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RESEARCH ARTICLE

Renewable bites: How energy sources shape food healthiness judgments

Michał Folwarczny[1], Agata Gasiorowska[2], Valdimar Sigurdsson[3] and Tobias Otterbring[4,5]

[1]Discipline of Marketing, J.E. Cairnes School of Business & Economics, University of Galway, Galway, Ireland; [2]Faculty of Psychology in Wroclaw, SWPS University, Warsaw, Poland; [3]Department of Business and Economics, Reykjavik University, Reykjavik, Iceland; [4]Department of Management and Innovation, University of Agder, Norway and [5] School of Electrical Engineering and Computer Science, Division of Media Technology and Interaction Design, KTH Royal Institute of Technology, Sweden

Corresponding author: Michał Folwarczny; Email: michal.folwarczny@universityofgalway.ie

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Abstract

Public opinion increasingly associates nuclear energy with negative environmental outcomes, but can this perception influence how people judge food? This study examines whether the perceived naturalness of energy sources used to manufacture kitchen appliances affects the perceived healthiness of foods prepared with those appliances. Food prepared with appliances manufactured using nuclear energy was consistently perceived as less healthy than food prepared with appliances manufactured without any specified energy source (Studies 1–3; N_{total} = 1,939), with this negative nuclear effect also emerging when compared against a wind energy condition in the most well-powered, preregistered experiment (Study 3). Further, the effect of nuclear energy on healthiness perceptions was indirect through perceived risk (Study 3), implying that nuclear energy evoked greater perceived risk, which ultimately reduced perceived healthiness. This work extends contagion theory by showing that perceptions of unnaturalness can spread through abstract and distant links—such as energy sources used in manufacturing—to shape judgments in unrelated domains. The persistence of negative contagion effects associated with nuclear energy, but the more modest positive effects from wind energy, aligns with the principle of negativity dominance in contagion research. These results suggest that consumer resistance to nuclear energy may stem, in part, from naturalness perceptions.

1. Introduction

Energy has always been critical for humans, starting with the discovery of fire, which allowed our ancestors to prepare food and keep warm, through the invention of the steam engine powered by coal, to today's sophisticated experiments with nuclear fusion—the same reaction that occurs in the sun (U.S. Department of Energy, 2021). Despite the many sources of energy that are vital for modern economies, public attitudes toward these sources differ significantly. For example, Ertör-Akyazı et al. (2012) found that in Turkey, people generally supported energy produced by dams and renewables, followed by natural gas, while coal and nuclear energy were typically opposed. A national British survey found similar results: solar, wind, and hydroelectric power were perceived most favorably, whereas nuclear power, coal, and oil were viewed less favorably, with natural gas and biomass rated in between (Corner et al., 2011). However, support for specific energy sources varies across populations. For instance, Poles are more supportive of nuclear energy than their German counterparts (Bohdanowicz et al., 2023).

Similarly, there are discrepancies within countries—although people in most U.S. states generally support renewable energy, the degree of this support is state-specific (Stokes and Warshaw, 2017).

After four decades of intense anti-nuclear campaigning, on April 15, 2023, Germany's last nuclear reactor ceased operations, marking a major milestone in the transition away from nuclear power (Clean Energy Wire, 2023). Nuclear power and fossil fuels are increasingly replaced by renewable energy, with wind now being a dominant source (Maguire, 2024). In tandem with this switch, consumers are increasingly demonstrating a growing preference for regional, organic, and minimally processed foods, reflecting a heightened demand for products deemed natural (Perkovic et al., 2022). This trend raises the following question: Could strong public support for phasing out nuclear energy be linked to a desire for more 'natural' foods in people's diets? In other words, are nuclear energy and natural food fundamentally at odds? The current research examines whether the naturalness of energy sources used to produce kitchen appliances influences the perceived naturalness of foods prepared using them.

1.1. Magical thinking

In daily life, people often exhibit a tendency to rely on magical thinking: attributing causal relationships to actions or events that lack a scientific basis, such as believing that specific rituals or symbolic acts can influence outcomes (Subbotsky, 2010). For instance, it is common to blow out candles on a birthday cake and make a wish, with the belief that performing this ritual increases the likelihood of the wish coming true. This form of thinking is not limited to lay beliefs. On the contrary, magical thinking has been identified as a potential contributor to misdiagnoses even among highly qualified medical professionals (Boardman and Sonnenberg, 2014).

For the current research, it is essential to distinguish between magical thinking in general and its specific form guided by the laws of *sympathetic magic*, particularly the concept of magical contagion beliefs (Rozin and Nemeroff, 2002). Although magical thinking and sympathetic magic both involve beliefs that contradict scientifically established norms, magical thinking is broadly defined and less structured, whereas the laws of sympathetic magic are well-defined. Additionally, unlike many forms of magic, sympathetic magic does not require animate agency to operate (Tambiah, 1990). Sympathetic magic consists of two main laws: the law of similarity and the law of contagion—the latter being the focus of this research (Nemeroff and Rozin, 2018).

Magical thinking also differs fundamentally from learning that involves evidence-based associations between cause and effect, allowing concepts to evolve over time. In contrast, magical thinking typically emerges in children aged three to six and persists into adulthood despite growing causal evidence against such beliefs (Rosengren and French, 2013). Moreover, the traditionally assumed chronological magic–religion–science sequence does not always hold. Scientific discoveries, such as the complex principles of quantum physics, have sometimes fueled new forms of magical thinking—seen in pseudoscientific ideas like quantum healing—rather than eliminating them. In sum, whereas scientific thinking seeks to understand and predict natural phenomena, magical thinking primarily serves to create a meaningful framework that offers a sense of control over the natural world (Nemeroff and Rozin, 2000).

1.2. Magical contagion

The concept of magical contagion—one form of magical thinking—introduced in the literature over a century ago, posits that objects in the natural world influence each other through the transfer of properties when they come into contact (Frazer, 1890/1959; Mauss, 1902/1972). This transfer is believed to occur via the transmission of an 'essence' from the source through physical contact, with the effect considered permanent, encapsulated in the principle 'once in contact, always in contact' (Rozin et al., 1986). For instance, people develop negative perceptions of clothing previously worn by individuals considered morally bad or evil, making them reluctant to wear such items (Morales and Fitzsimons, 2007; Nemeroff and Rozin, 1994).

Decades of research on contagion have established several key principles underlying this form of sympathetic magic. For the purposes of this study, the most relevant principle is that contagion typically requires direct or indirect contact—often via a medium—between a source and a target, with the effects of such contact considered permanent (Morales et al., 2018; Nemeroff and Rozin, 2018; Rozin and Nemeroff, 2002). Contagion is dose-insensitive, meaning even minimal contact is sufficient to trigger its effects. For instance, many people believe that a single COVID-19 virus particle can cause infection (Rozin, 2023). Attempts to remove contagion, such as sterilization, are often perceived as inadequate, with the negative effects believed to persist even after thorough cleaning (Nemeroff and Rozin, 1994). Moreover, negative contagion tends to be more impactful than positive contagion, as reflected in linguistic patterns: whereas negative nouns often have direct equivalents across languages, positive nouns are less likely to exhibit such equivalents (Rozin and Royzman, 2001; Rozin et al., 2010). Overall, contagion effects are broadly generalizable, with their core principles consistently observed across cultures and contexts, both in industrialized populations and among those leading traditional lifestyles (Apicella et al., 2018; Nemeroff and Rozin, 2018).

Considering the belief that 'essence' is transferred through contact between entities, research has investigated whether touching unhealthy foods with healthy alternatives transfers perceived healthiness, often associated with lower calorie density. Indeed, when healthy toppings are added to unhealthy foods, people tend to underestimate their calorie content and consume more of these unhealthy products masked by healthy toppings (Jiang and Lei, 2014). This transfer of properties extends beyond physical attributes, such as germs, to metaphysical attributes, such as virtue or abilities (Kim et al., 2023). For instance, studies have shown that touching an object previously handled by a celebrity or high performer increases people's belief in their anticipated performance levels, which subsequently enhances their actual task performance as well as their interest in said object, supporting contagion theory (Argo et al., 2008; Kramer and Block, 2014). Evidence also suggests that contagion can work in both directions: not only from a source to a receiver of an object but also in reverse. For example, people often feel uncomfortable if a sample of their hair falls into the hands of an enemy or a rapist, particularly if the receiver knows whose hair it is (Rozin et al., 2018).

1.3. Contagion in consumer behavior research

The law of contagion has garnered significant attention in consumer behavior research. Studies reveal that consumers attach symbolic or emotional value to objects, prefer handmade over machine-made products despite their higher costs, and revere certain brands much like religious symbols (Assaf, 2012; Fernandez and Lastovicka, 2011; Fuchs et al., 2015). Recent studies have sought to explain how, via contagion effects, customers strive to connect to nature (Marchais et al., 2024).

In Western developed countries, consumers generally prefer natural products, especially in food contexts, over their less natural or machine-made alternatives (Rozin et al., 2012; Scott and Rozin, 2020). Because products perceived as relatively natural are considered less potent and less risky than their unnatural alternatives, consumers show a particularly high preference toward them when preventing health conditions rather than curing them, as potency is more important than safety in the latter case (Scott et al., 2020). By the same token, as artificial drugs are seen as more potent in altering customers' true selves than their natural alternatives, they prefer natural drugs for treating psychological than physical conditions (Li and Gal, 2024). Consumers' negative perceptions of genetically modified foods further illustrate this point, as such modifications are thought to disrupt naturalness. However, this effect diminishes when the modification process is described as human-made and intentional (Hingston and Noseworthy, 2018). Adding an ingredient often reduces a product's perceived naturalness more than removing one, reflecting how contagion beliefs affect judgments about purity and authenticity (Perkovic et al., 2022; Scott and Rozin, 2017). For example, labeling a juice as handmade increases its perceived naturalness compared to labeling it as machine-made or providing no information (Abouab and Gomez, 2015).

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Few studies have explored the boundary conditions for contagion effects to emerge. Fedotova and Rozin (2018) investigated whether participants preferred interacting with an object not associated with negative contagion but in physical contact with a contagion source, such as an evil person, or an object associated with negative contagion but without physical contact with the contagion source. They found that participants generally preferred interacting with an item associated with negative contagion, such as a copy of Mein Kampf that had no physical contact with a contagion source, over a neutral item, such as an English dictionary, that had come into physical contact with the contagion source (e.g., Hitler). These findings highlight the critical role of physical contact with a negative contagion source in eliciting magical contagion effects (Fedotova and Rozin, 2018).

1.4. Overview of current research and contributions

Contagion research typically examines relatively short chains, where essence is transferred from a contagion source, through a medium, to a recipient (e.g., Huang et al., 2017; Rozin et al., 1994; Rozin, 2006; Scott et al., 2020). However, less is known about whether longer chains—those involving more than one medium transferring essence—also produce contagion effects. This question warrants further exploration, especially given recent research showing that merely associating products like clothing or chocolate with a disliked political party leader or its supporters can trigger a negative contagion effect, causing individuals to prefer these products less (Erlandsson et al., 2024). In the current research, we contribute to this literature by exploring essence transfer through longer chains. Specifically, we ask whether the perceived naturalness of an energy source used to manufacture an appliance affects healthiness inferences about food prepared using that appliance. This inference chain is relatively complex: the perception of the initial energy source's naturalness would have to transfer through a medium (the kitchen appliance) to the final food. In this context, physical contact does not occur, as the energy supplied to a factory does not 'touch' the appliance and certainly does not come into contact with the food (for an alternative perspective, see Fedotova and Rozin, 2018).

A related stream of literature also points at the possibility that not all energy sources show a similar contagion proclivity; for example, Hacquin et al. (2022) found that people were less inclined to wear a sweater that had been in a nuclear power plant than in a car manufacturing plant. However, this research examined direct contagion through physical proximity—the sweater was literally present in the nuclear facility. Our work extends this finding by demonstrating that contagion effects persist even when the connection is far more abstract and indirect: nuclear energy used during manufacturing processes can contaminate food products through a complex chain involving factory operations, appliance production, consumer purchase, and home food preparation. This suggests that nuclear-related contagion beliefs may be more pervasive and robust than previously assumed, operating not only through direct physical contact but through extended chains of associations that span industrial and domestic contexts.

Additionally, it is unclear whether the naturalness of an energy source would influence perceptions of the healthiness of the final food product. For such an effect to occur, a form of spiritual contagion would need to transform perceptions of the energy source's naturalness into healthiness inferences, as these are distinct categories. Although past research has identified positive associations between food naturalness and healthiness, the evidence is mixed (Ditlevsen et al., 2019; Folwarczny et al., 2023; Hagen, 2021; Roman et al., 2017; Skubisz, 2017). Furthermore, the energy sources examined in this study—wind and nuclear—are both human-engineered, with nuclear energy being even more directly tied to human activity. Therefore, it might be expected that such energy sources would not influence health perceptions of foods prepared with appliances manufactured using them (building on Hingston and Noseworthy, 2018).

Finally, whereas the literature suggests that individuals differ in their sensitivity to magical contagion beliefs, the study of individual differences in contagion potency remains limited (Kim et al., 2023; Nemeroff and Rozin, 2000). Likewise, the effects of contact duration, type, and the extent of contagion across longer chains are understudied, and no general rules have been established in this context (Huang et al., 2017; Nemeroff and Rozin, 2018). The present research aims to shed light on these questions.

2. Study 1

Study 1 had two primary purposes. First, in the absence of meta-analytic effect sizes or similar prior studies, we aimed to collect data to estimate the sample size for our subsequent preregistered studies. Second, Study 1 served as an initial test of our hypothesis grounded in the contagion literature. Specifically, drawing on a contagion account (Nemeroff and Rozin, 1994; Rozin et al., 1986), we hypothesized that people would perceive foods prepared with appliances manufactured using nuclear energy as less healthy than those prepared with appliances manufactured using wind energy or when no information about the energy source used in the manufacturing process was provided. All data, materials, and code used in this publication are publicly available through Open Science Framework (OSF; https://osf.io/tcygj/).

2.1. Method

2.1.1. Participants

A total of 120 US participants (M_{age} = 39.5, *SD* = 12.9, 52.5% women, 45.0% men, 2.5% preferred not to disclose their gender or identified differently) were recruited via Prolific Academic. Sensitivity analysis was conducted using the *simr* package in R (Green and MacLeod, 2016). The model included condition as a fixed effect and random intercepts for participants and appliances. Based on 5,000 simulations, the analysis revealed 92% power to detect the observed effect size of condition at $\alpha = 0.05$. Data collection was approved by the Ethics Committee for Research at the SWPS University (approval number: 02/E/09/2024).

2.1.2. Stimuli development

We conducted a pretest to develop a final set of stimuli for Studies 1 and 2. Here, 119 Prolific participants from the US (M_{age} = 44.7, *SD* = 15.5, 60.5% women, 37.8% men, 1.7% preferred not to disclose their gender or identified differently) evaluated the naturalness of seven energy sources: petroleum, natural gas, nuclear energy, coal, solar energy, wind, and hydro energy, respectively. Naturalness was measured following instructions by Scott and Rozin (2017):

> Please rate the following choices in terms of how natural you believe they are. The scale runs from 0, which is completely unnatural, to 100, which is completely natural. For this scale and all scales with a slider, you must move the slider for your answer to register. Even if you want your answer to be 50, you still have to move the slider away and back to 50 for your answer to count. How natural are the following items? (A) A tree on a mountain peak in the Andes that has never been climbed; (B) A plastic toy model of a pistol (C); A hard boiled egg. The tree should get a rating at or near 100, the plastic toy model of a pistol should be at or near zero, and the egg should be somewhere in between. Please check to make sure this is true for your ratings, and if not, think a bit before going on.

The mean ratings of naturalness of each energy source was the lowest for nuclear energy (*M* = 24.0, *SD* = 26.4) and the highest for wind energy (*M* = 95.2, *SD* = 11.0), $t = 25.18$, $p < 0.001$, $d = 3.51$. Consequently, these two energy sources were included across all studies.

2.1.3. Procedure

After participants gave their informed consent, they were then randomly assigned to one of three conditions: the control condition, in which they evaluated the healthiness of foods prepared using five kitchen appliances (e.g., blender, air fryer, and oven) without information about the energy source used to manufacture each appliance; the experimental 'nuclear' condition, in which they were informed that the appliances presented were manufactured using nuclear energy; or the experimental 'wind' condition, in which they were similarly informed about the energy source, though in this case, it was wind energy.

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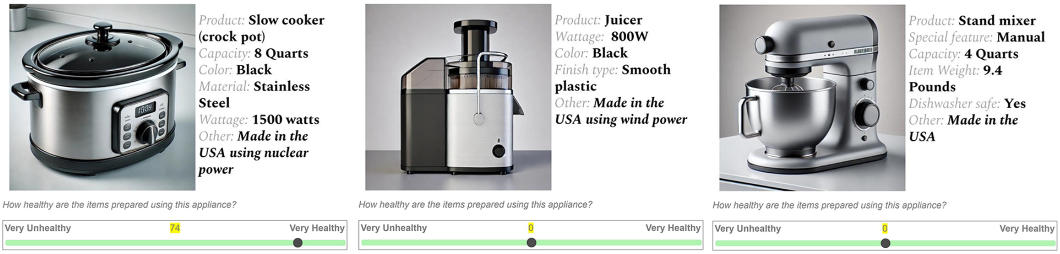

Figure 1. *Sample tasks in the three experimental conditions.*

Participants' primary task was to evaluate the healthiness of food prepared with the appliances in their assigned condition (control, nuclear, or wind). Specifically, food healthiness was measured by asking participants the following question: *How healthy is food prepared using this appliance?* Participants responded on a 201-point sliding scale (for a similar methodology, see Folwarczny et al., 2023) ranging from −100 *(Very unhealthy)* to 100 *(Very healthy)*. At the conclusion of the study, participants evaluated the naturalness of both nuclear and wind energy (for details, see the pretest) and provided basic demographic information.

Figure 1 shows sample appliances with their descriptions in nuclear, wind, and control conditions, respectively.

2.2. Results

2.2.1. Analytic approach

Given that our data were nested, with participants evaluating five different appliances, leading to autocorrelations across outcome measures, we used linear mixed models for analyses using the *lme4* and *lmerTest* packages in R (Bates et al., 2015; Kuznetsova et al., 2017). Random intercepts were incorporated for both participants and appliances in all analyses to account for within-participant and within-appliance category dependencies. The main predictor, i.e., experimental condition assignment, was dummy coded, with 'nuclear' being the reference category. The contrasts included a comparison between control versus nuclear conditions, and a second contrast comparing wind versus nuclear conditions.

2.2.2. Preliminary findings

Participants perceived food prepared with appliances manufactured using wind energy ($M = 37.6$, $SD = 28.7$) as significantly healthier than food prepared with appliances manufactured using nuclear energy ($M = 11.6$, $SD = 41.5$), $b = 25.96$, 95% CI [12.21, 39.70], $p < 0.001$. Similarly, participants rated food prepared with appliances when no information about the energy source was provided ($M = 31.0$, $SD = 26.2$) as significantly healthier than food prepared with appliances manufactured using nuclear energy, $b = 19.36$, 95% CI [3.76, 34.95], $p = 0.017$. Figure 2 depicts the distribution of responses in Study 1.

Next, to assess the robustness of our findings, we examined whether participants' perceptions of naturalness differences between energy sources moderated the effect of energy source condition on healthiness ratings. We calculated a naturalness difference score by subtracting participants' naturalness ratings of nuclear energy from their naturalness ratings of wind energy and mean-centered this variable. Here, we used simple contrast coding for the condition variable, so that the two dummy variables were mean-centered.

Results revealed significant main effects for both condition contrasts: control versus nuclear, $b = 2.85$, 95% CI [5.83, 35.88], $p = 0.008$, and wind versus nuclear, $b = 25.99$, 95% CI [12.81, 39.18], $p < 0.001$. Additionally, there was a significant main effect of the naturalness difference score, $b = -0.25$, 95% CI [−0.42, −0.09], $p = 0.004$, indicating that greater perceived naturalness differences between wind and nuclear energy were associated with lower healthiness ratings. However, the

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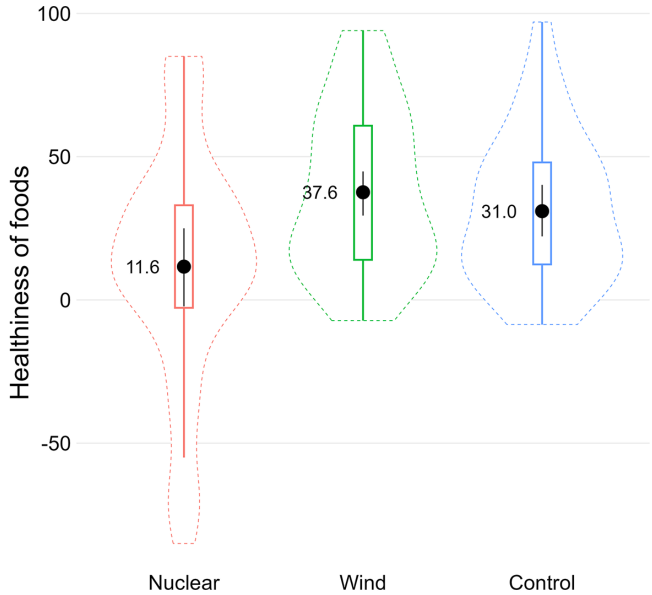

Figure 2. *Distribution of responses in Study 1.*
Note: The black dots in the boxplots represent the means, with their 95% bootstrapped CIs shown as black lines above and below. The numerical means, rounded to one decimal place, are displayed next to these dots. The boxplots depict the data range between the first and third quartiles, with whiskers extending up to 1.5 times the interquartile range.

interaction terms were not statistically significant: condition (control vs. nuclear) × naturalness difference, $b = 0.20$, 95% CI [−0.23, 0.63], $p = 0.374$, and condition (wind vs. nuclear) × naturalness difference $b = 0.36$, 95% CI [−0.03, 0.76], $p = 0.079$. A lack of significant interactions suggests that the condition effects on healthiness perceptions did not vary meaningfully based on participants' perceived naturalness differences between the energy sources, supporting the robustness of our primary findings.

All in all, Study 1 provides preliminary support for the notion that using nuclear energy in the manufacturing process of appliances is associated with perceptions of less healthy food prepared with these appliances. However, because one of the central aims of Study 1 was to generate preliminary data for estimating the desired sample size in subsequent studies, these findings should be interpreted with appropriate caution due to the relatively small cell sizes (Albers and Lakens, 2018), although such cell sizes should be viewed together with our mixed design, with our repeated measures still implying a relatively well-powered study setup.

3. Study 2

In Study 2, we conducted a more rigorous test of our hypotheses in a high-powered, preregistered experiment. Additionally, Study 2 aimed to examine several theoretically relevant boundary conditions of our focal effect.

3.1. Method

3.1.1. Participants

Based on the sample size calculations detailed below and to account for a potential 20% attrition rate across two waves of data collection and three between-subjects conditions, we recruited 371 participants ($M_{age} = 43.4$, $SD = 13.7$, 60.4% women, 38.3% men, 1.3% preferred not to disclose their gender or identified differently) from the US via Prolific Academic for wave 1 (preregistered;

see https://aspredicted.org/vjh4-gycp.pdf). Data collection was approved by the Ethics Committee for Research at the SWPS University (approval number: 02/E/09/2024).

We used the following rationale to estimate the required sample size. Study 1 with 120 participants revealed an effect size of $d = 0.75$ when comparing the 'nuclear' condition to the 'wind' condition, calculated using the *effectsize* package for R (Ben-Shachar et al., 2020). To provide a more stringent test of our hypotheses, we also calculated the effect size when comparing the 'control' and 'wind' conditions to the 'nuclear' condition, which yielded an effect size of $d = 0.72$. Further, comparing the 'nuclear' condition to the 'control' condition resulted in an effect size of $d = 0.55$. Although effect sizes in preliminary and pilot studies with small samples are often inflated (Albers and Lakens, 2018), basing our sample size estimate on an effect size of $d = 0.50$ with 95% power should reasonably be a cautious approach, especially considering that the typical effect sizes in consumer research are equivalent to $d = 0.58$ when aggregated across all outcomes, and $d = 0.73$ when focusing specifically on consumers' judgment and decision-making (Eisend et al., 2024). Using the *pwr* package for R (Champely, 2020) and maintaining the cell size ratio from the pilot study, we determined that a study with this sample size achieves 95% power to detect effect sizes of $d = 0.45$ or larger. This assumption remains conservative, as Study 2 would use 10 measures per participant (compared to five in Study 1), and the power was calculated using linear rather than mixed models, which further increases power (Brown, 2021). Additionally, Study 2 would feature more balanced cell sizes than Study 1 (random assignment with larger samples typically yields more equal group sizes than smaller samples). Importantly, a total of 300 participants, assuming an unequal cell size ratio as large as 7:3, is sufficient to achieve 95% power to detect an effect size of $d = 0.45$ or larger with the conventional alpha level of 0.05.

3.1.2. Procedure

The procedure in Study 2 was similar to that of Study 1. Participants first read and accepted an informed consent form. Next, they were assigned to one of the three between-subjects conditions: the control condition ($n = 137$), where they evaluated the healthiness of food prepared using ten distinct kitchen appliances without information about the energy source used to manufacture each appliance; the 'nuclear' condition ($n = 113$) where they learned that these appliances were manufactured using nuclear energy; or the 'wind' condition ($n = 121$) where they learned that these appliances were manufactured using wind energy. They provided their food healthiness ratings using the scale described in Study 1.

After the food healthiness judgments, participants provided demographic information: their age, gender identity, subjective socioeconomic status using the MacArthur Scale of Subjective Social Status (Adler et al., 2000), social class identification (Dietze and Knowles, 2016), and annual income before tax.

Upon completing the study, participants were informed that wave 2 would take place three days later and that they would receive an invitation via Prolific to participate. The second wave of data collection was completed by 332 participants (89.5% of the wave 1 sample). However, we only matched 304 (81.9% of the wave 1 sample) of Prolific IDs across these two waves of data collection, which was our final sample for the preregistered analyses. In wave 2, participants evaluated the naturalness of nuclear and wind energy and completed several questionnaires in a randomized order for other research projects.

For the purpose of the current research, participants completed two measures. First, the Spiritual Contagion Scale (SCS) measuring beliefs in the transfer of metaphysical contaminants, such as abilities or moral characteristics (Kim et al., 2023). The 12-item scale (e.g., 'I would be excited to hold an object that has traveled to outer space.') includes three factors: negative, neutral, and positive contagion. Responses ranged from 1 (*Strongly disagree*) to 7 (*Strongly agree*). We averaged participants' responses to create negative, neutral, and positive SCS indexes, respectively.

Participants also completed the Connectedness to Nature Scale (CNS), which measures the degree to which people feel emotionally connected to the natural world (Mayer and Frantz, 2004). The 14-item instrument (e.g., 'I often feel part of the web of life.') uses a response scale ranging from 1 (*Strongly*

Table 1. *Means, standard deviations, and correlations across the variables in Study 2.*

Variable	α	*M*	*SD*	1	2	3	4	5	6
1. Healthiness Index	0.84	24.35	27.64						
2. Naturalness Nuclear	–	22.74	26.07	0.07					
3. Naturalness Wind	–	95.61	9.92	0.12*	−0.15**				
4. SCS Negative Index	0.73	4.54	1.55	0.05	0.04	0.02			
5. SCS Neutral Index	0.86	3.84	1.56	0.01	−0.02	−0.06	0.23**		
6. SCS Positive Index	0.85	4.96	1.51	0.09	−0.03	0.03	0.22**	0.33**	
7. CNS Index	0.77	3.51	0.54	0.09	−0.04	0.09	0.09	0.33**	0.24**

Note: M and SD are used to represent mean and standard deviation, respectively. The Healthiness Index is the outcome variable, averaged across measures. Naturalness Nuclear and Naturalness Wind represent participants' ratings of the naturalness of these two energy sources. SCS refers to the Spiritual Contagion Scale, whereas CNS denotes the Connectedness to Nature Scale. * indicates $p < 0.05$. ** indicates $p < 0.01$.

disagree) to 5 (*Strongly agree*). Again, responses to these items were averaged to create an index of CNS. See Table 1 for descriptive statistics and correlations between the variables (these results are based on all participants who completed wave 2).

3.2. Results

3.2.1. Analytic approach

We split our analyses into two parts. First, we began by testing the preregistered hypotheses (https://aspredicted.org/vjh4-gycp.pdf) that people perceive food prepared using appliances manufactured with nuclear energy (i.e., the 'nuclear condition') as less healthy than food prepared using appliances manufactured with wind energy (i.e., the 'wind condition'; H1). We expected the same pattern of results when comparing appliances manufactured with nuclear energy to the condition where participants were not informed about the energy source used to manufacture an appliance (i.e., the 'control condition'; H2).

In line with the preregistered analytic protocol, and considering that our data were nested—each participant evaluated ten different appliances, leading to autocorrelations across outcome measures—we used linear mixed models using the *lme4* and *lmerTest* packages in R (Bates et al., 2015; Kuznetsova et al., 2017). Random intercepts were incorporated for both participants and appliances in all analyses to account for within-participant and within-appliance category dependencies. Again, the experimental condition was dummy coded, with 'nuclear' being the reference category. The contrasts included a comparison between control versus nuclear conditions, and a second contrast comparing wind versus nuclear conditions.

3.2.2. Preregistered hypotheses tests

Relative to the condition where participants were informed that the energy source was wind ($M = 24.3$, $SD = 26.7$), their peers informed about nuclear ($M = 19.9$, $SD = 33.0$) as a source did not perceive the food prepared with these appliances as healthier, although the means were in the expected direction, $b = 4.28$, 95% CI [−3.54, 12.10], $p = 0.285$. Unlike the results from Study 1, these findings did not provide empirical support for H1. However, consistent with H2, and similar to the findings from Study 1, participants who were not informed about the energy source ($M = 28.0$, $SD = 23.0$) perceived food prepared with these appliances as significantly healthier than their peers who were informed that their assigned appliances were made with nuclear energy, $b = 8.07$, 95% CI [0.45, 15.70], $p = 0.039$. See Figure 3 for an overview of the distribution of responses.

3.2.3. Robustness tests

Using a similar procedure to Study 1, we assessed the robustness of our findings by testing whether participants' perceptions of naturalness differences between energy sources moderated the effect of

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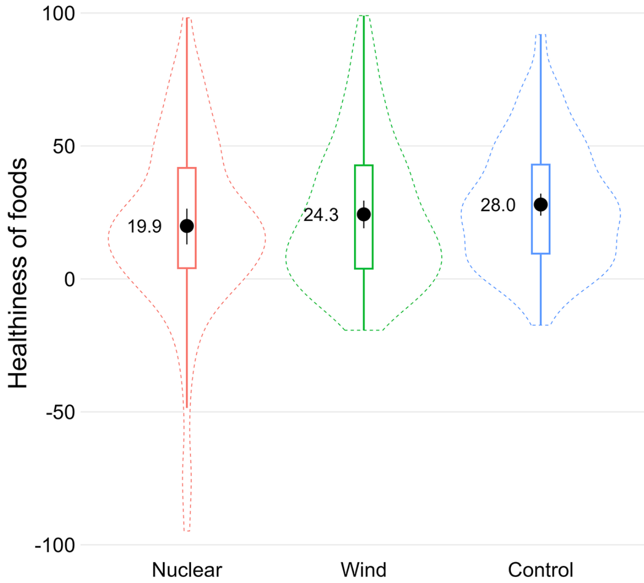

Figure 3. *Distribution of responses in Study 2.*
Note: The black dots in the boxplots represent the means, with their 95% bootstrapped CIs shown as black lines above and below. The numerical means, rounded to one decimal place, are displayed next to these dots. The boxplots depict the data range between the first and third quartiles, with whiskers extending up to 1.5 times the interquartile range.

energy source condition on healthiness ratings. Similar to Study 1, we centered the variable and applied simple contrast coding to the condition variable, so that the two dummy variables were mean-centered.

Results revealed a significant main effect for the first contrast: control versus nuclear, $b = 7.80$, 95% CI [0.15, 15.44], $p = 0.048$. The second contrast, i.e., wind versus nuclear, remained statistically non-significant, $b = 4.07$, 95% CI [−3.76, 11.91], $p = 0.312$. Additionally, there was no significant main effect of the naturalness difference score, $b = -0.02$, 95% CI [−0.14, 0.09], $p = 0.675$. Likewise, the interaction terms were not statistically significant: condition (control vs. nuclear) × naturalness difference, $b = 0.04$, 95% CI [−0.25, 0.33], $p = 0.774$, and condition (wind vs. nuclear) × naturalness difference, $b = 0.12$, 95% CI [−0.17, 0.41], $p = 0.408$. These non-significant interactions suggest that the condition effects on healthiness perceptions did not vary meaningfully based on participants' perceived naturalness differences between the energy sources, supporting the robustness of our primary findings.

In conclusion, Study 2 found that informing people about the use of nuclear energy in the manufacturing of kitchen appliances lowers their perceptions of the healthiness of food prepared with these appliances. This effect was evident when nuclear energy was compared to a condition where no information about the energy source was provided. Interestingly, despite the theoretical rationale for their inclusion, none of the proposed individual-level variables moderated this effect (for details, see the Supplemental analyses file available through this project's OSF folder).

4. Study 3

Although Studies 1 and 2 suggest that nuclear energy leads to lower ratings of the healthiness of the foods prepared using those appliances, compared to a control condition with no energy source information, some limitations remain. Study 1 had a small sample size for a three-cell between-subjects design, and neither study clearly described the final food products, which may have caused participants to focus on appliances rather than the food itself. Additionally, these studies did not examine whether

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the length of the contagion chain—from energy source to final food—moderates the effect, nor did they test any psychological mechanisms underlying the association between energy source information and healthiness ratings. Finally, the use of a control condition with no energy source information may have confounded the results.

To address these issues, Study 3 was a preregistered, high-powered (over 1,500 participants) experiment, which introduced several changes to the study design: participants were asked to focus on specific dishes, both short and long contagion chains were tested (energy used in manufacturing vs. at home), the control condition explicitly referred to electric energy, and perceived risk of the food was measured as a potential mediator. When considering nuclear energy—which is of particular interest in this article—past research demonstrates that the public generally perceives this energy source as risky, and that risk perception diminishes support for the construction of new nuclear power plants (e.g., Slovic, 1987; Slovic et al., 1991). This effect has been found to be particularly pronounced following nuclear disasters such as the Fukushima accident in 2011 (Huang et al., 2013). Although many factors shape food acceptance and preferences, perceived risk is one important determinant of food evaluations, especially in the health domain (Fife-Schaw and Rowe, 1996; Knox, 2000; Lusk and Coble, 2005). Therefore, we contend that the perceived risk of food prepared with these appliances is a plausible mediator of the effects reported above.

4.1. Method

4.1.1. Participants

Following the preregistration (https://aspredicted.org/mdkq-7p4v.pdf), we recruited 1,523 US participants via Prolific Academic. In line with the preregistered exclusion protocol, we removed eight participants who failed the attention check, resulting in a final sample of 1,515 participants (M_{age} = 46.0, SD = 15.9, 50.2% women, 49.1% men, 0.7% preferred not to disclose their gender or identified differently). Using Prolific's built-in feature, we ensured that the sample reflected US census data for gender identification, age, and political affiliation. Data collection was approved by the Ethics Committee for Research at the SWPS University (approval number: 02/E/09/2024).

The sample size was estimated as follows. We first prepared a simulated data file in R using data from Study 2, with the following assumptions: (1) the effect sizes for healthiness and riskiness in the 'proximal' condition are twice as large as those in the 'distant' condition; (2) perceived risk is highest for nuclear power and lowest for wind power; and (3) the correlation between perceived risk and healthiness is $r = -0.30$. We then performed an a priori Monte Carlo power simulation using this dataset and found that a sample of $N = 1,300$ participants would be sufficient to detect a moderated mediation index of 0.03, with a statistical power of 0.95 and the conventional alpha level of 0.05. To account for attrition due to failed attention checks (i.e., participants were asked to 'select number 4' on a sliding scale) and missing data, we planned to recruit 1,500 participants. The attention check was embedded within the main task.

4.1.2. Procedure

Upon providing informed consent, participants were randomly assigned to one of six experimental conditions in a 3 × 2 factorial design. The design crossed three energy types—electricity (control), nuclear, and wind—with two levels of contagion proximity: proximal (energy powering the appliance at home) and distant (energy used to manufacture the appliance). The six resulting combinations and their sample sizes were as follows: electricity–proximal (n = 250), electricity–distant (n = 257), nuclear–proximal (n = 255), nuclear–distant (n = 231), wind–proximal (n = 257), and wind–distant (n = 265).

In one block, participants rated the healthiness of food prepared using three appliances—microwave (mean healthiness = −5.0), air fryer (mean healthiness = 27.2), and slow cooker (mean healthiness = 43.1)—with these mean ratings taken from Study 2. Out of the ten appliances rated in Study 2, we selected these three because their healthiness ratings were close to the Study 2 average of 24.3, which

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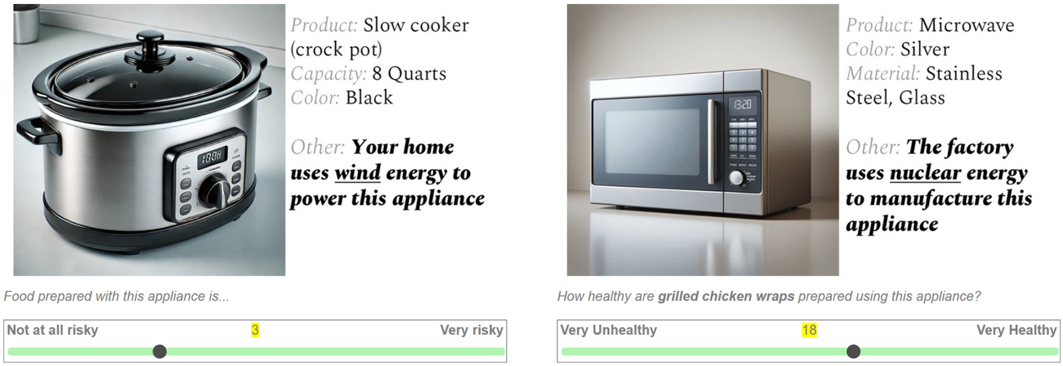

Figure 4. *Sample tasks in the two experimental conditions.*

helped minimize the risk of ceiling and floor effects, given that our response scale for healthiness evaluations ranged from −100 to 100. This selection also minimized participant burden, as our design included two separate blocks. We paired each appliance with a specific dish from Folwarczny et al. (2023), who reported healthiness ratings for 18 complex dishes. For each appliance, we selected a dish that was both appropriate for that appliance and close to the midpoint of the healthiness distribution in the dataset. For example, for the air fryer, participants responded to the question: “How healthy are steak medallions with roasted vegetables prepared using this appliance?” The response scale was the same as in Studies 1 and 2.

Next, participants provided risk evaluations, which served as the proposed mediator. Perceived risk was measured by asking participants for their level of agreement with the statement: “Food prepared using this appliance is risky.” Participants responded on an 11-point scale ranging from 0 *(Not at all risky)* to 10 *(Extremely risky)*. The order of the two rating blocks was counterbalanced across participants; that is, some participants completed the healthiness ratings first, while others completed the risk ratings first.

Finally, participants provided demographic information, including age and gender identity. Figure 4 displays sample appliances along with their descriptions under the wind × proximal and nuclear × distant contagion source conditions.

4.2. Results

4.2.1. Analytic approach

We performed two analyses using multilevel structural equation modeling in Mplus 8.10 with the Bayesian estimator and noninformative priors. We treated our data as nested and included random intercepts for participants. First, we fit a model with the manipulated source of energy (nuclear vs. wind vs. electric), its proximity to the food (distant—energy used in manufacturing—vs. proximal—energy used at home), and their interaction as predictors, with healthiness ratings of the food as the dependent variable (three repeated measures). We coded the nuclear condition as the reference category in the regression model, using the following contrasts: nuclear versus electric and nuclear versus wind, within a single model. Similar to Studies 1 and 2, we centered the variable and applied simple contrast coding to the condition variable, so that the two dummy variables were centered around mean. In our second model, we tested whether perceived food hazard (three repeated measures) mediated the effect of power source on dish healthiness, using a 2-1-1 mediation design (Preacher et al., 2010).

4.2.2. Preregistered hypotheses tests

Our first model fit the data well, as the 95% confidence interval (CI) for the difference between the observed and replicated values included zero, 95% CI [−10.76, 10.00], and the posterior predictive

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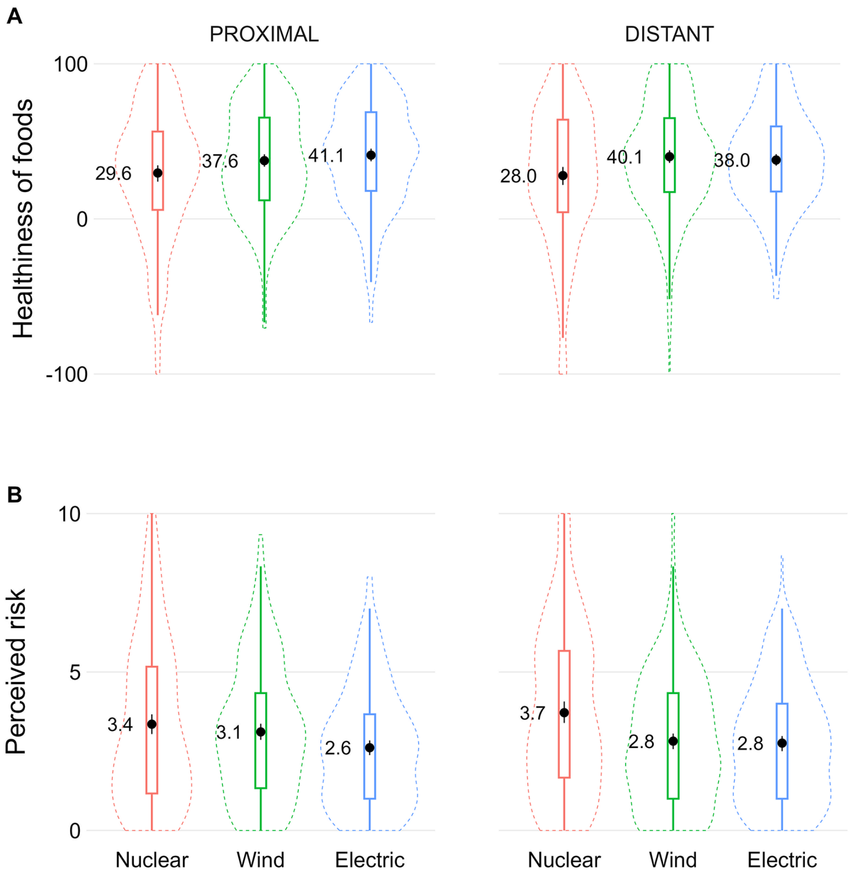

Figure 5. *Distribution of responses in Study 3.*
Note: Distribution of healthiness ratings (Panel A) and perceived risk ratings (Panel B) by contagion proximity. Ratings are shown separately for proximal (energy used at home) and distant (energy used during manufacturing) conditions. The black dots in the boxplots represent the means, with their 95% bootstrapped CIs shown as black lines above and below. The numerical means, rounded to one decimal place, are displayed next to these dots. The boxplots depict the data range between the first and third quartiles, with whiskers extending up to 1.5 times the interquartile range.

p-value was *ppp* = 0.500. The effect of wind energy versus nuclear energy was significant (H1), such that participants perceived food prepared with wind energy equipment as healthier than food prepared with nuclear energy equipment, $b = 6.53$, 95% CI [4.13, 10.46], $p < 0.001$. Similarly, participants rated food prepared with appliances associated with electric energy as significantly healthier than food prepared with appliances associated with nuclear energy (H2), $b = 7.32$, 95% CI [4.01, 10.14], $p < 0.001$. The main effect of distance on perceived healthiness of food was not significant, $b = 0.13$, 95% CI [−1.54, 2.22]. Contrary to our hypotheses (H3), we found no moderation by distance between the energy source and the food for the wind versus nuclear power × distance interaction, $b = -1.44$, 95% CI [−3.78, 1.41], and no moderation by distance for the electric versus nuclear power × distance interaction, $b = 0.53$, 95% CI [−1.79, 3.49]. Figure 5 depicts the distribution of responses in Study 3.

Our second model tested whether the effects of energy source on perceived healthiness of food were mediated by perceived risk (H4). This model also fit the data well, as the 95% CI for the difference between the observed and replicated values included zero, 95% CI [−12.72, 13.98], and the posterior predictive *p*-value was *ppp* = 0.500. At the within-participant level, dish healthiness was negatively associated with the perceived riskiness of food prepared with specific appliances, $b = -7.00$, 95% CI [−7.68, −6.06], $p < 0.001$. At the between-participant level, the total effect of wind versus nuclear energy on perceived food healthiness was significant, $b = 6.82$, 95% CI [3.45, 9.94], $p < 0.001$, as

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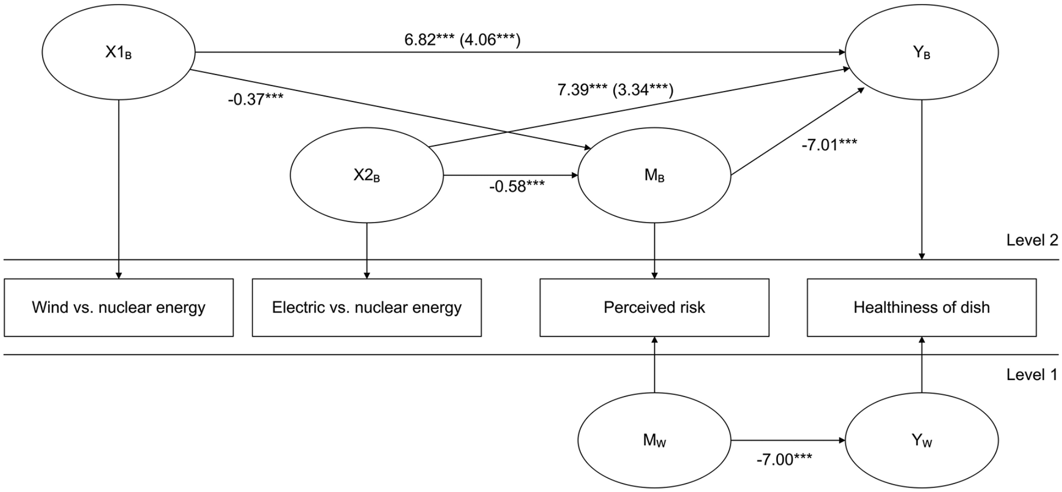

Figure 6. *The two-level mediation model in Study 3.*
Note: Level 2 predictors ($X1_B$: wind vs. nuclear energy; $X2_B$: electric vs. nuclear energy) as predicting perceived risk (M_B) and perceived healthiness of a dish (Y_B). Perceived risk mediates the effect of energy source on dish healthiness. At Level 1, perceived risk (M_W) negatively predicts dish healthiness (YW). Path coefficients are unstandardized; direct effects in parentheses. ***$p < 0.001$

was the total effect of electric versus nuclear energy, $b = 7.39$, 95% CI [4.56, 10.23], $p < 0.001$. The effect of wind versus nuclear energy on perceived riskiness was significant and negative, $b = -0.37$, 95% CI [−0.58, −0.18], $p < 0.001$, such that participants perceived food prepared with an appliance associated with wind energy as less risky than with an appliance associated with nuclear energy. The effect of electric versus nuclear energy on perceived riskiness was also significant and negative, $b = -0.58$, 95% CI [−0.76, −0.37], $p < 0.001$. The riskiness of food prepared with a specific appliance was negatively associated with the healthiness of the given dish, $b = -7.01$, 95% CI [−7.79, −5.81], $p < 0.001$. After controlling for the mediator, both direct effects remained significant: $b = 4.06$, 95% CI [1.37, 7.46], $p < 0.001$, for the effect of wind versus nuclear energy, and $b = 3.34$, 95% CI [0.61, 5.79], $p < 0.001$, for the effect of electric versus nuclear energy. Indirect effects of energy source on the healthiness of specific dishes via perceived risk were significant for both the wind versus nuclear energy comparison, $b = 2.66$, 95% CI [1.26, 4.31], $p < 0.001$, and the electric versus nuclear energy comparison, $b = 4.03$, 95% CI [3.52, 4.09], $p < 0.001$. Figure 6 shows the two-level mediation model.

In summary, we found that people perceive food prepared with equipment associated with nuclear energy—regardless of whether it is powered or manufactured with it—as less healthy than food prepared with equipment associated with wind energy or electricity. However, contrary to our expectations, this effect was not moderated by the proximity of the energy source to the food (i.e., home use or use during manufacturing). In other words, the negative effect of nuclear energy on the perceived healthiness of food is consistent regardless of whether the energy is used in manufacturing (farther away) or at home (closer). Finally, this effect was mediated by the perceived risk of preparing the food with a certain equipment, such that nuclear energy induces a higher perceived risk, which in turn reduces perceptions of dish healthiness.

5. General discussion

Does nuclear energy negatively impact food healthiness ratings? To address this question, the current research tested whether the energy source used to manufacture food preparation appliances affects the perceived healthiness of the final product. We compared the energy source perceived as the least natural—nuclear—with the most natural energy source (according to US participants), i.e., wind,

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as well as a control condition in which no information about the energy source was provided (or electricity, as in the case of Study 3). The findings consistently support the notion that nuclear energy, when compared to the control condition, negatively impacts food healthiness ratings, whether used during the manufacturing of kitchen appliances or when powering these appliances at home. Across all three studies, nuclear energy was associated with lower healthiness ratings compared to control conditions, with Study 3 demonstrating that this effect operates regardless of whether the energy source is used distally (during manufacturing) or proximally (at home). Similar findings emerged when comparing nuclear and wind energy conditions in Studies 1 and 3; however, in Study 2, these results were only directional. Study 3 further revealed an indirect effect via perceived risk: nuclear energy increases perceived risk of food prepared with associated appliances, which in turn reduces healthiness perceptions. There was also a similar positive link with participants' ratings of the naturalness of wind energy: those who considered wind energy as more (vs. less) natural rated food prepared with these appliances as healthier (vs. less healthy).

Whereas substantial research over the last few decades has explored how and when contagion beliefs affect decision making and perception, the studied contagion chains from source to recipient have typically been short, with just one medium between them (e.g., Abouab and Gomez, 2015; Huang et al., 2017; Rozin et al., 1994; Rozin, 2023; Scott and Rozin, 2020). Therefore, relatively little is known about what happens when the physical or psychological distance between source and recipients increases, and especially whether there is a specific number of links that dilutes the contagion effect to the point where it ceases to influence consumer judgment. The current work provides some answers to these questions. Specifically, the contagion chain in our case had several links: there was an energy source, such as a nuclear power plant or a wind turbine; this energy was then transferred to a factory where kitchen appliances were manufactured through the further transformation of this energy. Subsequently, the appliances containing the essence of the energy source were shipped and offered to consumers. Consumers then had to imagine preparing food with these appliances, meaning that something had to be transferred from an appliance to the final food item. At least in the context of nuclear energy, we found that such a long chain between source and recipient still has the potency to transfer the essence of nuclear energy, as evidenced by reduced healthiness ratings of food prepared with appliances manufactured with this energy source (when compared against appliances that were described without information about the energy source used in the manufacturing process, as is commonly the case in the marketplace).

However, although it was expected that wind energy, perceived as substantially more natural than nuclear energy, would transfer the essence of this naturalness, thus positively affecting healthiness ratings (Ditlevsen et al., 2019; Jiang and Lei, 2014; Rozin et al., 2004), this effect did not consistently emerge across studies. Although this result might seem surprising given that we observed the predicted pattern of healthiness inferences for the nuclear energy condition (when compared against the control condition), past research has extensively documented negativity bias in studies of contagion effects across different domains. In line with this bias, negative contagion is generally stronger and more persistent than positive contagion (Haselton and Nettle, 2006; Kelly et al., 2016; Nemeroff and Rozin, 1994; Rozin and Royzman, 2001; Rozin et al., 2010). Therefore, it is plausible that with respect to source—medium—recipient chains, the effects of negative contagion (i.e., unnatural nuclear energy) are more persistent than comparable effects of positive contagion (i.e., natural wind energy).

Relatively recent discussions of the contagion account raise questions about whether—and what form of—contact is needed for essence to be transferred from source to recipient, albeit the literature usually points to physical contact of some form as crucial (Fedotova and Rozin, 2018; Huang et al., 2017; Morales et al., 2018). Whereas the current findings do not provide direct evidence against physical contact as necessary for contagion effects to emerge, they broaden the operationalization of what contact is. For example, if a factory runs on nuclear power, then a microwave produced there is manufactured using this energy source. The essence of nuclear energy would then have to be transferred through the manufacturing process to the microwave. Subsequently, a microwave that reheats food

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would have to transfer this essence, somehow, into the food products. This abstract definition of (multiple) physical contacts between the source (nuclear energy) and the final reheated food item raises questions about what constitutes physical contact. Although it does not challenge the contact principle in contagion research, the definition of contact may need to be expanded according to our findings. It is impossible to 'touch' electricity, as electricity has neither mass nor volume. Yet, its effects can be experienced, suggesting that the operationalization of physical contact in contagion research should be broadened considerably.

Additionally, the presumed essence in this context was naturalness, or the lack thereof, as in the case of nuclear energy. Yet, in our study, this medium transferring an 'essence' of naturalness was sufficient to alter healthiness ratings. Although past research has found links between naturalness and healthiness perceptions (Ditlevsen et al., 2019; Hagen, 2021; Perkovic et al., 2022; Skubisz, 2017), such abstract and distant relationships—between energy source naturalness and food healthiness via the food preparation appliance manufacturing process and the food preparation itself—have been understudied. Thus, the current research sheds light on how naturalness and healthiness are intertwined in contagion research within food-related contexts.

Individual differences have been proposed to moderate sensitivity to magical contagion beliefs, albeit research in this area has been relatively scarce (Nemeroff and Rozin, 2000). We tested whether the SCS (Kim et al., 2023) or connectedness to nature (Mayer and Frantz, 2004) moderated the relationship between nuclear energy source and food healthiness ratings, but found no significant interactions (see OSF for supplemental analyses). These null findings may reflect insufficient power, as our sample size was determined for main effects only, not moderation analyses, which typically require larger samples (Shieh, 2009).

After nuclear accidents such as the Fukushima nuclear accident in 2011, public opinion toward nuclear energy shifted toward phasing out this energy source altogether. This trend is also evident in some industrialized countries such as Germany (Clean Energy Wire, 2023). The current findings point at the possibility that this trend stems, at least in part, from consumers' negative perceptions of nuclear energy as unnatural, often leading them to overestimate its environmental impact, particularly its emission of hazardous substances. Despite these misconceptions, nuclear power is a low-carbon energy source and, as such, could be considered relatively natural, as it causes less environmental harm than commonly assumed (Hill, 2008). Study 3 sheds light on the psychological mechanisms underlying perceptions of food prepared using appliances manufactured with, or powered by, nuclear energy relative to wind or electric energy. This final study found that perceived risk of the food prepared with each appliance mediated the relationship between energy source and food healthiness ratings. Specifically, nuclear energy was associated with a higher perceived risk that, in turn, reduced food healthiness evaluations. Importantly, however, this is not the only plausible mechanism that could drive changes in food evaluations. For example, previous literature has identified disgust and fear as predictors of consumer judgments (Eskine et al., 2011; Morales et al., 2012; Tal et al., 2022; Tal et al., 2017). Given that our study focused on nuclear energy—a politically charged topic—it is reasonable to expect that simply reading about this energy source may trigger such negative emotions, which could serve as alternative mechanisms to our proposed risk perception pathway. Yet, although evidence exists that supports contagion without physical contact, it appears that intention-based (vs. contact-based) contagion may not be strongly related to the emotion of disgust (Stavrova et al., 2016). This finding supports our proposed mechanism of perceived risk rather than disgust-based pathways. If our observed contagion effects operate through intention-based rather than contact-based mechanisms—given the abstract nature of energy transfer during manufacturing—then risk perception may represent a more theoretically viable indirect pathway than disgust. However, as Fiedler et al. (2018) show, testing only a single variable in our analysis of indirect effects leads to limitations in our ability to draw conclusions about the underlying mechanisms. Indeed, significant indirect effects can occur not only when a tested variable represents the true causal pathway, but also when it merely correlates with unmeasured processes or when completely different causal structures underlie the observed relationships. Without

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simultaneously testing alternative mechanisms such as disgust or fear alongside risk perception, we cannot determine whether our observed effects reflect risk perception as the primary pathway or whether risk perception serves as a proxy for other unmeasured emotional or cognitive processes.

The contagion beliefs observed in the current study—that nuclear energy used to manufacture food preparation appliances lowers food healthiness inferences among consumers—may negatively impact global efforts toward a sustainable energy future. This is because, if such an energy source is associated with a less healthy food landscape, consumers may be less interested in consuming specific food products or purchasing appliances due to the nuclear energy in manufacturers' or retailers' electricity supply. Research shows that people generally place great value on food healthiness when making food choices (Folwarczny et al., 2023; Hagen, 2021). Therefore, in an era of rapidly disseminating information, some retailers and manufacturers, especially those in the food industry, may become reluctant to rely on nuclear energy and may opt for alternative energy sources.

However, the perceived unnaturalness and related reluctance to try products could potentially be mitigated by informing consumers about the human factor involved in the supply chain (Abouab and Gomez, 2015; Hingston and Noseworthy, 2018). For instance, a plausible boundary condition for our effects could involve testing whether informing people that the kitchen appliances, despite relying on nuclear energy manufacturing processes, were human-made with minimal or no machine interventions. Potentially, such information may attenuate these negative perceptions.

Although in all our studies we included multiple appliances—and in Study 3, we referred to three distinct dishes when asking participants to make their judgments—participants always evaluated each product separately. Across studies, we found that foods prepared using appliances either manufactured with nuclear energy or powered by nuclear energy were consistently perceived as less healthy and more risky compared to those associated with wind energy or without a specified energy source. However, it is possible that these perceptions of lower healthiness and higher risk might be more or less pronounced in a joint evaluation context, where people directly compare multiple options side-by-side. Joint evaluation may highlight differences and change the salience of certain product attributes, potentially influencing perceptions. Indeed, prior research has shown that presenting products jointly can facilitate mental imagery of consumption, thereby altering product evaluations (Zhao and Xia, 2021). Future research should investigate whether and how the evaluation context modulates perceptions of products associated with different energy sources.

It is an intriguing possibility that merely making nuclear energy salient—without any direct link to the consumed food—might be sufficient to elicit similar effects. Whereas our design focused on contagion cues tied to the source of energy used in food preparation, we acknowledge that nuclear salience alone could activate broader risk-related associations or affective responses. Future research could explore this by introducing nuclear-related prompts (e.g., attitude questions or informational texts) prior to food evaluations, to test whether such priming alone can influence perceptions. This would help disentangle the specific role of contagion-based mechanisms from more general nuclear risk salience effects.

Data availability statement. All data, materials, and code used in this publication are publicly available through Open Science Framework (OSF; https://osf.io/tcygj/).

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Competing interests. The authors declare that they have no conflicts of interest to disclose.

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