies and cookies among children (Niemyjska, Myślińska-Szarek, & Cantarero, 2021) and warm-hearted (but not cold-hearted) adults (Schroll, 2022), which may be useful for health-related interventions seeking to reduce sugar intake. Besides, the experiments in Chapter 4 have been evaluated and selected for inclusion in the first systematic review for high-quality studies on anthropomorphism and pro-environmental outcomes in another leading journal *Biological Conservation* (Williams, Whitmarsh, & Chróst, 2021), and have been mentioned by other influential review papers concerning meat-related cognitive dissonance (Rothgerber, 2020) and interventions to reduce meat consumption (Kwasny, Dobernig, & Riefler, 2022).

As a natural progression of Chapter 4, Chapter 6 is the first to demonstrate the effectiveness of anthropomorphic feedback on food waste reduction. This chapter (Wang, Shreedhar, Galizzi, & Mourato, 2022) wins the *Resources, Conservation & Recycling Advances* 2022 Best Paper Awards²², and has been featured in both UK and Chinese media channels (e.g.,

²² <https://www.sciencedirect.com/journal/resources-conservation-and-recycling-advances/about/news>

the Food Tank²³ and the Macao News²⁴). Winnow, the smart technology company we collaborated with in this research project, is very interested in this innovative anthropomorphic intervention and has incorporated it into their future service to see if the effects can be extended to other sociocultural contexts.

Conceptual replications provide external support to our theoretical hypotheses, and suggest that the effectiveness of metaphorical interventions are robust and generalizable in various operationalizations (Crandall & Sherman, 2016). Internally, I have also directly replicated many of my own studies for robustness checks or cross-cultural comparisons. To summarize the main findings across chapters and evaluate the cumulative evidence, I conducted two mini meta-analyses (Goh, Hall, & Rosenthal, 2016) on studies around anthropomorphism and meat consumption (Chapters 4 and 5), and the “Healthy is Up” metaphor (Chapters 2 and 3), respectively. Chapter 6, the field experiment, is too costly in time and resource to replicate, so we checked robustness within the study by analysing the same data with alternative but plausibly appropriate modelling approaches or estimation strategies (Duncan, Engel, Claessens, & Dowsett, 2014). For instance, linear regression models and ordered logistic regression models, which treated Likert-scales either as continuous or ordinal variables, yielded similar results from the post-intervention survey data.

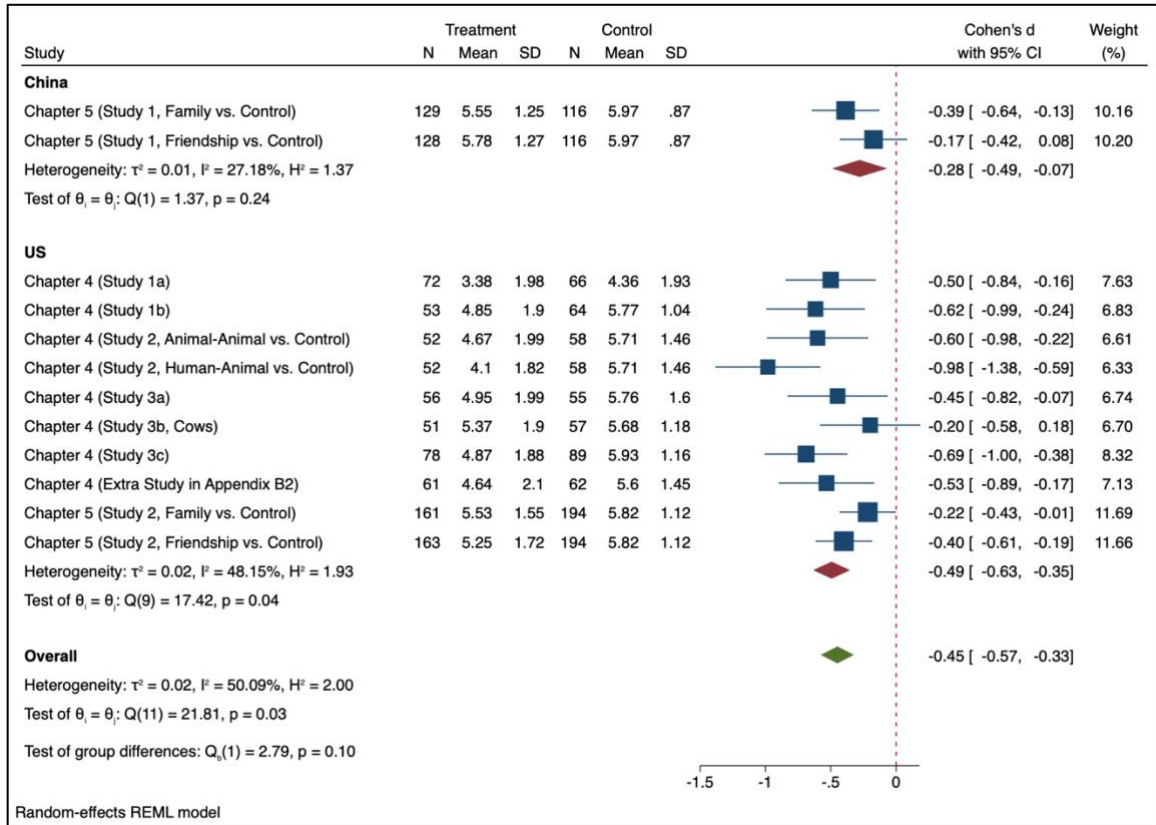
The key finding of Chapters 4 and 5 is that exposure to anthropomorphism of animals decreases omnivores’ intentions to consume meat. The effects of experimental

²³ <https://foodtank.com/news/2021/12/how-behavioral-science-can-help-mitigate-food-waste/>

²⁴ <https://macaonews.org/living/how-melcos-denise-chen-turned-a-passion-for-sustainability-into-a-career/>

manipulation (anthropomorphism vs. control) on meat-consumption intentions were extracted from all the relevant studies. I meta-analysed them in Stata with the raw mean, standard deviation, and sample size per condition. A restricted maximum likelihood (REML) random-effects model showed that exposure to anthropomorphism had a medium-size negative effect on intentions to consume meat, $d = -0.450$, 95% $CI = [-0.575, -0.325]$, $z = -7.06$, $p < 0.0001$, Heterogeneity: $I^2 = 50.09\%$. An inverse-variance (IV) fixed-effect model produced likewise results, $d = -0.418$, 95% $CI = [-0.503, -0.333]$, $z = -9.62$, $p < 0.0001$, Heterogeneity: $I^2 = 49.56\%$. The fixed-effect model assumes that all studies in the analysis share a common effect size, while the random-effects model estimates the mean of the distribution of true effect sizes (Borenstein, Hedges, Higgins, & Rothstein, 2010). The random-effects model suited this meta-analysis better, as the effects included varied in term of metaphor content (“Animals are Friends” or “Animals are Family”), sample country (US or China), target animals (pigs or cows), and consumption type (purchasing meat or going to a meat-serving restaurant), which also explained the moderate level of heterogeneity across studies. The forest plot is presented in Figure 1, with an exploratory subgroup analysis by country. The average effect among US omnivores was slightly stronger than that among Chinese omnivores, but the difference was not statistically significant, $\chi^2(1) = 2.79$, $p = 0.095$.

Figure 1. Forest plot of the effects of anthropomorphism on intentions to consume meat.



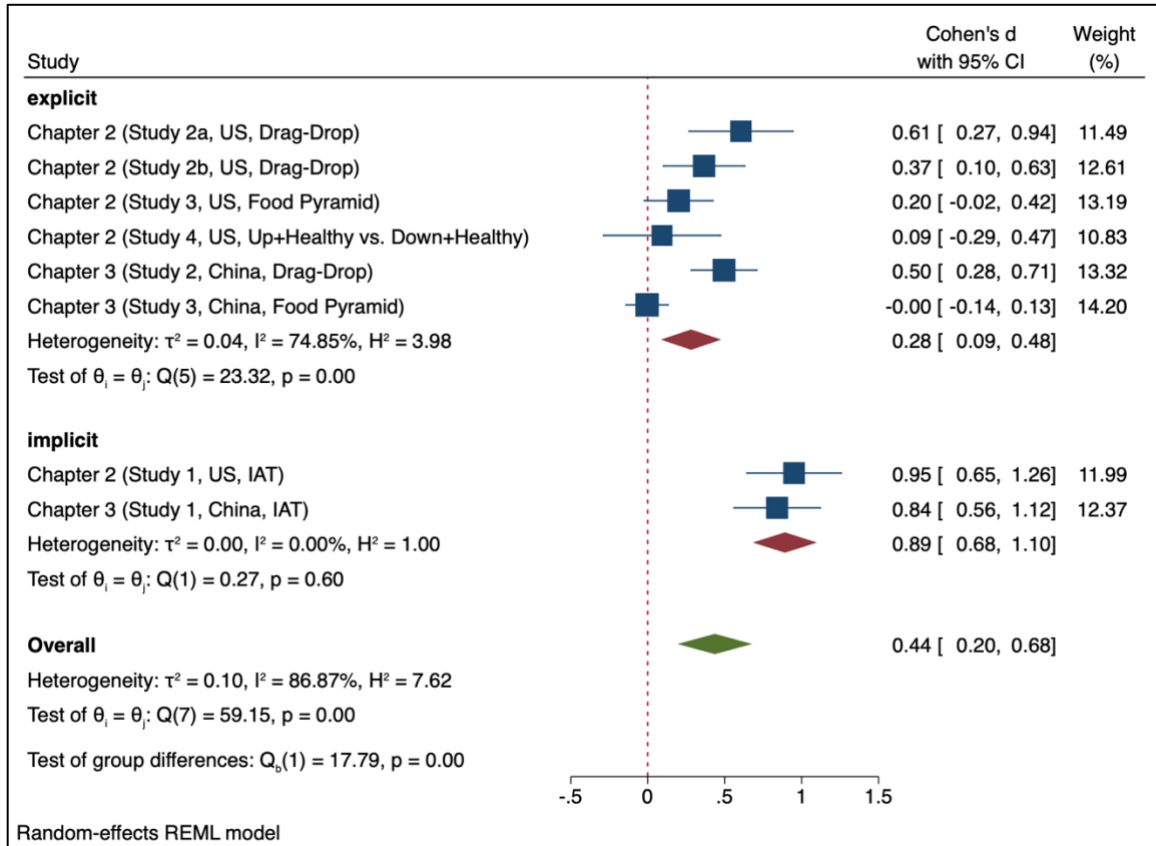
The primary research question of Chapters 2 and 3 is whether people automatically associate “Healthy Food” with “Up” and “Unhealthy Food” with “Down” in their minds. Out of purpose to strengthen the convergent validity (Campbell & Fiske, 1959; Drost, 2011), I examined the endorsement of this “Healthy is Up” metaphor with different methods and instruments, including the implicit association test (IAT) which measured reaction time, and several explicit tests which directly asked people to indicate their preferences or judgment. All the effects that compared between metaphorically congruent and incongruent scenarios (i.e., the IAT D score, the probability of placing healthy food picture up [vs. down] in the drag-and-drop task, the probability of choosing the “Healthy is Up” [vs. “Healthy is Down”] food pyramid, and the intentions to consume a healthy juice

product when it was pictured from an upward-looking [vs. downward-looking] camera angle) were selected for the meta-analysis, with *Cohen's d* computed for continuous outcomes and the *Odds ratio (OR)* calculated for binary outcomes. The *OR* was then converted into *Cohen's d* using the method outlined by Chinn (2000):

$$d = \frac{\sqrt{3}}{\pi} \ln OR \quad (1)$$

Simulation studies found that this transformation could sometimes lead to a slight underestimation of the true effect size, but the magnitude was negligible (Sánchez-Meca, Marín-Martínez, & Chacón-Moscoso, 2003). A meta-analysis was conducted in Stata with pre-computed effect sizes and associated standard errors (Hasselblad & Hedges, 1995; Sánchez-Meca et al., 2003). The REML random-effects model yielded that people had a medium-size preference for “Healthy is Up” (vs. “Healthy is Down”), $d = 0.436$, 95% *CI* = [0.196, 0.676], $z = 3.56$, $p = 0.0004$, Heterogeneity: $I^2 = 86.87\%$. The IV fixed-effect model estimated the effect size to be slightly smaller, $d = 0.314$, 95% *CI* = [0.232, 0.396], $z = 7.52$, $p < 0.0001$, Heterogeneity: $I^2 = 88.17\%$. Heterogeneity across studies was very high, which was understandable given the diverse experimental designs. The forest plot is presented in Figure 2, with an exploratory subgroup analysis by test type (implicit or explicit). The average effect of the implicit association tests was significantly stronger than that of the explicit tests, $\chi^2(1) = 17.79$, $p < 0.001$. One speculative explanation would be that in relatively slow explicit tests, some people’s reliance on automatic processing decreased. Future research may look into this hypothesis by testing if individual differences in intuitive-experiential and analytical-rational thinking styles (Epstein, Pacini, Denes-Raj, & Heier, 1996) moderate the effects of metaphors on people’s attitudes and behaviours.

Figure 2. Forest plot of the endorsement of the “Healthy is Up” metaphor.



More generally, the moderating role of other individual-level differences is also worthy of investigation. It would enhance our knowledge about metaphorical thinking and generate more precise guidance for relevant interventions.

For example, individual differences in metaphor use could be investigated. Since linguistic exposure may influence how strongly and readily one’s attitudes, intentions and behaviours are influenced by a specific metaphor (Casasanto et al., 2004; Dolscheid, Shayan, Majid, & Casasanto, 2013), it is reasonable to assume that people who use metaphorical language more frequently in daily life will be more sensitive to metaphorical interventions. Fetterman, Bair, Werth, Landkammer, and Robinson (2016) developed a Metaphor Usage

Measure (MUM) for English speakers and demonstrated a positive correlation between the MUM score and the tendency to associate valence with brightness and interpersonal agreeableness with sweet tastes. Nonetheless, the moderation effect of MUM was not replicated with other metaphors like “God is Up/Bright” (Meier & Fetterman, 2022) or “Social Impacts are Physical Impacts” (Touré-Tillery & Fishbach, 2017), potentially because people use metaphors nonverbally as well (e.g., the metaphor “God is Up” is manifested in gestures, architectures, and paintings). Nonverbal cross-cultural measurements may be required to properly capture individual differences in metaphor use.

In addition, individual differences in perception of the source concept could be researched. This point is in line with the source resonance hypothesis, i.e., individuals’ pre-existing experience about the source concept could moderate the effects of the same metaphor (Landau, Arndt, & Cameron, 2018). The finding that warm- and cold-hearted consumers responded differently to anthropomorphism of food (Schroll, 2022) is an illustration of this. Presumably, cold-hearted people might not be able to import any empathetic emotions from the source to the target due to their lack of empathy for other human beings. Anthropomorphic metaphors should thereby be applied to warm-hearted consumers and other interventions ought to be developed for cold-hearted ones. Chapter 5 supports this hypothesis with cultural-level variations in response to metaphorical interventions. Chinese people, who had been documented to have a family-oriented culture, were more heavily influenced by the metaphor “Animals are Family” than US participants.

Last, individual differences in perception of the target concept could be studied. It is suggested by the CMT literature that negative experiences with the target concept could

decrease one's sensitivity to a corresponding conceptual metaphor. People high in psychopathic attributes (i.e., those who despised moral principles) did not mentally represent "Morality" on the vertical dimension (Meier, Sellbom, & Wygant, 2007), and those who were primed to feel powerless did not associate "Power" with "Up" (Sundar & Noseworthy, 2014). In the field of sustainable healthy eating, health interventions were more likely to trigger healthier food choices among consumers who had chronic health goals (Hung & Labroo, 2011; van Ooijen, Fransen, Verlegh, & Smit, 2017), and the effects of pro-environmental interventions were more pronounced among those already concerned about environmental problems (Cooremans & Geuens, 2019; Moussaoui, Desrichard, & Milfont, 2020; Prelez, Wang, & Shreedhar, 2023). Further investigations are needed on what metaphorical interventions could help curb unhealthy and unsustainable dietary practices among those who presently have low commitment to personal and planetary health.

2. Rational choice, automatic processes, and ethics of interventions

The central premise of the rational choice paradigm (RCP), that people weigh costs and benefits and make choices to maximize their (self-perceived) interests (Scott, 2000), underlies common interventions for sustainable healthy diets (Liu, Wisdom, Roberto, Liu, & Ubel, 2014; Vermeulen, Park, Khoury, & Béné, 2020). Nutrition guidelines, calorie labels, awareness campaigns, and other forms of informational provision generally assume that people would reduce food waste behaviour as well as consumption of refined fats, sugars, and meat after knowing the negative health consequences and environmental costs of their current practices (Bleakley, Jordan, Mallya, Hennessy, & Piotrowski, 2018; Maziak & Ward, 2009; Read & Muth, 2021; Roberto, Schwartz, & Brownell, 2009;

Wolstenholme, Poortinga, & Whitmarsh, 2020). Financial incentives (e.g., price discounts, vouchers and lotteries), on the other hand, are trying to entice consumers into purchasing sustainable and healthy food (e.g. whole grains, vegetables and fruits) with monetary benefits (Liberato, Bailie, & Brimblecombe, 2014; Richards & Sindelar, 2013). Those interventions have met with mixed success. Incentive interventions are shown to be effective across regions and age groups, though the results diverge on the long-term impact after the withdrawal of incentives (An, 2013; Cohen et al., 2017; Ferreira, Goldszmidt, & Andrade, 2019; Loewenstein, Price, & Volpp, 2016). Informational interventions occasionally induce healthier food choices in small-scale experiments (Hellyer, Fraser, & Haddock-Fraser, 2012; Roberto, Larsen, Agnew, Baik, & Brownell, 2010; Wolstenholme et al., 2020), but exhibit weak or no effects on eating and wasting behaviours in most field trials (Cadario & Chandon, 2020; Campbell-Arvai, Arvai, & Kalof, 2014; Finkelstein, Strombotne, Chan, & Krieger, 2011; Sinclair, Cooper, & Mansfield, 2014; Soma, Li, & Maclaren, 2020; Weingarten, Meraner, Bach, & Hartmann, 2022). There seems to be a gap between possessing health and environmental knowledge, and putting them into positive actions (Kollmuss & Agyeman, 2002; Lappalainen, Kearney, & Gibney, 1998; Vermeir & Verbeke, 2006).

Lately, some critics propose that the RCP-driven informational interventions may have overlooked the automaticity of food-related behaviours in daily life (Benito-Ostolaza, Echavarri, Garcia-Prado, & Oses-Eraso, 2021; Liu et al., 2014; Vermeulen et al., 2020). Qualitative interviews reveal that people tend to minimize the time and effort they invest in making food choices, follow habitual routines in shopping and cooking, prioritize gustatory pleasure while eating, consume ultra-processed food for convenience, and rarely

ponder on how much food they have wasted (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Graham-Rowe, Jessop, & Sparks, 2014; Van Kesteren & Evans, 2020). In experimental studies, contextual cues are frequently shown to automatically trigger unhealthy dietary practices (Cohen & Babey, 2012), such that people drank significantly less water when it was not available on the dining table but about twenty feet away (Engell, Kramer, Malafi, Salomon, & Leshner, 1996), that older children and adults increased their energy intake when meals or snacks were served in larger portions (Ello-Martin, Ledikwe, & Rolls, 2005; Fisher, Rolls, & Birch, 2003; Levitsky & Youn, 2004; Rolls, Morris, & Roe, 2002; Rolls, Roe, Kral, Meengs, & Wall, 2004), and that college students who were at a cinema (vs. in a meeting room) ate significantly more popcorn while watching videos (Neal, Wood, Wu, & Kurlander, 2011). Researchers have thus encouraged dietary interventions to target automatic processes and reduce the cognitive effort required for making sustainable healthy choices (Larsen & Hollands, 2022; Liu et al., 2014; Vermeulen et al., 2020). The idea is echoed by the success of some food-related nudging interventions (Thaler & Sunstein, 2009), including setting healthy options as the default on the menus (Campbell-Arvai et al., 2014; Loeb et al., 2017; van Kleef et al., 2018), placing healthy food in a more accessible location (Cheung, Gillebaart, Kroese, Marchiori, Fennis, & De Ridder, 2019; Kroese, Marchiori, & De Ridder, 2016), and manipulating the portion size of healthy or unhealthy food (Higgins et al., 2022; Rolls, Roe, & Meengs, 2010; Vermote et al., 2018).

In line with this reasoning, the embodied cognition approach also recognizes that cognitive activities are time-pressured and capacity-limited (Risko & Gilbert, 2016; Wilson, 2002), and that human decisions are extensively influenced by automatic processes such as

sensory perception, motor control, and metaphorical thinking (Landau, Meier, & Keefer, 2010; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Rueschemeyer, Lindemann, Van Elk, & Bekkering, 2009). Metaphorical thinking is activated without much cognitive effort and can often lighten the difficulties of comprehending abstract or unfamiliar ideas (Gibbs & Chen, 2018; Landau, et al., 2010; Thibodeau & Boroditsky, 2011). Therefore, incorporating metaphors into informational interventions may help alleviate some problems with the mainstream RCP strategy. This possibility has been supported by the findings of the current thesis. Chapter 4 demonstrated that the “Animals are Friends” metaphor decreased US omnivores’ intentions to consume pork by intensifying (moral) guilt feelings towards pigs. By contrast, Piazza and Loughnan (2016) provided US omnivores with scientific information about pig intelligence, but the message did not increase moral concerns about eating pork. In Chapter 6, we implemented two types of informational interventions in Macau cafeterias, one presenting the environmental impact of reducing food waste and the other combining environmental messages with non-verbal anthropomorphic metaphors (e.g., “The Earth is A Person”, “Food Items are People”). Data suggested that diners receiving both environmental messages and anthropomorphic metaphors put more effort into saving food than those who were merely exposed to environmental messages. Going beyond my own studies, the well-known traffic-light label intervention (Borgmeier & Westenhoefer, 2009; Thorndike, Riis, Sonnenberg, & Levy, 2014) is arguably operating through metaphorical thinking too. People in modern cities have learnt to associate “Red” with “Stop” and “Green” with “Go” in their mind, which, in turn, leads them to be automatically alerted by the red signs on food products, and to feel comfortable with purchasing if the signs are green (Carlsson,

Kataria, Lampi, Nyberg, & Sterner, 2022; Zhang, Liu, Gu, Wang, & Chen, 2020). The automatic activation of metaphors could help explain why the traffic-light labels promote healthy food consumption more effectively than the conventional numeric labels (Cecchini & Warin, 2016; Sinclair, Cooper, & Mansfield, 2014).

It should be noted that this thesis has no intention of downplaying the importance of information provision in promoting sustainable healthy diets. It is just calling for improvement in “how” information is provided. Informational interventions are only likely to facilitate behavioural change if they are appealing enough to get people’s attention, and are not too difficult to process for people with limited time and background knowledge. By tapping into automatic processing, metaphors would enable consumers to grasp the information provided more easily, and to translate information into practice effortlessly.

Nevertheless, strategically framing information with metaphors may sometimes elicit ethical concerns. One possible criticism might be that interventions targeting automatic processes are manipulative by nature and could violate the freedom of choice (see also the debate on the ethics of nudging interventions, Barton & Grüne-Yanoff, 2015; Gigerenzer, 2015; Schmidt & Engelen, 2020; Smith, Goldstein, & Johnson, 2013; White, 2013). I would argue, though, that the strategic use of metaphors in sustainable healthy diet promotion is ethically justifiable for three reasons.

First, informational interventions may evoke metaphorical thinking even if they are not designed to do so. One such case has been demonstrated in Chapter 2 - the traditional healthy eating pyramid placed unhealthy food at the top and healthy food at the bottom, which unintentionally conveyed the metaphor “Unhealthy is Up”. It contradicted the

primary metaphor “Healthy is Up” in people’s minds, and could add difficulties to information processing. Indeed, a native Chinese speaker who proofread the food pyramid study of Chapter 3 commented “I thought the food items presented higher are richer in nutrients so that a small amount of them would be equivalent to larger quantities of food presented below”. This kind of misinterpretation might also occur if traffic-light labels have not been crafted in a metaphorically congruent way (imagine if a high level of sugar, fat, or salt is marked in green whereas labels for healthy food are all red). Given the pervasiveness of metaphorical thoughts (Lakoff & Johnson, 1980; Landau, et al., 2010), strategically designing interventions with desirable metaphors would reduce the chance of misleading consumers with unwanted metaphors.

Second, metaphors have been prevalently used by the industry to advertise fast food, red and processed meat, high-fat snacks, and sugar-sweetened beverages (Bolognesi & Strik Lievers, 2020; Pérez-Hernández, 2019; Rogers, 2008). A few clever and alluring examples of them are displayed in Figure 3. By targeting automatic processes, commercial advertisements have boosted the consumption of unsustainable and unhealthy food for decades, and greatly contributed to the current obesogenic food environment (Folkvord & Hermans, 2020; Zimmerman, 2011; Zimmerman & Shimoga, 2014). Drawing upon metaphors to promote sustainable healthy diets could potentially balance out this negative influence from the other side.

Figure 3. Metaphorical advertisements for unsustainable and unhealthy food products. Adapted from Bolognesi and Strik Lievers (2020), and Pérez-Hernández (2019).

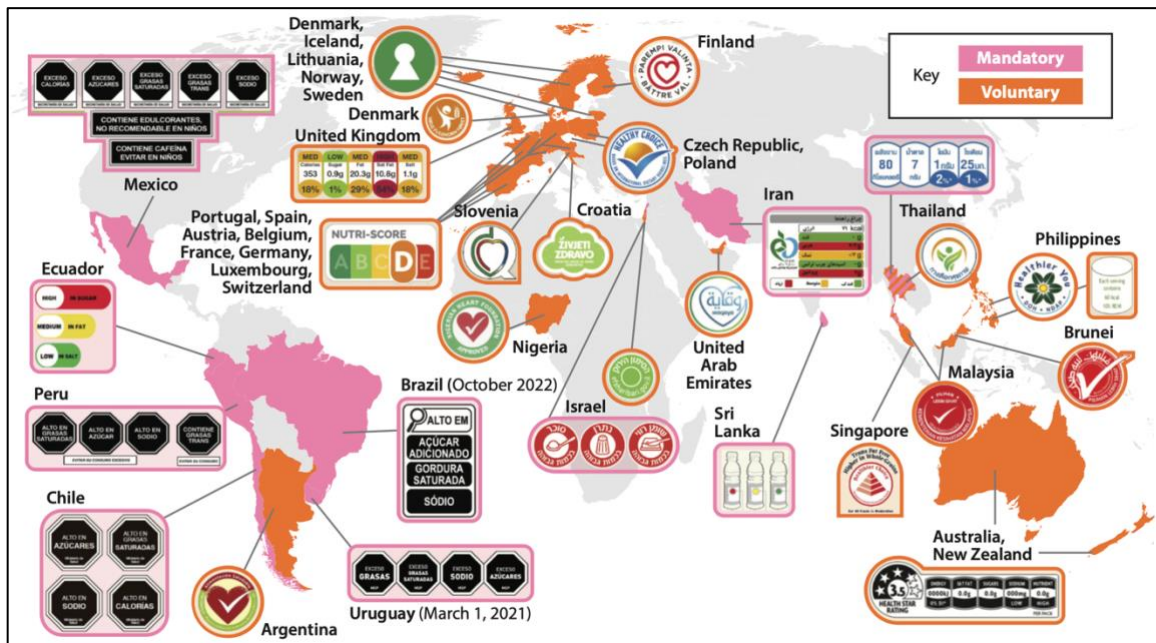


Third, the conventional RCP-driven informational interventions appear to be transparent, but may actually widen inequality (Lorenc, Petticrew, Welch, & Tugwell, 2013). People with higher education show a stronger preference for rational-analytical thinking style (Aarnio & Lindeman, 2005). Adults in low-income countries have substantially longer working hours than those in high-income countries (Bick, Fuchs-Schündeln, & Lagakos, 2018), which limits the time they can spend on choosing and preparing food (Beshara, Hutchinson, & Wilson, 2010; Devine, Connors, Sobal, & Bisogni, 2003). These all imply that the socio-economically disadvantaged groups are less likely to benefit from the RCP-driven informational interventions. Supporting this hypothesis, awareness campaigns and nutritional education are found to be less effective among people with lower socio-economic status (Oldroyd, Burns, Lucas, Haikerwal, & Waters, 2008; Watson, Watson, Bell, & Halliday, 2001). Low income and education are also associated with a poor understanding of the numeric food nutrition labels (Rothman et al., 2006). In comparison, metaphorical interventions (e.g., anthropomorphic cues and traffic-light labels) are more likely to work for all socio-economic groups as the information provided could be processed quickly and easily (Méjean, Macouillard, Péneau, Hercberg, & Castetbon, 2013; Shrestha, Cullerton, White, Mays, & Sendall, 2023).

That being said, I agree that metaphorical interventions should try to improve transparency whenever possible. One way of achieving that is to present metaphorical messages together with numeric/analytical ones, so that consumers can decide which type of information they feel like attending to. This combined approach has been tried out in Chapter 6 (i.e., anthropomorphic cues are provided alongside numeric feedback), and with real-world food nutrition labels (see Figure 4, in Iran and the UK, the traffic-light labelling is used in

conjunction with numeric nutritional information). The effectiveness of combined messaging on various food-related behaviours should be further evaluated among different socio-economic groups.

Figure 4. Countries with mandatory or voluntary interpretive front-of-package labels on packaged foods and drinks (Roberto, Ng, Ganderats-Fuentes, Hammond, Barquera, Jauregui, & Taillie, 2021).



3. Unexpected findings, cultural comparisons and alternative theories

While the main hypotheses tested and confirmed in this thesis are inspired by the CMT, there are also unexpected findings pointing to the limitations of Lakoff and Johnson’s (1980) theory. Most of the unexpected results are yielded by the cross-cultural comparison studies, and could be better explained if we revisit some earlier theoretical perspectives on metaphorical language and metaphorical thoughts.

One finding that the classical CMT fails to predict occurred in Chapter 3, where the ubiquity of primary metaphors was only partially supported. Chinese people associated “Healthy Food” with “Up” and “Unhealthy Food” with “Down” in cognitive tasks, even though their mother tongue has no linguistic expressions for the metaphor “Healthy is Up”. However, this mental association was not reflected in Chinese participants’ judgments of the food pyramids, which differed from what had been observed in the US study. It seems that language use does enhance people’s automatic reliance on a particular metaphor, which the CMT seldom talks about. Historically, Lakoff and Johnson (1980; 1999) proposed the CMT as a counterargument to the traditional viewpoint that metaphors are merely linguistic devices. They highlighted the embodied underpinning of metaphorical thoughts, and perceived metaphorical language as secondary manifestations. In consequence, the linguistic relativity hypothesis (i.e., the language a person habitually use has a great impact on his non-linguistic cognitive activities; Gumperz & Levinson, 1996; Whorf, 1997) is not particularly welcomed by the CMT researchers. The current evidence suggests that the linguistic relativity hypothesis should not be entirely abandoned. Metaphorical thoughts could have more than one origin and rely on multiple mechanisms (Barsalou, Santos, Simmons, & Wilson, 2008; Borghi, Binkofski, Castelfranchi, Cimatti, Scorolli, & Tummolini, 2017; Casasanto, 2014). Repeated language use or linguistic exposure may foster automatic metaphorical thinking just like recurring bodily experiences, and further studies are warranted to explore the interplay between them.

The null effects of the “Animals are Friends” metaphor on beef consumption came as a surprise too. As discussed in Chapter 4, it might be due to that cows are associated with anger and agitation in US culture, which conflicts with the source concept “a friendly

person”. In the same vein, Chapter 5 found that the metaphor “Animals are Friends” had a relatively weak effect on Chinese omnivores’ intentions to consume pork, presumably because pigs symbolize stupidity and laziness in Chinese culture. Although the evidence is far from conclusive, those phenomena indicate that perceived dissimilarity between the source and the target may impair novel metaphor processing. This speculation is consistent with the analogy approach to metaphor, a theory that used to be popular before the emergence of the CMT. Originated with Aristotle, the analogy approach posits that metaphors (like analogies in general) are essentially based on source-target similarities (Gentner, Bowdle, Wolff, & Boronat, 2001; Holyoak & Stamenković, 2018), which can be either attributional similarity (e.g., “His eyes were burning coals”) or relational similarity (e.g., “my job is a jail”). The CMT contests this theory by showcasing a range of primary metaphors low in source-target similarity, but widely used in everyday language (e.g., “Healthy is Up”, “Affection is Warmth”). It has been acknowledged thereafter that source-target similarity is not necessary for metaphorical thinking, and a more plausible basis for primary metaphors would be correlations in embodied experience (Grady, 1997; Kövecses, 2015). However, this cannot dismiss all evidence in favour of the analogy approach. People find new verbal metaphorical expressions more comprehensible when source-target similarity is high (Wolff & Gentner, 2000; 2011). Shape similarity improves visual metaphor comprehension and aids creative interpretation in children and adults (Indurkha, & Ojha, 2013; Van Weelden, Maes, Schilperoord, & Cozijn, 2011; Van Weelden, Maes, Schilperoord, & Swerts, 2012). It seems that source-target similarity and correlations in experience both facilitate metaphorical thoughts (Casasanto, 2013; Kövecses, 2015). By

taking a middle group between the CMT and the analogy approach, we may be able to create better metaphorical interventions for sustainable healthy diets.

Besides, it remains unclear what psychological mechanisms regulate the effects of metaphorical interventions on behaviours and behavioural intentions. Chapter 4 revealed that anticipatory guilt mediated the negative effects of the metaphor “Animals are Friends” on meat consumption. Yet, the mediation was partial, so other affective responses such as empathic concern and disgust (Buttler & Walther, 2022; Kunst & Hohle, 2016; Niemyjska, Cantarero, Byrka, & Bilewicz, 2018) might have played a role too. Chapter 5 found no difference in Chinese people’s guilt feelings across conditions, which indicated that the effects of the metaphor “Animals are Family” operated through alternative psychological mechanisms. This observation shows that similar effects of metaphors on behaviours or behavioural intentions could be driven by distinct psychological mechanisms, so conclusions about universal cognitive processes should be drawn with caution. To gain a deeper understanding of the underlying psychological mechanisms, future research may go beyond self-report instruments, and monitor participants’ brain responses, skin conductance, heart rates, and facial expressions in exposure to certain metaphorical interventions (Mauss & Robinson, 2009).

Practically, the abovementioned unexpected findings have stressed the necessity of adjusting intervention design according to sociocultural contexts. In US health communication campaigns, the “Healthy is Up” metaphor had better be considered whenever vertical cues are involved. In China, this association is less powerful, but may become useful if one aims to promote healthy eating with novel metaphors (e.g., the

metaphor “Eating Junk Food is Drowning Your Body” might efficiently change Chinese consumers’ food choices because of its congruency with the mental association between “Unhealthy” and “Down”). Policymakers and activists in the US could apply the metaphor “Animals are Friends” to their interventions for plant-based diets, whereas their Chinese counterparts would be well-advised to turn to the metaphor “Animals are Family”.

In sum, this thesis provides evidence for the effectiveness of metaphorical interventions in promoting sustainable healthy diets across US and Chinese cultures, which sheds new light on a range of theoretical topics and entails significant practical implications. Continued and sustained efforts are needed to make those metaphorical interventions more accessible to people with different psychological traits and sociocultural backgrounds.

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