Food Quality and Preference 91 (2021) 104189

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Seeking confirmation? Biased information search and deliberation in the food domain

David L. Dickinson [a,b,c], Naomi Kakoschke [d,e,1,*]

[a] Department of Economics and Center for Economic Research and Policy Analysis—Appalachian State University, Boone, NC, United States
[b] IZA (Institute of Labor Economics)—Bonn, Germany
[c] ESI (Economic Science Institute)—Chapman University, Orange, CA, United States
[d] Turner Institute for Brain and Mental Health and School of Psychological Sciences, Monash University, Melbourne, Victoria, Australia
[e] Commonwealth Scientific and Industrial Research Organisation, Health and Biosecurity, Adelaide, South Australia, Australia

ARTICLE INFO

Keywords:
Food choice
Dietary behaviour
Confirmation bias
Information search
Decision making
Cognitive dissonance

ABSTRACT

Individuals are often confronted with choosing between competing food attributes (e.g., healthiness vs. tastiness). To promote healthier food choices, is it important to understand what drives these choices. One potential driver of food choices is a confirmation bias, namely, a systematic bias in our approach to seeking information related to food attributes. This bias may generate avoidance of belief-disconfirming information and/or discounting of the value of belief-disconfirming arguments, both of which are documented in other domains (e.g., politics, religion). This study aimed to examine the confirmation bias in the food domain. We conducted an online study with a large sample (N = 427) stratified by sex and body mass index. Our sample, hypotheses, and analysis plan were pre-registered on the Open Science Framework. We measured pro-health and pro-taste food-related information aimed at directly testing the presence of the confirmation bias in the food domain. We also examined whether higher deliberation (indexed by higher amount of thought, lower sleepiness, and higher cognitive reflection) modulated this bias. Results showed that individuals avoided exposure to information that promoted the food attribute that they utilized less (i.e., healthiness or tastiness). Furthermore, arguments promoting less used food attributes were perceived as weaker, and this effect was enhanced for more alert individuals (i.e., less sleepy). To our knowledge, these findings provide the first evidence for a confirmation bias in the food domain and suggest that unlike other cognitive biases, higher deliberation may enhance this bias. Marketing could focus efforts on convincing consumers that healthy food is tasty, rather than convincing them to care more about health.

1. Introduction

Poor dietary choices can increase the risk of developing obesity and other related non-communicable diseases (e.g., heart disease, diabetes, cancer; Guh et al., 2009). Given the clear link between diet and health status, a better understanding of the drivers of dietary choices is crucial for facilitating healthier eating habits (Swinburn et al., 2013). It is widely acknowledged that optimizing healthy food choices can result from modifying food-related attitudes and values (Aikman, Crites, & Fabrigar, 2006; Contento, 2007; Prescott, Young, O'Neill, Yau, & Stevens, 2002; Worsley, 2002). Attitudes and values have been consistently examined as key drivers of health behavior. Attitudes, namely, an evaluative response (positive or negative), towards a particular object (e.g., person, place, event) are derived from affective, behavioral, and cognitive information (Ong, Frewer, & Chan, 2017a, 2017b). Values share conceptual overlap, including evaluative aspects, but reflect abstract core beliefs that operate as important ideals in life (Maio, Olson, Bernard, & Luke, 2006; Verplanken & Holland, 2002).

1.1. Food-related attitudes and values

Attitudes and values differ not only conceptually, but

* Corresponding author at: Turner Institute for Brain and Mental Health and School of Psychological Sciences, Monash University, Wellington Road, Clayton, Victoria, Australia.

E-mail addresses: naomi.kakoschke@monash.edu, naomi.kakoschke@csiro.au (N. Kakoschke).

[1] Present address: Commonwealth Scientific and Industrial Research Organisation – Health and Biosecurity, SAHMRI, North Terrace, Adelaide, South Australia 5000, Australia.

https://doi.org/10.1016/j.foodqual.2021.104189
Received 24 September 2020; Received in revised form 17 January 2021; Accepted 17 January 2021
Available online 23 January 2021
0950-3293/

methodologically. While attitudes are often rated on an evaluative dimension (e.g., favorable–unfavorable), values are typically assessed in terms of perceived importance (Verplanken & Holland, 2002). Although attitudes and values can be considered broad or domain-specific, here we focus on domain-specific attitudes and values related to food and beverages. In the current study, food-related attitudes refer to attitudes towards specific foods (e.g., bread, pumpkin) and broader dietary patterns (e.g., vegetarianism, gluten-free diet), while food-related values infer "a stable set of beliefs about the relative importance of meta-attributes, consequences, and 'end states' associated with food purchase and consumption" (Lusk, 2011). Furthermore, it has been proposed that food-related values influence attitudes, which in turn influence food consumption behaviour (Hauser, Nussbeck, & Jonas, 2013). For example, it may be that a person who values health has a positive attitude toward fresh foods, and as a result, consumes fruits and vegetables as part of their diet. Given the importance of values in driving both attitudes and behaviors (Hauser et al., 2013; Jastran, Bisogni, Sobal, Blake, & Devine, 2009; Sobal & Bisogni, 2009), food-related values are the focus of the current study.

There are many possible values that may influence consumers' food choices, including quality, cost, taste and health (Steptoe, Pollard, & Wardle, 1995). Research has shown that, when faced with choosing what to eat, consumers are often conflicted between competing values such as price versus quality, or taste versus health considerations (Connors, Bisogni, Sobal, & Devine, 2001; Hauser, Jonas, & Riemann, 2011; Shepherd, 1999). Indeed, the opposing values of taste (short-term pleasure) and health (long-term, goal-related) are considered two of the most influential drivers of dietary choice (Grunert & Wills, 2007; Januszewska, Pieniak, & Verbeke, 2011; Kourouniotis et al., 2016; Li, Streletskaya, & Gómez, 2019; Markovina et al., 2015; Prescott et al., 2002). Thus, consumers may be confronted with deciding between what they hedonically desire to eat and adhering to nutrition guidelines (Schlinkert, Gillebaart, Benjamins, Poelman, & De Ridder, 2020). Importantly, consumers with differing food values have been shown to display different choice patterns regarding products that they typically consider healthy or tasty (Aggarwal, Monsivais, Cook, & Drewnowski, 2014; Hearty, McCarthy, Kearney, & Gibney, 2007; Kowalkowska et al., 2018; Nguyen, Girgis, & Robinson, 2015; Pelletier, Laska, Neumark-Sztainer, & Story, 2013; Roininen & Tuorila, 1999; Scheibehenne, Miesler, & Todd, 2007; Zandstra, De Graaf, & Van Staveren, 2001). Healthiness and tastiness values are also encoded differently in terms of neural representations (Londeree & Wagner, 2020), suggesting that such values play a critical role in determining dietary choice.

Individual differences including demographic factors can also influence food-related attitudes and values. For example, research has shown that older adults are more likely to make food choices based on health considerations than younger adults, who have been shown to prioritize the tastiness of food (Chambers, Lobb, Butler, & Traill, 2008; Renner, Sproesser, Strohbach, & Schupp, 2012; Steptoe et al., 1995). In terms of sex differences, women have been shown to place greater value on the health attributes of food relative to men (Mialon, Clark, Leppard, & Cox, 2002; Steptoe et al., 1995; Wardle et al., 2004; Westcombe & Wardle, 1997). Regarding weight status, individuals with a lower body mass index ([BMI] < 25 kg/m^2) have reported placing stronger importance on health than overweight or obese individuals (BMI > 25 kg/m^2; Renner et al., 2012). Thus, the relative importance of these different food-related values appears to vary across individuals.

Whilst numerous theories have been proposed to explain food choice behaviour, there is not a commonly accepted theoretical framework given the number of food-related attitudes and values as well as the modulating factors such as demographic variables. Nevertheless, it is important to examine the core mechanisms underlying consumer food choice. One approach to explaining the complexity of food choice behaviour is by examining the drivers of attitudes and values. A theory that has commonly been used to examine the utility of attitudes and related attitude change in other domains is cognitive dissonance theory (Festinger, 1957). Cognitive dissonance is proposed to exert influence on food choice behaviour via a type of cognitive bias known as a confirmation bias, which is explained below in Section 1.2. Understanding how confirmation bias and cognitive dissonance influence food-related attitudes may help to guide the development of marketing efforts aimed at exerting beneficial effects on dietary choices.

1.2. Confirmation bias

Confirmation bias refers to a desire to shield oneself from arguments or information that are dissonant with our beliefs, and can be assumed to influence information searching in many domains (Hart et al., 2009; Lord, Ross, & Lepper, 1979; Tsang, 2019). Moreover, cognitive dissonance theory (Festinger, 1957) contributes to our understanding of the confirmation bias, because one way to relieve cognitive dissonance is to avoid exposure to the information that is not aligned with our own beliefs (see also: Cotton, 1985; Frey, 1986; Frimer, Skitka, & Motyl, 2017). If information avoidance is not altogether possible, another strategy to reduce cognitive dissonance is to discount the value of the disconfirmatory information (Golman, Hagmann, & Loewenstein, 2017). The confirmation bias has been previously documented in decision making, perhaps most notably in the political choice arena (Allcott & Gentzkow, 2017; Bail et al., 2018; Bakshy, Messing, & Adamic, 2015; Dickinson, 2020b; Knobloch-Westerwick, Mothes, & Polavin, 2020; Taber & Lodge, 2006; Tsang, 2019). Recent research has shown that this bias may result from how the brain encodes confirmatory information with anticipation (Kobayashi & Hsu, 2019), or as a reward to approach (Charpentier, Bromberg-Martin, & Sharot, 2018). The task design we use is patterned after Taber and Lodge (2006), where one component of the decision task involves selective information exposure by allowing one to choose the source of the information one reviews on an issue. A second component of the task elicits viewpoints on both consonant and dissonant arguments regarding the issue at hand as a way to evaluate how one's ideology may affect perceptions of information one is required to review.

In the food domain, cognitive dissonance has been proposed to elicit two opposing patterns of responses. One such pattern involves ignoring opposing information and instead seeking out information that supports existing food-related ideas (i.e., confirmation bias). Alternatively, individuals may confront important contradictory (i.e., health-related) information, as a result, change their pre-existing food-related ideas to resolve the dissonance. The latter response may be more likely to occur among those individuals who lacked a strong initial stance on the issue.

To date, there has been a paucity of research on cognitive dissonance in the food domain. Most studies in this area have tended to *ex poste* attribute their findings to the confirmation bias or cognitive dissonance theory rather than pre-planning (*ex ante*) to test the central tenants of the theory (Ong et al., 2017a). Notably, the basic cognitive dissonance process involves two key stages: dissonance arousal and dissonance resolution, while only the latter has been typically studied. Some studies examined dissonance arousal via a belief disconfirmation paradigm whereby individuals are exposed to information inconsistent with their beliefs (Harmon-Jones & Harmon-Jones, 2007; Ong et al., 2017b). For example, Knobloch-Westerwick, Johnson, and Westerwick (2013) examined whether selective exposure to online health messages could help to self-regulate health behaviour. Participants were asked to browse and read through four online health messages each with an opposing and supporting stance from high and low credible sources on the topics of organic food, coffee, fruits and vegetables, and exercise. They found that individuals who actively engaged in specific health behaviors spent less time reading messages opposing those behaviors regardless of credibility. The findings indicate the existence of a confirmation bias in the health domain more broadly, but it is not clear to what extent other factors modulate the strength of the confirmation bias.

1.3. The role of deliberation in confirmation bias

Unlike other biases that are thought to result from more automatic decision-making processes (Toplak, West, & Stanovich, 2011), the confirmation bias may grow stronger through deliberation. In some cases, the utility generated from new information may override a confirmation bias, but others have found that increased cognitive reflection and thought promotes a stronger confirmation bias (Dickinson, 2020b; Knobloch-Westerwick & Kleinman, 2012). Theoretically, deliberation refers to systematic and reasoned thought patterns that are internally consistent and self-reinforcing (Jones & Sugden, 2001). For example, research has shown that the anticipation of cognitive dissonance or regret from rejecting one's status quo beliefs may drive the confirmation bias (Frimer et al., 2017; Nicolle, Fleming, Bach, Driver, & Dolan, 2011). Such findings point to a more deliberation-driven phenomenon that may be at work with the confirmation bias.

In general, we consider that deliberation or thoughtfulness regarding a topic or issue may be captured in various ways, which informs our choice to preregister multiple proxy variables for deliberation. Specifically, we test the deliberation hypothesis using the following proxy variables: the self-reported amount of thought one states to have put into the issue of dietary choice; one's self-reported state-level sleepiness (i.e., *less* sleepy means more alert and proxies for more available cognitive resources at hand); one's score on a validated measure of cognitive reflection that assess tendencies to cognitively reflect versus give quick responses in decision making. A variety of measures for related, but potentially distinct, ways to conceptualize deliberation is one approach to examine the generality of the deliberation hypothesis regarding the confirmation bias. Each of these proxy measures for deliberation has been used previously in related work (Dickinson, 2020a, 2020b, Knobloch-Westerwick & Kleinman, 2012).

1.4. The current study

We aimed to test the existence of the confirmation bias in the food domain using a novel food-themed information task based on the design of Taber and Lodge (2006), as noted in Section 1.2. We preregistered the task, hypotheses, sample size, and statistical analyses plan on the Open Science Framework.[2] The broad research question was whether a relative preference for health or taste attributes of food makes an individual more likely to avoid exposure to information that promotes the other attribute (taste or health, respectively). Given that avoidance of information incongruent with one's preference or dietary ideology is not always possible, a related question was whether this type of confirmation bias in information choice leads one to discount the quality of arguments that promote the less preferred food attribute. For example, in the food domain, it may be that a "taste" preference leads one to consider any argument that promotes the healthiness of food as weaker than any argument that promotes the importance of tasty food. In addition, we aimed to examine demographic determinants of dietary preference for healthiness over taste, as well as the link between dietary preference and favorability ratings of food items. Specifically, we preregistered the following hypotheses:

H1: Women (vs men), individuals with healthy BMI (vs obese) and older adults (vs younger) would indicate a higher relative preference for healthiness over tastiness of food choices.

H2: Individuals preferring health attributes of food more than taste would display higher favorability ratings toward food items and dietary patterns generally considered to be related to healthier living.

H3: Confirmation bias in food choice exists, and this confirmation bias would manifest both via information exposure choices, as well as in the perceived strength of arguments made surrounding the taste or healthiness of food.

H4: Higher deliberation would enhance the size of the confirmation bias. Higher deliberation was proxied by the following distinct measures: higher self-reported thought put into the issue of dietary choice; lower self-reported state-sleepiness levels; higher scores on a Cognitive Reflection Task.[3]

2. Methods

2.1. Procedure

The food-themed confirmation bias task was part of a survey we developed in Qualtrics survey software, which we administered via the Prolific platform (www.prolific.co; Palan & Schitter, 2018). Upon posting the study on Prolific, participants who met the filter criteria filled the study on a first come-first serve basis. There were at least 3,000 eligible participants (from among the total of over 100,000 participants on the platform) matching each of our characteristic-pair filters who had been active on the Prolific platform in the previous three months. Other than age, we did not elicit additional demographics of our participants besides those used in our participant custom sample screening (i.e., sex, BMI category, self-report of no dietary restrictions). The Prolific platform publishes demographic data on their overall participant pool on their website at https://www.prolific.co/demographics/ . Though this is not as specific to our sample as one may like—we balanced our desire for participant characteristic information with the need to keep the survey relatively short to induce participation—we can at least identify what are sample may contain. Specifically, Prolific participants are, on average, either in the U.S.A. or the U.K., in the 20–40 years old age range, full-time or part-time employed, likely some post-high school education, and largely non-minority (i.e., White/Caucasian represent about 70% of the Prolific participant pool).

Participants were paid for completing the survey at a rate that was at or above the fair-pay standard (USD $6.50/hour) required by Prolific of researchers using their platform. The advertised compensation was for "a 15-minute survey on dietary choice preferences". Subjects were also informed they would respond to other demographic questions and complete a simple task assessing cognitive style, namely, a 6-item Cognitive Reflection Task (Primi, Morsanyi, Chiesi, Donati, & Hamilton, 2016) that we preregistered as one measure of deliberation. Our study was approved by the human subject review board at Appalachian State University, North Carolina, for full compliance with commitments to ethically conduct research.[4]

2.2. Participants

Our total sample was N = 427 with equal sizes in each group (n = 107, 107, 105, and 108 for healthy-BMI males, healthy-BMI females, obese-BMI males, and obese-BMI females, respectively). *Ex ante* power

[2] See: Dickinson, D. L., & Kakoschke, N. (2020, February 24). Confirmation Bias in Food Choice. Retrieved from osf.io/ze48b (original).Dickinson, D. L., & Kakoschke, N. (2020, April 23). Confirmation Bias in Food Choice. Retrieved from osf.io/cmv7r (correction) (see supporting document for April 23 correction at osf.io/puja5)

[3] Our original preregistration document (osf.io/ze48b) inadvertently misstated H4 to indicate a hypothesized effect of deliberation *reducing* the confirmation bias, which was the opposite of the intended hypothesis that deliberation will *enhance* the confirmation bias. We therefore issued a follow-up registration of our study. (osf.io/cmv7r) and uploaded several pieces of time-stamped evidence to osf.io/puja5 that document our intended H4.

[4] Information on the study was provided in the Prolific details of the study, which participants would read prior to their decision to participate. Then, the first page of the study survey was a Consent statement such that each participant had to actively provide Consent prior to moving past that page. The research was performed in accordance with the Declaration of Helsinki. The study was approved by the Institutional Review Board at Appalachian State University (ethics approval #20–0287).

analysis was conducted prior to data collection to evaluate and plan the total sample size necessary to have sufficient statistical power to identify small main effects of a single predictor in our data. Using G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009), we concluded that a total sample size of n = 395 could identify small main effects (Cohen, 2013) using effect size measure, $f^2 = 0.02$, on a single regression coefficient in a multivariate model with power = 0.80, alpha = 0.05 level. Here, we considered a main effect to be the test of a single regression coefficient in a multivariate linear model with four total co-variates (allowing for age, sex, and BMI-group controls in the model in addition to the key independent variable *Rel. Care Health* for evaluation of H3). Such a sample size also approximately represents the power to test H1 in a multivariate model, which would have only three regressors to control for the key demographic categories). Power is reduced for the H4 test, given this involves the examination of an interaction term to test a moderation effect. Alternative, with the planned sample size, we considered that H4 is sufficiently powered (power = 0.80) only to identify medium or larger effect sizes in the data. Some of these power calculations can be considered somewhat conservative given our preregistered plan to assess directional hypotheses using the appropriate 1-tailed test.[5] We did not exclude participants based on age, and our sample had a mean age of 31.84 years (*SD* = 10.84, range = 18–72).[6]

Participants were recruited via the Prolific platform to allow for recruitment of niche samples using custom filter options, which we used to administer the survey in four studies to recruit roughly equal samples (we preregistered target samples of n = 100) on each of the four combinations of sex (male, female) and BMI (kg/m^2) group (healthy BMI [20–24.9 kg/m^2], and obese BMI [>30 kg/m^2]). We also used the custom filters to recruit only participants who indicated no dietary restrictions. Based on these custom filters, the study was only made available to participants who met our inclusion criteria for that filter (e.g., females with healthy BMI, males with obese BMI). Given that BMI or dietary restriction at the time of our study may be different from what the participant input into their participant profile upon registration with Prolific, the first questions of our survey double-checked the screening filters and would only allow those matching our criteria to continue.

2.3. Measures

All measures are described here, and the more complete details on the survey are in the Supplementary Materials. In addition to the key independent measures of dietary preference, the proxy measures of deliberation elicited, and the constructed outcome measures used to assess the confirmation bias task, we also elicited information on a participant's ideological position regarding dietary matters, one's favorability ratings on dietary relevant items, and basic measures of attitude strength regarding dietary choice. Regarding ideological positions, we used a 1–5 Likert scale to elicit measures on how much one enjoys learning about dietary health, how closely one pays attention to information regarding food and drink, and how health conscious one considers oneself. The strength of one's dietary ideology, as well as how much one cares about healthiness and tastiness in making food and beverage choices, were elicited using 0–100 scales. Favorability or "thermometer" ratings elicitation used a 0–100 scale to rate one's favorability on several items and dietary groups (0="Not favorable/cold feelings (I don't care much for this item or dietary group", 100="Favorable/warm feeling towards this item or dietary group."). Specifically, we assessed a participant's favorability ratings on: carbohydrates, vegetarians, meat eaters, sodas, sweet coffee drinks, salty snacks, desserts, and gluten free (by choice) diets. Attitude strength measures used a 0–100 scale to measure how much the participant personally cares about the issue of dietary choice, the strength and certainty of one's feelings on the issue of dietary choice, and the amount of thought put into the issue of dietary choice (0 = lowest, 100 = highest).

2.3.1. Individual and relative dietary attribute preference (i.e., "values"). As noted in the previous section, dietary attribute preference for healthiness and taste in making dietary choices, *Health Matters* and *Taste Matters*, were each rated on separate 0–100 scales (0 = I don't care at all about taste/healthiness, 100 = I care as much as possible about taste/healthiness). Separately, an individual's *relative* preference for health or taste attributes of food was captured to measure food-related values in response to the following question: "Please indicate whether you care relatively more about taste or healthiness of the food and drink you consume when making your food and beverage choices." Responses were on a [1–9] scale from 1 = "I care most about TASTE" to 9 = "I care most about Healthiness", which we then rescaled to be in the [-4 , +4] interval with the midpoint 0 = "I care equally about taste and healthiness." We defined this variable, *Rel. Care Health,* as a key independent variable to measure one's relative preference for healthiness in dietary choice. The use of a "relative" score may reduce response bias whereby individuals might rate both motivations equally and instead, determine how these two motivations relate to one another (Clarke & Best, 2019).

2.3.2. Confirmation bias. Two key components of the survey allowed for tests of the confirmation bias in information exposure and perceived argument strength (see: Taber & Lodge, 2006). The 'information board task' required individuals to select 10 information clips with each clip either promoting a "taste matters most" or "health matters most" message in describing dietary choice (see Supplementary Materials for the full library of information clips). For example, the first page of this task asked the participant whether he/she wished to view a "Taste Matters Most" or a "Health Matters Most" information clip. After the participant's selection was made, the brief information clip was displayed. The participant then proceeded to the next page where asked whether he/she wanted to see the next information clip from the "Taste Matters Most" or "Health Matters Most" information clip set. This continued for a total of 10 information clips, and we used the constructed [0,10] measure of *#Taste Matters Most* information clips as the dependent variable for analysis of H3 with respect to information exposure.

The dependent variable used to assess perceived argument strength was constructed from a set of responses to six arguments that each participant was *required* to view and rate for strength or weakness of the argument on a 9-point scale. Three arguments promoted the taste attributes of food and three arguments promoted the healthiness attributes of food; thus, each individual saw a mix of arguments both more and less aligned with a personal dietary choice ideology. The bullet options were unnumbered but ranged from "incredibly weak argument" to "incredibly strong argument"; these were recorded as responses ranging from −4 to + 4 respectively. We preregistered our plan to combine the 6 response items and reverse score the responses on healthiness-promotion arguments such that the final metric ranged from −24 to + 24 to represent one's overall view of the *Pro-Taste* arguments (i.e., higher/positive values indicated higher overall perceived strength of the *Pro-Taste* arguments, while lower/negative values indicated higher

[5] In this case (1-tailed test of hypotheses), the power to identify the same small-sized main effect with α=0.05, 4 predictors, and a total sample size of n=395 is calculated with G*Power to be closer to 0.88.

[6] Our pre-registration plan indicated our survey would include a poison pill question as an attention check. This was inadvertently omitted from the survey. A similar sized study (n=402) was run by one of the authors (Dickinson, 2020) on the same Prolific platform and included a *longer* confirmation task assessment in the domains of politics and religion. In this case, he found less than 2% of the respondents failed the attention check question in this similar (and longer) survey, and so the potential issue of inattentive respondents in the present paper is likely minimal. Furthermore, for the present paper, we proactively rejected the surveys of 2.8% of the respondents on the Prolific platform due to the fact that their completion times that were too fast to be consistent with attentiveness throughout the whole survey. As such, we have reason to belief the oversight of an attention check *within* the survey itself should not be a concern regarding the quality of our data.

overall perceived strength of the *Pro-Health* arguments). The Supplementary Materials contains the full details of the arguments used to construct this metric, as well as the full library of information clips used to create the *#Taste Matters Most* variable.

2.3.3. Deliberation. We preregistered our plan to examine three distinct measures of deliberation put into the decision task. First, as a type of domain-specific deliberation, we elicited the amount of thought the individual considers having put into the topic of dietary choice. Specifically, participants were asked "People have told us they have thought a lot about some issues and haven't thought at all about some other issues. How would you rate the amount of thinking you have done about the issue of dietary choice?" Responses were given on a scale of [0, 100] for this measure, *Thought Much*. A second proxy for deliberation was based on the idea of cognitive resource availability at the time of the survey, which was captured by one's self-reported sleepiness using the Karolinska 9-point scale (Akerstedt & Gillberg, 1990). Here, the working hypothesis is that sleepier individuals (i.e., less alert) have fewer available cognitive resources at that moment and are therefore engaged in generally less deliberative decision making. We called this variable *Ksleepy*. Finally, we elicited a measure of one's cognitive reflection tendencies or thinking style (more impulsive versus more reflective) using the 6-point cognitive reflection task (CRT) in Primi et al. (2016). A series of 6 questions of the following type are asked: "Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class?" (see Supplementary Materials). Here, there is an intuitive, but wrong response (30 students) that must be suppressed to arrive at the correct response (in this case, 29 students). From the set of these 6 CRT questions, we sum the total correct score and use $CRT \in [0, 6]$ as the third measure of deliberation for our analysis.

In addition to these preregistered measures, as an exploratory variable we considered '*Age*' as another potential proxy for deliberation. Middle-aged and older individuals can be assumed, in general, to have put more thought into many decision areas given the simple fact of their longer life experience compared to a younger individual (Ong et al., 2017b; Visser & Krosnick, 1998). This is clearly not always the case; however, because dietary choice is a regular decision made by almost every adult, we assume that older individuals have likely put more thought into the issue of dietary choice. A distinction between younger and older individuals present in our sample will therefore make a useful *exploratory* analysis of yet another proxy for deliberation in the food domain.

2.4. Statistical analysis

All hypotheses (H1-H4) as well as the analytical approach were specified prior to data collection in our preregistration plan.[7] Any data-driven exploratory analysis we conducted are clearly identified below and discussed appropriately. Tests of each preregistered hypothesis were conducted as follows: Hypothesis 1 was tested using nonparametric Mann-Whitney tests[8] and multivariate linear regressions, while Hypothesis 2 was tested with a series of simple (binary) and multivariate (demographic controls age, sex, BMI category) linear regressions to examine the impact of the *Rel. Care Health* measure on favorability ratings for the dietary item/group measures. To examine Hypothesis 3 we estimated simple (binary) and multivariate (demographic controls) linear regressions for the two potential dimensions of confirmation bias, namely, information exposure (*# pro-Taste* info clips viewed) and perceived argument strength (*Relative Strength of Pro-Taste arguments)*. Our preregistered hypothesis was that deliberation would make the confirmation bias worse, and we preregistered three proxy variables for deliberation noted in the previous section: *Thought Much, Ksleepy*, and *CRT*. The test of Hypothesis 4 used regression estimations similar to the multivariate (with demographic controls) specifications used to test Hypothesis 3, but with the addition of three main effect variables for the deliberation proxies, and corresponding interactions between each deliberation proxy and *Rel. Care Health*. Our statistical analyses focused on our preregistered hypotheses, but with additional consideration given to exploratory findings in areas that may stimulate future research.

3. Results

3.1. Sample characteristics

We first present summary information regarding the sample characteristics in Tables 1-3. In each case, the data are presented across two panels. Panel A shows the summary statistics for the data separated by sex and BMI group (pooling across the other dimension), while Panel B shows the data by sex-BMI combination as generated via our custom sample restrictions. Table 1 focuses on the participants' positions regarding food knowledge, dietary position, and matters of dietary choice. Table 2 shows summary information for the favorability ratings food related items and dietary preference groups. Table 3 presents the summary statistics for the attitude strength measures we elicited.

3.2. H1: Demographics and preference for healthy vs. Tasty food

Using a multivariate regression approach allows us to control simultaneously for the level of each main factor while testing H1 (complete results for the H1 tests are shown in Supplementary Material Table S4-S5).[9] In general, average ratings of the importance on individual attributes of *Health Matters* and *Taste Matters* revealed average ratings over 50 (on [0,100] scale) for each attribute by each tested subgroup (see Table 1). As such, it is clear that these values are not mutually exclusive in making dietary choices. However, the variable *Rel. Care Health* focused the individual on identifying if one food attribute value was more important than the other. Table 4 presents the multivariate estimation results that test H1. Specifications that examined the impact of sex, BMI category, and age on separate dietary ideology measures for taste and healthiness (and their difference) are shown in the first three columns, and the model testing H1 with the pre-registered independent measure *Rel. Care Health* is found in the far-right column. The Table 4 results show evidence that healthy-BMI (*Obese* $= 1$; $p < .01$) and relatively *Older* individuals reported caring significantly more about healthiness over taste in dietary choice ($p = .01$), respectively for the 1-tail test on the preregistered hypotheses.

[7] Though we are not specific as to the exact multivariate model specifications to be used, what we mean in stating that our analysis plan was preregistered is that we noted our plans regarding multivariate (conditional) model estimations based on pre-registered variable constructs, as well as the planned significance levels to be used to evaluate our results.

[8] Our choice of the Mann-Whitney test was intended to initially examine central tendencies of relative taste versus healthiness preference differences across demographic group without making any distributional assumptions upon the data.

[9] Mann Whitney test of medians were first used to perform an unconditional test of H1 (see Table S1), though the preferred multivariate results are presented here in the main text. Results show support for H1 only with respect to BMI—individuals with obesity indicated a lower relative preference for *healthiness* over *taste* in dietary choice ($p = .005$) than those with a healthy BMI. A separate test on the individual attributes ratings reveals that this is driven mostly by lower *Health Matters*, as opposed to higher *Taste Matters*, ratings of Obese BMI individuals. The Mann-Whitney test results fail to reject the null hypothesis of equal *Relative Care Health* ratings for males and females ($p >.10$). In addition, the difference in *Relative Care Health* ratings between older younger individuals was non-significant ($p = .079$).

Table 1
Dietary Information and ideological positions.

Panel A: *Summary Outcomes by sex and BMI category*

Dietary Variables	Female (pooled on BMI) [n = 215] Mean (SD)	Male (pooled on BMI) [n = 212] Mean (SD)	Healthy BMI (pooled on sex) [n = 214] Mean (SD)	Obese BMI(pooled on sex) [n = 213] Mean (SD)
Enjoy Diet Info [1,5]	3.29 (1.09)	3.39 (1.04)	3.59 (1.01)	3.09 (1.07)
Attend Info Diet [1,5]	3.03 (0.86)	2.92 (0.97)	2.97 (0.92)	2.97 (0.91)
Health Conscious [1,5]	3.18 (0.88)	3.11 (1.00)	3.36 (0.90)	2.92 (0.93)
Diet Ideol Strength [0,100]	51.76 (21.30)	48.78 (22.94)	55.62 (21.28)	44.92 (21.76)
Health Matters [0,100]	63.57 (19.64)	58.89 (20.08)	65.46 (18.98)	57.02 (20.09)
Taste Matters [0,100]	84.82 (14.13)	79.91 (13.43)	81.34 (15.40)	83.43 (12.35)
Rel. Care Health [-4,+4]	−0.81 (1.71)	−0.73 (1.78)	−0.58 (1.71)	−0.96 (1.77)

Panel B: *Summary Outcomes by sex-BMI combinations (custom sample cells)*

Dietary Variables	Female- Healthy BMI [n=107] Mean (SD)	Male-Healthy BMI [n=107] Mean (SD)	Female-Obese BMI [n=108] Mean (SD)	Male-Obese BMI [n=105] Mean (SD)
Enjoy Diet Info [1,5]	3.87 (0.84)	3.31 (1.09)	2.71 (1.01)	3.48 (0.99)
Attend Info Diet [1,5]	3.07 (0.85)	2.88 (0.99)	2.99 (0.87)	2.95 (0.95)
Health Conscious [1,5]	3.42 (0.82)	3.31 (0.98)	2.94 (0.87)	2.90 (0.99)
Diet Ideol strength [0,100]	58.52 (18.88)	52.72 (23.17)	45.06 (21.53)	44.76 (22.10)
Health Matters [0,100]	69.07 (17.04)	61.84 (20.18)	58.92 (20.58)	55.89 (19.61)
Taste Matters [0,100]	83.72 (16.14)	78.96 (14.31)	85.92 (11.77)	80.87 (12.46)
Rel Care Health [-4,+4]	−0.52 (1.56)	−0.64 (1.85)	−1.10 (1.82)	−0.82 (1.71)

Note: Values of *Relative Care about Health* less than zero indicate a relative higher preference for tastiness of food over healthiness of food (*Rel. Care Health* = 0 indicates caring equally about each attribute).

Table 2
Ratings of food related items.

Panel A: *Summary Outcomes by sex and BMI category*

Variable	Female (pooled on BMI) [n = 215] Mean (SD)	Male (pooled on BMI) [n = 212] Mean (SD)	Healthy BMI (pooled on sex) [n = 214] Mean (SD)	Obese BMI(pooled on sex) [n = 213] Mean (SD)
Carbohydrates	66.77 (21.51)	59.31 (20.41)	64.96 (18.89)	61.16 (23.32)
Vegetarians	57.10 (25.69)	46.43 (26.14)	54.51 (25.90)	49.08 (26.73)
Meat Eaters	65.43 (20.70)	72.35 (20.03)	68.04 (20.62)	69.69 (20.68)
Sodas	38.77 (29.90)	44.78 (27.09)	36.39 (27.24)	47.14 (29.11)
Sweet Coffee	31.12 (30.07)	36.60 (29.08)	30.90 (29.14)	35.78 (30.17)
Salty Snacks	61.50 (22.64)	56.87 (24.92)	56.22 (25.13)	62.20 (22.22)
Desserts	67.23 (23.96)	57.24 (26.10)	59.80 (25.91)	64.76 (24.92)
Gluten free (by choice) diets	25.48 (24.52)	27.68 (23.29)	26.76 (24.70)	26.38 (23.15)

Panel B: *Summary Outcomes by sex-BMI combinations (custom sample cells)*

Variable	Female- Healthy BMI [n=107] Mean (SD)	Male-Healthy BMI [n=107] Mean (SD)	Female-Obese BMI [n=108] Mean (SD)	Male-Obese BMI [n=105] Mean (SD)
Carbohydrates	66.19 (19.73)	63.73 (18.02)	67.34 (23.22)	54. 81 (21.77)
Vegetarians	62.36 (23.34)	46.67 (26.07)	51.89 (26.93)	46.19 (26.33)
Meat Eaters	62.81 (20.98)	73.27 (18.94)	68.03 (20.18)	71.41 (21.14)
Sodas	32.66 (27.30)	40.12 (26.78)	44.82 (31.23)	49.52 (26.69)
Sweet Coffee	27.78 (28.69)	34.03 (29.38)	32.44 (31.34)	39.22 (28.67)
Salty Snacks	59.00 (23.98)	53.44 (26.05)	63.98 (21.06)	60.37 (23.32)
Desserts	64.78 (24.00)	54.82 (26.88)	69.67 (23.78)	59.70 (25.17)
Gluten free (by choice) diets	25.46 (25.36)	28.06 (24.07)	25.50 (23.76)	27.30 (22.58)

Note: Favorability ratings for each item given on a [0 , 100] scale (0 = unfavorable/cold feelings, 100 = favorable/warm feelings)

3.3. H2: Preference for healthy vs. Tasty food and favorability ratings

Simple and multivariate regression results testing the impact of *Rel. Care Health* on favorability ratings are presented in Table 5. Fig. 1 shows a summary of the key coefficient estimates, which presents the coefficient plots from each dependent variable modeled both in the binary and multivariate regression specification. The results show that higher values of *Rel. Care Health* predict significantly more favorable ratings of "Gluten free (by choice) diets" and "Vegetarians", but significantly lower favorability ratings on all other items. The results are robust to the inclusion of demographic controls except in the case of favorability ratings of "Sweet Coffee Drinks", where the marginally significant findings of lower favorability ratings on Sweet Coffee Drinks given by those with higher values of *Rel. Care Health* become statistically non-significant. Thus, we report robust support for H2 with respect to the dietary items for which we elicited the ratings.[10]

[10] We did not itemize or pre-test which of our dietary items should be considered more related to healthiness versus taste. While we generally consider our data supportive of H2, one may consider these results more descriptive in nature.

Table 3
Attitude Strength measures.

Panel A: *Summary Outcomes by sex and BMI category*

Variable	Female (pooled on BMI) [n = 215] Mean (SD)	Male (pooled on BMI) [n = 212] Mean (SD)	Healthy BMI (pooled on sex) [n = 214] Mean (SD)	Obese BMI(pooled on sex) [n = 213] Mean (SD)
Personal care about issue of dietary choice	67.39 (18.18)	59.03 (22.00)	63.09 (21.46)	63.38 (19.69)
Strength of feelings on dietary choice	64.83 (18.86)	57.83 (19.77)	60.51 (20.36)	62.20 (18.84)
Certainty about feelings on dietary choice	63.70 (21.67)	65.16 (20.16)	65.23 (20.81)	63.62 (21.06)
How much thought on issue of dietary choice	66.09 (23.55)	59.13 (23.37)	60.18 (23.81)	65.10 (23.37)

Panel B: *Summary Outcomes by sex-BMI combinations (custom sample cells)*

Variable	Female- Healthy BMI [n=107] Mean (SD)	Male-Healthy BMI [n=107] Mean (SD)	Female-Obese BMI [n=108] Mean (SD)	Male-Obese BMI [n=105] Mean (SD)
Personal care about issue of dietary choice	67.90 (18.79)	58.29 (22.93)	66.88 (17.63)	59.78 (21.09)
Strength of feelings on dietary choice	63.93 (19.14)	57.09 (21.05)	65.73 (18.63)	58.57 (18.44)
Certainty about feelings on dietary choice	65.78 (21.91)	64.68 (19.74)	61.65 (21.34)	65.65 (20.67)
How much thought on issue of dietary choice	65.52 (21.89)	54.83 (24.54)	66.66 (25.17)	63.50 (21.35)

Note: Attitude strength measures for each item were given on a [0 , 100] scale (0 = lowest rating, 100 = highest rating)

Table 4
Hypothesis 1 tests—Multivariate regressions.

IndependentVariable	(1) Dependent Variable: ***Health Matters*** Coeffecient (SE)	(2) Dependent Variable: ***Taste Matters*** Coeffecient (SE)	(3) Dependent Variable: ***(Health – Taste) Matters*** Coeffecient (SE)	(4) Dependent Variable: ***Rel. Health Matters*** Coeffecient (SE)
constant	61.898 (1.707)**	78.657 (1.216)**	−16.758 (2.119)**	−0.657 (0.153)**
Female (=1)	3.957 (1.905)*	4.750 (1.357)**	-0.793 (2.364)	−0.154 (0.172)
Obese-BMI (=1)	−9.754 (1.959)**	1.801 (1.396)	−11.554 (2.432)**	−0.499 (0.176)**
Older (=1)	4.395 (1.992)*	0.861 (1.419)	3.534 (2.473)	0.417 (0.178)**
R-squared	0.0696	0.0372	0.0507	0.0249

Notes: N = 427 observations for each regression. *$p < .05$, ** $p < .01$ for the 1-tailed test of the preregistered directional hypotheses in column (4) model (otherwise, 2-tailed tests). *Older* is defined in this variable as equal to 1 for all individuals 30 years of age and older.

3.4. H3: Confirmation bias in food choice

Table 6 shows the estimation results for both simple and multivariate analyses. The statistically significant negative coefficients on *Rel. Care Health* across models for both the selective information exposure tests (models 1 and 2) and the perceived argument strength tests (models 3 and 4) offer strong support for H3. For example, in model (2) the magnitude of the negative coefficient estimate implies that an individual who is 4-units higher on the 9-point scale (indicating a relatively higher preference for healthiness over tastiness in food choice) predicts approximately one fewer (-0.247 * 4 ≈ 1) "taste matters most" clip viewed out of the 10 total information clips. Given the average number of "taste matters most" clips viewed was 4.75 (out of 10), the estimated magnitude represents a>20% predicted reduction in the number of "taste matters most" info clips viewed that would result from such a difference in *Rel. Care Health*. The range of values in our sample regarding *Rel. Care Health* are such that a 4-unit difference on the *Rel. Care Health* measure is comparable to moving from just below the median to approximately the 90th percentile of values on our *Rel. Care Health* measure.

Regarding the confirmation bias effect on *Relative Argument Strength*, the negative coefficient in model (4) of Table 6, for example, implies that this same increase of 4-units on the *Rel. Care Health* scale predicts an approximately 2-unit reduction (-0.519 * 4 ≈ 2) in perceived strength of the pro-Taste arguments. The average value of *Relative Argument Strength* across the sample within the [-24, +24] scale ranged from −18 to + 8, with average value of −5.60 (i.e., most viewed the set of 6 argument as being relatively *weaker* regarding the pro-Taste arguments and *stronger* regarding the pro-Health arguments, overall). Thus, a 2-unit predicted reduction is slightly smaller than a 10% decrease in the observed level of the dependent variable.

3.5. H4: Confirmation bias and deliberation

Finally, hypothesis 4 (H4) focuses on whether the confirmation bias is reduced with additional deliberation, as assumed of many biases, or whether it is enhanced by deliberation. Table 7 uses the binary + controls specifications estimated in Table 6, and then adds each distinct preregistered deliberation proxy variable. The result is a series of estimations that include the main effect variables (deliberation proxy, *Rel. Health Care*) and the interaction (deliberation proxy × *Rel. Care Health)*. Across all models, the only support we find for H4 is in model (5) of Table 7, whereby more alert respondents (i.e., *lower* values of *Ksleepy*) were estimated to show a significantly stronger main effect of a negative *Rel. Care Health* on perceived argument strength. Put differently, the model (5) estimates in Table 7 imply that a relatively sleepy individual does not display a confirmation bias in argument strength, but a more alert individual does. Fig. 2 displays the forecast of those model (5) results in Table 7. Here, we graph the impact of *Rel. Care Health* for a relatively alert (Ksleepy = 3) compared to a relatively sleepy (Ksleepy = 7) individual as predicted by the estimated (significant) coefficients in the model. The H4 support is found in the significantly different slopes of the forecast lines for perceived argument strength ($p < .027$). Based on the estimates in model (5) of Table 7, *only* the more alert individuals displayed a downward trend that relates *Rel. Care Health* to lower values of the perceived (pro-taste) argument strength.

3.6. Exploratory analyses

Exploratory tests of demographic differences in *Health Matters* and *Taste Matters* are shown in the Supplementary Materials Table S1 and models (1) and (2) of Table 4. Results revealed that females had higher ratings than males for *Health* and *Taste*, and participants with a BMI in the healthy range had higher ratings than those with a BMI in the Obese

Table 5
Estimates of Rel. Care Health effect on favorability ratings (see also Fig. 1 coefficient plots).

	Model by Dependent Variable (ratings all on [0 , 100] scale)							
	Simple Regression Results Coefficients (standard errors)							
Variable	**Gluten –Free (by choice)**	**Vegetarians**	**Meat Eaters**	**Carbs**	**Salty Snacks**	**Desserts**	**Sodas**	**Sweet Coffee**
constant	27.93 (1.26)**	54.21 (1.37)**	67.35 (1.08)**	61.37 (1.11)**	56.67 (1.23)**	59.35 (1.31)**	38.21 (1.46)**	32.11 (1.57)**
Rel. Care Health	1.76 (0.66)**	3.11 (0.72)**	−1.96 (0.56)**	−2.19 (0.58)**	−3.28 (0.64)**	−3.79 (0.68)**	−4.44 (0.77)**	−1.59 (0.82)*
R-squared	0.0165	0.0423	0.0276	0.0323	0.0576	0.0672	0.0733	0.0087
	Multivariate Regression Results Coefficients (standard errors)							
Variable	**Gluten –Free (by choice)**	**Vegetarians**	**Meat Eaters**	**Carbs**	**Salty Snacks**	**Desserts**	**Sodas**	**Sweet Coffee**
constant	33.92 (3.76)**	50.84 (4.00)**	70.87 (3.19)**	60.54 (3.26)**	47.51 (3.64)**	57.30 (3.82)**	46.65 (4.26)**	49.10 (4.57)**
Rel. Care Health	1.94 (0.67)**	3.05 (0.72)**	−1.96 (0.57)**	−2.26 (0.58)**	−3.28 (0.65)**	−3.45 (0.68)**	−3.85 (0.76)**	−0.91 (0.82)
Age	−0.18 (0.11)	−0.001 (0.12)	−0.02 (0.10)	−0.02 (0.10)	0.17 (0.11)	−0.16 (0.12)	−0.34 (0.13)**	−0.57 (0.14)**
Female (=1)	−1.55 (2.32)	10.95 (2.47)**	−7.04 (1.97)**	7.36 (2.01)**	3.87 (2.25)	10.11 (2.36)**	−5.48 (2.63)*	−5.07 (2.82)
Obese (=1)	1.63 (2.45)	−4.35 (2.61)	1.07 (2.08)	−4.56 (2.13)*	3.55 (2.38)	4.67 (2.50)*	11.67 (2.78)**	8.44 (2.99)**
R-squared	0.0244	0.0918	0.0576	0.0738	0.0810	0.1120	0.1258	0.0635

Note: *$p < .05$, ** $p < .01$ for the 1-tailed test of the preregistered directional hypothesis on *Rel Care Health* (otherwise, for the 2-tailed test). N = 427 for each regression.

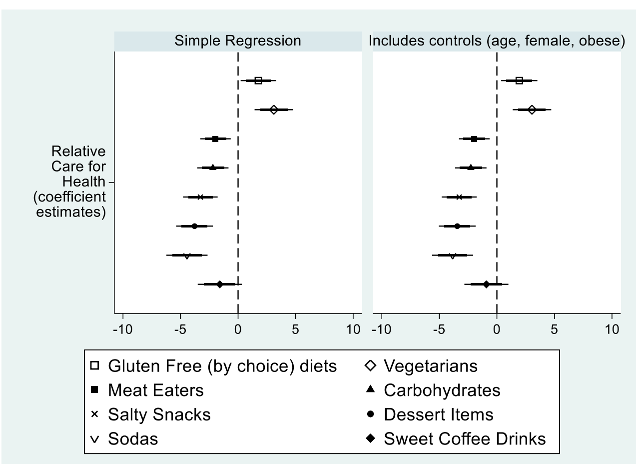

Fig. 1. Effect of caring relatively more about health on favorability ratings. Note: The x-axis displays the coefficient estimate of the effect of Rel. Care Health on the favorability rating of each item. Left-panel estimates are from a simple binary regression, while the coefficient estimates in the right-panel are from multivariate regressions that included controls for age, sex, and BMI category (see Table 5 for full results). Confidence intervals for the pre-registered 1-tailed test are shown as the 99% (thinner line) and 95% (thicker line) bars around each coefficient point estimate. A greater relative preference for healthiness over tastiness attributes for food leads to significantly higher favorability ratings for "Gluten Free (by choice) diets" and "Vegetarians", but significantly lower favorability ratings for everything else.

range for how much *Healthiness* matters in dietary choice. These two separate measures allow one to score relative preference for health over taste in dietary choice by looking at the difference between the two measures. As individuals generally reported high (>50) ratings for *both* these attributes, it is clear that both values regarding food attributes were important in our sample. We considered such separate measures exploratory relative to the alternative direct measure (*Rel. Care Health*), which forced the participant to make the direct relative value comparison. For this reason, we noted above our decision to preregistered only the *direct* measure of relative attribute preferences, *Rel. Care Health*, to test H1. An analysis of these measures may nonetheless provide further insights regarding our data.

Our data also allow for exploratory analysis that may shed additional light on key findings beyond what we envisioned at the time we preregistered our design, hypotheses, and analysis plans. We further explored H4 by examining the impact of *Thought Much* on the confirmation bias, *conditional* on self-reported higher ideological strength with respect to dietary choice. To conduct this exploratory analysis, we replicated models (1) and (4) from Table 7 with the subset of participants who self-reported an ideological strength regarding dietary issue of>50 (on the 0–100) scale. This left us with a subsample of n = 196 relatively high ideological strength individuals for analysis. In this instance, we estimated a significant impact of *Thought Much* on information exposure in this subsample, but not on perceived argument strength (model 4). Our results showed that those who had a strong dietary choice ideology *and* had *Thought Much* on the issue (≥67 on the [0, 100] scale) displayed a stronger confirmation bias on information exposure ($p = .01$). Alternatively, those having not thought much on the issue were willing to sample additional information clips on opposing

Table 6
Confirmation Bias tests (on selective information exposure and perceived argument strength).

Variable	***# Taste Matters Most* Info clips viewed (out of 10)** (1) Coefficient (SE)	(2) Coefficient (SE)	***Relative Argument Strength* in favor of pro-*Taste* [∈ −24 , +24]** (3) Coefficient (SE)	(4) Coefficient (SE)
Constant	4.563 (0.094)**	4.665 (0.282)**	−6.059 (0.303)**	−6.435 (0.894)**
Rel. Care Health ∈ [−4 , +4]	−0.247 (0.049)**	−0.241 (0.050)**	−0.597 (0.159)**	−0.519 (0.160)**
Age	–	−0.003 (0.009)	–	−0.341 (0.552)
Female (=1)	–	−0.174 (0.174)	–	−0.341 (0.552)
Obese (=1)	–	0.157 (0.184)	–	2.198 (0.584)**
R-squared	0.056	0.060	0.032	0.066

Note: * $p < .05$, ** $p < .01$ for the 2-tailed tests (1-tailed test of significance highlighted as specified in pre−registration plan of the study for *Relative Care Health* effects). N = 427 observations.

Table 7
Deliberation Impact tests (on selective information exposure & perceived argument strength).

	***# Taste Matters Most* Info clips viewed (out of 10)**			***Relative Argument Strength* in favor of pro−*Taste* ∈ [−24 , +24]**		
Variable	(1) Coefficient (SE)	(2) Coefficient (SE)	(3) Coefficient (SE)	(4) Coefficient (SE)	(5) Coefficient (SE)	(6) Coefficient (SE)
Constant	5.333 (0.372)**	4.393 (0.356)**	4.666 (0.350)**	4.702 (1.184)**	−7.932 (1.122)**	−5.745 (1.112)**
Age	−0.0003 (0.009)	−−0.002 (0.009)	−0.001 (0.009)	−0.012 (0.028)	−0.010 (0.027)	−0.014 (0.027)
Female (=1)	−0.107 (0.175)	−0.175 (0.174)	−0.208 (0.180)	−0.103 (0.555)	−0.345 (0.549)	−0.526 (0.574)
Obese (=1)	0.193 (0.186)	0.132 (0.185)	0.114 (0.187)	2.396 (0.590)**	2.061 (0.584)**	2.095 (0.592)**
Rel Care Health∈ [−4 , +4]	−0.122 (0.139)	−0.340 (0.118)**	−0.378 (0.101**	−0.522 (0.442)	−1.273 (0.373)**	−0.573 (0.322)
Thought Much about Dietary Choice∈ [0,100]	−0.012 (0.004)**	–	–	−0.032 (0.014)*	–	–
K-Sleepy∈ [1 , 9]	–	0.064 (0.051)	–	–	0.350 (0.161)*	–
CRT∈ [0 , 6]	–	–	−0.001 (0.051)	–	–	−0.169 (0.161)
Thought Much * *Rel Care Health*	**−0.001 (0.002)**	–	–	**0.002 (0.006)**	–	–
Ksleepy *_Rel Care Health_	–	**0.024 (0.027)**	–	–	**0.188 (0.084)***	–
CRT *_Rel Care Health_	–	–	**0.038 (0.025)**	–	–	**0.010 (0.079)**
R-squared	0.078	0.064	0.066	0.083	0.081	0.069

Note: * $p < .05$, ** $p < .01$ for the 2-tailed tests (1-tailed test significance highlighted as specified in pre-registration plan of the study for *Rel. Care Health* scale, and their interaction with deliberation measures). N = 427.

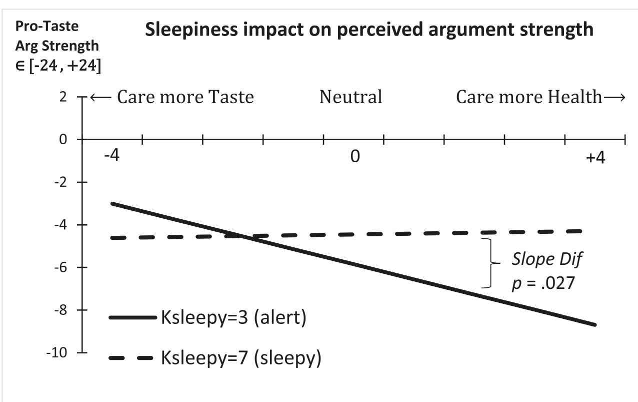

Fig. 2. Estimated impact of alertness (sleepiness) on confirmation bias in perceived argument strength (Table 7, model (5)).

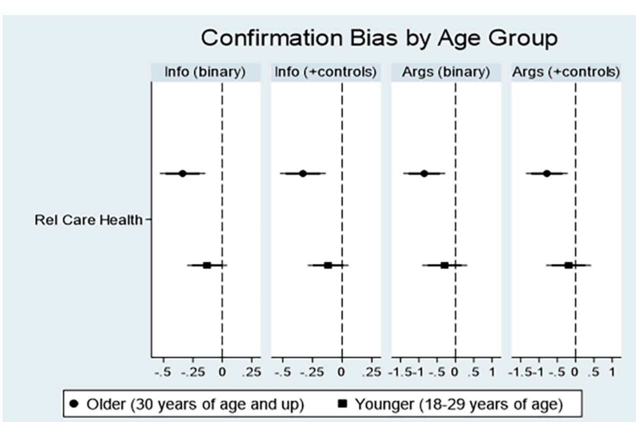

Fig. 3. Confirmation bias by age (exploratory analysis) for Information Exposure and Perceived Argument Strength. Samples size is n = 216 (Older) and n = 211 (Younger) participants. See Supplementary Materials, Table S2, for full results. Negative coefficient estimates indicate a confirmation bias. Confidence intervals for the 2-tailed test are shown as the 99% (thinner line) and 95% (thicker line) bars around each coefficient point estimate. Note: In all panels, the measure of "confirmation bias" is statistically significant in the older adults (no significant confirmation bias estimated in the subset of younger adults). Two panels on left show this in models of selective information exposure, while models on right show this regarding perceived argument strength.

beliefs (see Supplementary Materials, Figure S1).

Next, we extended the confirmation bias analysis in Table 6 to the subsamples of those 18–29 years of age (*Older* = 0, n = 211) versus those 30 + years (*Older* = 1, n = 216). It may be that a relatively older individual has put more cumulative thought into the issue of dietary choice (among many other issues). As such, age is another potential proxy for thought or "deliberation" put into the issue of dietary choice. Fig. 3 highlights the results from a series of regressions similar to the Table 6 estimations, but separated by subsample *Older* = 1 and *Older* = 0 (i.e., Younger). Table S2 (Supplementary Materials) contains full details of these estimation results, but they reveal that participants aged over 30 had significant confirmation bias effect estimated for both information exposure and perceived argument strength, while the estimated effect was generally non-significant for younger adults. Thus, with age (and presumably additional deliberation on the issue of dietary choice) the confirmation bias in dietary choice becomes stronger and more precisely estimated in our data.

Finally, we examined whether choice of information clip content influenced one's Dietary Position measure. This test is possible because we elicited one's position on dietary choice both before and after the key confirmation bias tasks, and so we created a *Change in Dietary Position* variable from their difference (positive values indicate a position change towards the *Pro-Taste* direction). We ran a simple binary linear regression of the *Change in Dietary Position* measure on the number of *Pro-Taste Arguments* viewed, with results shown in Supplementary Materials Fig S2). For the full sample, the estimated coefficient on *Pro-Taste Args* was positive, but non-significant. This result remained similar when we ran a more compete specification to include demographic controls for age, sex and BMI category. However, when conducting this exploratory analysis separately for the subsample of participants with high ideological strength (n = 196), we estimated a positive and statistically significant coefficient on this key variable ($p = .01$), and this result is robust to the inclusion of demographic controls ($p = .016$). The impact of information clips viewed on *Change in Dietary Position* is non-significant for the low dietary choice ideology subsample (n = 231). Also, in none of the models did any of the demographic control have significant explanatory power.

4. Discussion

To the best of our knowledge, this paper is the first to conduct a (pre-registered) direct test of two distinct dimensions of a confirmation bias in the food domain. Specifically, participants who indicated a higher relative preference for healthiness over tastiness in dietary choices were *less* likely to view taste-promoting information clips compared to health-promoting information clips. Additionally, we reported robust evidence that a higher relative preference for healthiness leads one to consider taste-promoting arguments as weaker than health-promoting arguments. Thus, the strong support found for our H3 was along *both* confirmation bias dimensions we examined. This finding is important given that there is a large volume of dietary choice messages and information presented to consumers and, given natural ideological differences in dietary choice preferences, the environment is ripe for the presentation of an ideology-reinforcing approach to process such information.

Another contribution of our study was to investigate whether deliberation facilitated the confirmation bias. Whilst deliberation is thought to help overcome other decision biases resulting result from short-cuts or lack of attentiveness, we expected that deliberation would enhance the confirmation bias. We therefore preregistered multiple proxy measures for deliberation that would allow us to test this hypothesized mechanism using different constructs. We did not make any claims as to which proxy for deliberation would capture the H4 effect regarding deliberation and the confirmation bias, or whether they all would. Our preregistered analysis plan was that we hypothesized this particular effect and we would test for it using each of our proxy measures. We found support regarding one of the preregistered deliberation measures, *sleepiness*, that was consistent with our H4. Some other recent studies have examined the ability of sleep state (either self-reported sleepiness or experimentally manipulated sleep levels) to predict the confirmation bias in the direction of our H4 (Dickinson, 2020a, 2020b), with varied findings. As such, it is important to build the literature regarding the validity, or lack thereof, of sleep state as a proxy for deliberation in important decision domains.

These results were complemented by some related exploratory findings: (1) the confirmation bias (along both dimensions) was only significant among older participants who have likely put more cumulative thought into the issue of dietary choice, and (2) more thought on the specific issue of dietary choice was connected to a stronger confirmation bias in information exposure among those with a stronger dietary choice ideology. Thus, we conclude some support for H4, but we did not find robust support across all measures of deliberation.

Another interesting exploratory result worthy of further attention is the possibility that those with strong ideology regarding dietary choice may be open to modest changes in their viewpoints if exposed to dissonant arguments. Of course, this speculation must be viewed with caution because being subject to viewing additional opposing-view arguments is not the same as voluntarily choosing to expose oneself to such arguments. This disposition itself may be a signal of the individual's willingness to be persuaded.

4.1. Strengths, limitations and future directions

Our study was a theoretically driven investigation with *a priori* hypotheses regarding the existence of the confirmation bias in the food domain. Moreover, we addressed the two key components of cognitive dissonance, namely, selection information exposure and perceived argument strength. Our sample was filtered by sex and BMI such that we could examine individuals' responses in a large representative sample roughly balanced on those dimensions.

The study was subject to several limitations. First, although we recruited participants across the BMI spectrum, we relied on self-reported height and weight due to the online nature of the study. Such measures have been shown to be subject to under- and over-reporting, respectively, which can result in a misrepresentation of BMI and obesity prevalence (Flegal et al., 2019; Gorber, Tremblay, Moher, & Gorber, 2007). However, other studies have shown strong associations between self-reported and objective height and weight measurements (Breland, Joyce, Frayne, & Phibbs, 2020; Hodge, Shah, McCullough, Gapstur, & Patel, 2020; Tang, Aggarwal, Moudon, & Drewnowski, 2016). Second, while we stratified our sample for sex, we did not stratify for age, which resulted in a sample that was biased toward younger participants. Age is an important factor in predicting food choice motives (Chambers et al., 2008) and attitude strength (Visser & Krosnick, 1998) with group differences observed between younger, middle-aged and older adults. Thus, future research should aim to recruit a sample representative of the lifespan to examine age-related differences in the food-domain confirmation bias. Because our recruitment strategy did not filter on age categories, the data did not contain sufficient numbers for a more traditional examination of older adults—within our sample there were less than 10% of participants aged over 50 years. Nevertheless, our exploratory finding of a significant confirmation bias *only* in older participants is intriguing and merits further investigation.

It would also have been desirable to know details of other demographic characteristics of our participants. As noted in section 2.1 above, additional information on the Prolific participant pool is at least somewhat helpful, and the age distribution of the Prolific pool is reflected in the average age of our participants, which was 31.83 ($\pm$10.84) years of age. However, it is unclear to what extent we can extend this to claim that our sample also mirrors the typical Prolific demographics on education level, nationality, minority status, or employment status. To the extent that any of these demographic dimensions correlate with sex or BMI category, they will be represented differentially in our data set. Future related research should seek to more comprehensively collect and analyze demographics to better understand the role these may play in our findings.

In addition, we examined only two key drivers of food choice in the context of confirmation bias: taste and health. We did not examine other important predictors of food choice of which there are many, including frequently studied motives (i.e., price) and those less often considered (e.g., sustainability, ethical concerns; Steptoe et al., 1995). Future researchers could extend our approach to examine other food attributes as well.

In the context of healthy food choices, these results highlight that individuals' ideology about the tastiness versus healthiness of food exerts a powerful influence by selectively filtering information and biasing our exposure to messaging regarding what we should or should not eat. Both ways in which the confirmation bias may manifest represent an opportunity to better understand how marketing may either reinforce or help to alleviate this bias with respect to dietary choice. For example, it is a common perception that unhealthy food is tasty, while healthy food is less tasty (Raghunathan, Naylor, & Hoyer, 2006). However, it may be possible to change perceived relations between health and taste attributes of foods through product marketing (Jo & Lusk, 2018). It may therefore be helpful to present consumers with food options that are less likely to pose a conflict between healthiness and tastiness attributes. Thus, marketing efforts could potentially leverage these findings to help positively influence consumers views of healthiness regarding dietary choices.

The current findings could be used to inform the development of interventions aimed at changing attitudes via belief disconfirmation paradigms to induce more desirable eating habits (Ong et al., 2017b). For example, such interventions could be used to promote the taste attributes of healthy food as much as possible to help "nudge" individuals towards healthier food choices. It is important to consider that consumers are continually being presented with food and related cues via marketing in our modern environment (Schifferstein, 2020). Thus, taking advantage of confirmation bias tendencies by highlighting the tastiness of (at least some) healthy food and beverage choices may prove effective. In other words, rather than attempting to convince consumers to care more about the healthiness of their food choices, efforts can focus more on convincing consumers that healthy food is tasty.

5. Conclusion

The current study makes an important contribution to the limited evidence on confirmation bias in the food domain. Furthermore, we used a distinct research paradigm not previously utilized in the area of healthy food choice to induce cognitive dissonance and then assessed how it was resolved. Our large, online study provides evidence for the existence of a confirmation bias in the food domain. Additionally, our findings enhance our understanding of the factors that may exacerbate this bias, including deliberation, as indicated here via sleepiness and other more exploratory factors such as age. The current findings have implications for marketing efforts that are aimed at influencing more desirable consumer food-related choices, not so much by attempting to eliminate the bias, but rather by leveraging the power of the bias itself.

CRediT authorship contribution statement

David L. Dickinson: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing - original draft, Writing - review & editing. **Naomi Kakoschke:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing.

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.

Acknowledgements

The authors would like to thank the participants for volunteering to take part in the study.

Funding Sources

This work was supported by funds from the Economics department and the Walker College of Business at Appalachian State University, United States. The funding body was not involved in the study design, the collection, analysis, and interpretation of data, the writing of the report, and in the decision to submit the article for publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2021.104189.

References

Aggarwal, A., Monsivais, P., Cook, A. J., & Drewnowski, A. (2014). Positive attitude toward healthy eating predicts higher diet quality at all cost levels of supermarkets. *Journal of the Academy of Nutrition and Dietetics, 114*(2), 266–272.
Aikman, S. N., Crites, S. L., & Fabrigar, L. R. (2006). Beyond Affect and Cognition: Identification of the Informational Bases of Food Attitudes1. *Journal of Applied Social Psychology, 36*(2), 340–382.
Akerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. *International Journal of Neuroscience, 52*(1–2), 29–37.
Allcott, H., & Gentzkow, M. (2017). Social Media and Fake News in the 2016 Election. *Journal of Economic Perspectives, 31*(2), 211–235.
Bail, C. A., Argyle, L. P., Brown, T. W., Bumpus, J. P., Chen, H., Hunzaker, M. B. F., et al. (2018). Exposure to opposing views on social media can increase political polarization. *Proceedings of the National Academy of Sciences of the United States of America, 115*(37), 9216–9221.
Bakshy, E., Messing, S., & Adamic, L. A. (2015). Exposure to ideologically diverse news and opinion on Facebook. *Science, 348*(6239), 1130–1132.
Breland, J. Y., Joyce, V. R., Frayne, S. M., & Phibbs, C. (2020). Differences in body mass index based on self-reported versus measured data from women veterans. Obesity Science & Practice.
Chambers, S., Lobb, A., Butler, L. T., & Traill, W. B. (2008). The influence of age and gender on food choice: a focus group exploration. 32(4), 356-365.
Charpentier, C. J., Bromberg-Martin, E. S., & Sharot, T. (2018). Valuation of knowledge and ignorance in mesolimbic reward circuitry. *Proceedings of the National Academy of Sciences of the United States of America, 115*(31), E7255–E7264.
Clarke, C., & Best, T. (2019). Food choice motivations: Profiling low-carbohydrate, high-fat dieters. *Appetite, 141*, Article 104324.
Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Academic press.
Connors, M., Bisogni, C. A., Sobal, J., & Devine, C. M. (2001). Managing values in personal food systems. *Appetite, 36*(3), 189–200.
Contento, I. R. (2007). *Nutrition education: Linking research, theory, and practice*. Jones & Bartlett Learning.
Cotton, J. L. (1985). Cognitive dissonance in selective exposure. *Selective exposure to communication*, 11–33.
Dickinson, D. L. (2020a). Deliberation enhances the confirmation bias in politics. *Games, 11*(4), 57.
Dickinson, D. L. (2020b). Deliberation Enhances the Confirmation Bias: An Examination of Politics and Religion. *IZA Discussion Paper, 13241*.
Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160.
Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford University Press.
Flegal, K. M., Ogden, C. L., Fryar, C., Afful, J., Klein, R., & Huang, D. T. (2019). Comparisons of Self-Reported and Measured Height and Weight, BMI, and Obesity Prevalence from National Surveys: 1999–2016. *Obesity, 27*(10), 1711–1719.
Frey, D. (1986). Recent research on selective exposure to information. Edited by Berkowitz. *In* (Vol. 19).
Frimer, J. A., Skitka, L. J., & Motyl, M. (2017). Liberals and conservatives are similarly motivated to avoid exposure to one another's opinions. *Journal of Experimental Social Psychology, 72*, 1–12.
Golman, R., Hagmann, D., & Loewenstein, G. (2017). Information Avoidance. *Journal of Economic Literature, 55*(1), 96–135.
Gorber, S. C., Tremblay, M., Moher, D., & Gorber, B. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: A systematic review. *Obesity Reviews, 8*(4), 307–326.
Grunert, K. G., & Wills, J. M. (2007). A review of European research on consumer response to nutrition information on food labels. *Journal of Public Health, 15*(5), 385–399.
Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C. L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: A systematic review and meta-analysis. *BMC Public Health, 9*(1), 88.
Harmon-Jones, E., & Harmon-Jones, C. (2007). Cognitive dissonance theory after 50 years of development. *Zeitschrift für Sozialpsychologie, 38*(1), 7–16.
Hart, W., Albarracin, D., Eagly, A. H., Brechan, I., Lindberg, M. J., & Merrill, L. (2009). Feeling Validated Versus Being Correct: A Meta-Analysis of Selective Exposure to Information. *Psychological Bulletin, 135*(4), 555–588.
Hauser, M., Jonas, K., & Riemann, R. (2011). Measuring salient food attitudes and food-related values. An elaborated, conflicting and interdependent system. *Appetite, 57*(2), 329–338.
Hauser, M., Nussbeck, F. W., & Jonas, K. (2013). The Impact of Food-Related Values on Food Purchase Behavior and the Mediating Role of Attitudes: A Swiss Study. *Psychology & Marketing, 30*(9), 765–778.
Hearty, Á. P., McCarthy, S. N., Kearney, J. M., & Gibney, M. J. (2007). Relationship between attitudes towards healthy eating and dietary behaviour, lifestyle and demographic factors in a representative sample of Irish adults. *Appetite, 48*(1), 1–11.
Hodge, J. M., Shah, R., McCullough, M. L., Gapstur, S. M., & Patel, A. V. (2020). Validation of self-reported height and weight in a large, nationwide cohort of U.S. adults. *PLoS ONE, 15*(4), Article e0231229.
Januszewska, R., Pieniak, Z., & Verbeke, W. (2011). Food choice questionnaire revisited in four countries. Does it still measure the same? *Appetite, 57*(1), 94–98.
Jastran, M. M., Bisogni, C. A., Sobal, J., Blake, C., & Devine, C. M. (2009). Eating routines. Embedded, value based, modifiable, and reflective. *Appetite, 52*(1), 127–136.
Jo, J., & Lusk, J. L. (2018). If it's healthy, it's tasty and expensive: Effects of nutritional labels on price and taste expectations. *Food Quality and Preference, 68*, 332–341.
Jones, M., & Sugden, R. (2001). Positive confirmation bias in the acquisition of information. *Theory and Decision, 50*(1), 59–99.
Knobloch-Westerwick, S., Johnson, B. K., & Westerwick, A. (2013). To Your Health: Self-Regulation of Health Behavior Through Selective Exposure to Online Health Messages. *Journal of Communication, 63*(5), 807–829.
Knobloch-Westerwick, S., & Kleinman, S. B. (2012). Preelection Selective Exposure: Confirmation Bias Versus Informational Utility. *Communication Research, 39*(2), 170–193.
Knobloch-Westerwick, S., Mothes, C., & Polavin, N. (2020). Confirmation bias, ingroup bias, and negativity bias in selective exposure to political information. *Communication Research, 47*(1), 104–124.
Kobayashi, K., & Hsu, M. (2019). Common neural code for reward and information value. *Proceedings of the National Academy of Sciences of the United States of America, 116*(26), 13061–13066.
Kourouniotis, S., Keast, R. S. J., Riddell, L. J., Lacy, K., Thorpe, M. G., & Cicerale, S. (2016). The importance of taste on dietary choice, behaviour and intake in a group of young adults. *Appetite, 103*, 1–7.
Kowalkowska, J., Lonnie, M., Wadolowska, L., Czarnocinska, J., Jezewska-Zychowicz, M., & Babicz-Zielinska, E. (2018). Health- and Taste-Related Attitudes Associated with Dietary Patterns in a Representative Sample of Polish Girls and Young Women: A Cross-Sectional Study (GEBaHealth Project). *Nutrients, 10*(2).
Li, J., Streletskaya, N. A., & Gómez, M. I. (2019). Does taste sensitivity matter? The effect of coffee sensory tasting information and taste sensitivity on consumer preferences. *Food Quality and Preference, 71*, 447–451.
Londeree, A. M., & Wagner, D. D. (2020). The orbitofrontal cortex spontaneously encodes food health and contains more distinct representations for foods highest in tastiness. *Social Cognitive and Affective Neuroscience*.
Lord, C. G., Ross, L., & Lepper, M. R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. *Journal of Personality and Social Psychology, 37*(11), 2098.

Lusk, J. L. (2011). External validity of the food values scale. *Food Quality and Preference, 22*(5), 452–462.
Maio, G. R., Olson, J. M., Bernard, M. M., & Luke, M. A. (2006). *Ideologies, values, attitudes, and behaviour In: Handbook of social psychology*. Springer.
Markovina, J., Stewart-Knox, B. J., Rankin, A., Gibney, M., de Almeida, M. D. V., Fischer, A., et al. (2015). Food4Me study: Validity and reliability of Food Choice Questionnaire in 9 European countries. *Food Quality and Preference, 45*, 26–32.
Mialon, V., Clark, M., Leppard, P., & Cox, D. N. (2002). The effect of dietary fibre information on consumer responses to breads and "English" muffins: A cross-cultural study. *Food Quality and Preference, 13*(1), 1–12.
Nguyen, S. P., Girgis, H., & Robinson, J. (2015). Predictors of children's food selection: The role of children's perceptions of the health and taste of foods. *Food Quality and Preference, 40*, 106–109.
Nicolle, A., Fleming, S. M., Bach, D. R., Driver, J., & Dolan, R. J. (2011). A regret-induced status quo bias. *Journal of Neuroscience, 31*(9), 3320–3327.
Ong, A.-S.-J., Frewer, L., & Chan, M.-Y. (2017a). Cognitive dissonance in food and nutrition–A review. *Critical Reviews in Food Science and Nutrition, 57*(11), 2330–2342.
Ong, A.-S.-J., Frewer, L., & Chan, M.-Y. (2017b). Cognitive dissonance in food and nutrition - A conceptual framework. *Trends in Food Science & Technology, 59*, 60–69.
Palan, S., & Schitter, C. (2018). Prolific.ac-A subject pool for online experiments. *Journal of Behavioral and Experimental Finance, 17*, 22–27.
Pelletier, J. E., Laska, M. N., Neumark-Sztainer, D., & Story, M. (2013). Positive Attitudes toward Organic, Local, and Sustainable Foods Are Associated with Higher Dietary Quality among Young Adults. *Journal of the Academy of Nutrition and Dietetics, 113*(1), 127–132.
Prescott, J., Young, O., O'Neill, L., Yau, N. J. N., & Stevens, R. (2002). Motives for food choice: A comparison of consumers from Japan, Taiwan, Malaysia and New Zealand. *Food Quality and Preference, 13*(7–8), 489–495.
Primi, C., Morsanyi, K., Chiesi, F., Donati, M. A., & Hamilton, J. (2016). The Development and Testing of a New Version of the Cognitive Reflection Test Applying Item Response Theory (IRT). *Journal of Behavioral Decision Making, 29*(5), 453–469.
Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The Unhealthy = Tasty Intuition and Its Effects on Taste Inferences, Enjoyment, and Choice of Food Products. *Journal of Marketing, 70*(4), 170–184.
Renner, B., Sproesser, G., Strohbach, S., & Schupp, H. T. (2012). Why we eat what we eat. The Eating Motivation Survey (TEMS). *Appetite, 59*(1), 117–128.
Roininen, K., & Tuorila, H. (1999). Health and taste attitudes in the prediction of use frequency and choice between less healthy and more healthy snacks. *Food Quality and Preference, 10*(4–5), 357–365.
Scheibehenne, B., Miesler, L., & Todd, P. M. (2007). Fast and frugal food choices: Uncovering individual decision heuristics. *Appetite, 49*(3), 578–589.
Schifferstein, H. N. J. (2020). Changing food behaviors in a desirable direction. *Current Opinion in Food Science, 33*, 30–37.
Schlinkert, C., Gillebaart, M., Benjamins, J., Poelman, M., & De Ridder, D. (2020). The snack that has it all: People's associations with ideal snacks. *Appetite, 152*, Article 104722.
Shepherd, R. (1999). Social determinants of food choice. *Proceedings of the Nutrition Society, 58*(4), 807–812.
Sobal, J., & Bisogni, C. A. (2009). Constructing food choice decisions. *Annals of Behavioral Medicine, 38*(suppl_1), s37–s46.
Steptoe, A., Pollard, T. M., & Wardle, J. (1995). Development of a measure of the motives underlying the selection of food: The food choice questionnaire. *Appetite, 25*(3), 267–284.
Swinburn, B., Sacks, G., Vandevijvere, S., Kumanyika, S., Lobstein, T., Neal, B., et al. (2013). INFORMAS (International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support): Overview and key principles. *Obesity Reviews, 14*, 1–12.
Taber, C. S., & Lodge, M. (2006). Motivated skepticism in the evaluation of political beliefs. *American Journal of Political Science, 50*(3), 755–769.
Tang, W., Aggarwal, A., Moudon, A. V., & Drewnowski, A. (2016). Self-reported and measured weights and heights among adults in Seattle and King County. *BMC Obesity, 3*(1).
Toplak, M. E., West, R. F., & Stanovich, K. E. (2011). The Cognitive Reflection Test as a predictor of performance on heuristics-and-biases tasks. *Memory & Cognition, 39*(7), 1275–1289.
Tsang, S. J. (2019). Cognitive Discrepancy, Dissonance, and Selective Exposure. *Media Psychology, 22*(3), 394–417.
Verplanken, B., & Holland, R. W. (2002). Motivated decision making: Effects of activation and self-centrality of values on choices and behavior. *Journal of Personality and Social Psychology, 82*(3), 434–447.
Visser, P. S., & Krosnick, J. A. (1998). Development of attitude strength over the life cycle: Surge and decline. *Journal of Personality and Social Psychology, 75*(6), 1389.
Wardle, J., Haase, A. M., Steptoe, A., Nillapun, M., Jonwutiwes, K., & Bellisie, F. (2004). Gender differences in food choice: The contribution of health beliefs and dieting. *Annals of Behavioral Medicine, 27*(2), 107–116.
Westcombe, A., & Wardle, J. (1997). Influence of relative fat content information on responses to three foods. *Appetite, 28*(1), 49–62.
Worsley, A. (2002). Nutrition knowledge and food consumption: Can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition, 11*(s3), S579–S585.
Zandstra, E., De Graaf, C., & Van Staveren, W. (2001). Influence of health and taste attitudes on consumption of low-and high-fat foods. *Food Quality and Preference, 12*(1), 75–82.