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Thinking of food: The mental representation of healthy foods as unprepared

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ABSTRACT

We find that people implicitly and explicitly represent healthy foods they categorize as healthy in their purest, least prepared forms but represent foods they categorize as unhealthy in their most prepared forms (e.g., a veggie patty is represented as frozen while a beef burger is represented in a bun with melted cheese and ready to eat). We find this effect across several studies using both image and word sorting measures in explicit tasks and implicit association tasks. The effect results from the perception of health and taste as two conflicting goals. Preparation (e.g., cooking, adding toppings) makes food more delicious, which creates categorization ambiguity. Hence, healthy food is thought of as unprepared. Indeed, individual differences in perceived health-taste goal conflict moderate the effect. Critically, the representation of healthy foods matters for food decisions. In an experiment that manipulated the descriptive language on a restaurant menu, emphasizing the preparation of foods increased participants' preference for healthy foods (with no improvement for unhealthy foods).

1. Introduction

"Anything raw is superior to anything cooked."
– Chef Victoria Boutenko, leader of the Raw Food Movement

In modern society, the categorization of foods as healthy or unhealthy is almost as common as taxonomic categorizations (e.g., vegetables, fruits, and breads; Ross & Murphy, 1999). Yet, this is a relatively new way that people categorize food. While humans have always preferred calorie-dense, plentiful, and cheap food, nutritional guidelines are a modern phenomenon (Davis & Saltos, 1999). Our biology has always directed us to identify sugary, salty, and fatty foods as good-tasting (Breslin, 2013) and unripe, spoiled, or fermented foods as bad tasting (i.e., bitter or sour, Zhang et al., 2019). But the more novel, top-down categorization of healthy or not healthy is based on high-level cognitions. Instead of relying on taste buds, people use knowledge to determine whether food is healthy.

Here, we ask how thinking of food as a means to promoting health has influenced the mental representation of food. What comes to mind when people label some food "healthy"? Possibly, people think of foods they categorize as healthy in their purest, unprepared forms. Some of these foods are edible in their raw form (e.g., apples, carrots), but many, such as beans or Brussels sprouts, are not palatable raw. In contrast, people may imagine food that they label "unhealthy" as ready-to-eat, covered with toppings, and on a plate—in their final, fully prepared form. For example, people might think of a veggie patty as frozen and wrapped but envision a beef burger as fully prepared, plus bun, cheese, and condiments. The unhealthy, unlike the healthy food, is mentally represented as fully composed, hot, and ready to eat.

This difference could result from the lay perception (supported by modern culture) that goals conflict (Freund, 2008; Kung & Scholer, 2021), in particular, the health and taste goals (Conner et al., 2022; Finkelstein & Fishbach, 2010; Fishbach & Zhang, 2008; Fujita & Han, 2009; Hennecke & Bürgler, 2020; Hofmann et al., 2012; Kunz et al., 2023; Papies et al., 2015; Provencher, Polivy, & Herman, 2009) . Presumably, some foods facilitate health, and others facilitate taste (Fishbach et al., 2003; Stroebe et al., 2013). Whereas health and taste are generally positively correlated in the natural world (e.g., poisonous foods are not tasty), and many foods do not fall into the health-taste dichotomy (e.g., many people enjoy the taste of fruits and veggies), people tend to perceive a negative correlation between health and taste (Kunz et al., 2023). In turn, food that fits only one category—either healthy or tasty—is more prototypical and easier to categorize, though sometimes erroneously. For example, many people falsely believe that a diet free from sugar and salt is healthier than that same diet with a pinch of sugar or salt in it. The categorization of sugar and salt as "bad" leads to dose insensitivity to a nonsensical degree because sugar and salt are essential components for human life (Rozin et al., 1996).

Further, food that hinders one goal seems especially instrumental for a conflicting goal. According to the principle of *counterfinality*, a means

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that facilitates one goal will appear more instrumental if it simultaneously undermines another goal (Kruglanski et al., 2015). For example, a mouthwash that causes an unpleasant stinging sensation is judged to have greater health benefits than one that is pain-free (Schumpe et al., 2018), and many adolescents believe substance abuse is a strong signal of commitment to a social group because it undermines health (Köpetz & Orehek, 2015). By this logic, a food that is less tasty might seem especially healthy while a food that is tasty might seem less healthy. Relatedly, by the principles of over-justification (Lepper et al., 1973) and dilution (Zhang, et al., 2007), a means that facilitates several goals simultaneously will appear less instrumental for each of these goals. Translated into cognitions about food, people will struggle to categorize food as both healthy and tasty.

Food categorization matters and has been studied in tasks involving the categorization of food stimuli (e.g., Chollet et al., 2011) as well as the categorization of food descriptions and images (e.g., Raghunathan et al., 2006). Specifically, the categorization of food according to the health and taste goals and the perception of goal conflict influence the assumed features of food (Rajagopal & Burnkrant, 2009). Foods that are strongly associated with the healthy category are explicitly and implicitly associated with being less tasty (Cornil & Chandon, 2016; Mai & Hoffmann, 2015). For example, on the Implicit Association Test (IAT), participants were faster to associate pictures of unhealthy foods with enjoyable words like "tasty," "delicious," and "flavorful" and healthy foods with unenjoyable words like "disliked," "bland," and "flavorless" than vice versa (Raghunathan et al., 2006). Similarly, labels that emphasize healthiness decrease the appeal of a food, the perceived flavor of food, and food choices (Maimaran & Fishbach, 2014; Turnwald et al., 2019; Wansink & Chandon, 2006).

To the extent that people perceive foods as being healthy at the expense of tastiness, their mental representations of healthy foods may come to reflect those assumptions. Thinking that healthy foods are not tasty is likely associated with mentally representing healthy foods in less tasty forms, which could be raw or unprepared—not mixed with sauces, seasonings, or condiments and far from how these foods are often served and consumed.

1.1. Food preparation

Throughout human history, food preparation has served as a method for making food safer, more palatable, and culturally relevant. Global cuisines demonstrate the large variety of ways in which foods can be prepared. In the present research, we define preparation as any mechanical changes, such as cutting, mixing, topping, and blending, as well as chemical changes, such as roasting, frying, pickling, canning, or smoking. We refer to preparation just prior to eating that is primarily for the purposes of making foods more palatable, as opposed to processes such as canning, freezing, pickling, or otherwise preserving foods for consumption intended weeks or months in the future.

Food preparation can influence its categorization. When thinking of a category, people tend to imagine clear and canonical exemplars rather than ambiguous examples. In the U.S., carrots and apples are easier to identify as belonging to the categories of vegetables and fruits, respectively, than are watercress or kumquats. In goal-derived categories of healthiness versus tastiness, prototypicality is predicted by similarity to the ideals of the category and estimates of how often a food is encountered as a category member (Barsalou, 1985). Consider a fried vegetable with dipping sauce or a burger with just lettuce and tomato on whole-grain bread. In the first case, the vegetable is healthy, but the preparations make it less so. In the second, ground beef is less healthy, but the preparations make it healthier. Such examples are more difficult to categorize than healthy foods in their healthiest form and unhealthy foods in their least healthy form (Nguyen, 2007; Nguyen & Murphy, 2003).

Importantly, although the preparation of food does not, by default, make it less healthy (e.g., adding healthy ingredients like vitamins or removing unhealthy components like sugar, André et al., 2019), people tend to believe it does. This belief underlies the raw food movement, which advocates for the consumption of uncooked food. It is also reflected in Rozin's (2005) findings that chemical preparation (e.g., roasting) makes food appear less natural and hence, less healthy than mechanical changes (e.g., mixing). Similarly, warm foods appear to be more calorie-rich than matched cold foods, because warm foods are perceived as more filling and tastier ("warm-is-calorie-rich intuition"; Yamim et al., 2020).

Consistent with the notion that health goals guide evaluations of food preparation, calorie estimations are particularly sensitive (and often accurate) when toppings are added to healthy foods (Jiang & Lei, 2014). Any topping can be the tipping point, switching the perception of food from healthy to unhealthy. The health/taste goal conflict not only leads people to infer that preparation that improves taste likely undermines the food's health. It could also affect something more basic: the mental representation of food as prepared versus not.

1.2. Present research

In this research, we ask whether healthy food is mentally represented as less prepared. For example, while previous research could predict that cooking beans makes them seem less healthy, we ask whether people's mental representation of beans (and Brussels sprouts) is as uncooked, naked, and not on a plate.

Our main hypothesis is that *people mentally represent healthy foods (e.g., vegetables, plant-based dishes, healthier versions of ambiguous foods) as less prepared than unhealthy foods*. This is despite the fact that many foods (and all foods used in our studies) can be prepared and are more commonly consumed in their prepared forms. For example, we predict that people's mental representation of whole wheat pasta is of uncooked spaghetti, yet the mental representation of white pasta is of fully cooked, covered with sauce, and ready to eat. While unhealthy foods tend to be more processed (e.g., less likely to grow on a tree), we study the kind of preparations that are equally likely for healthy and unhealthy foods prior to consumption.

We test our hypothesis with explicit measures by having participants choose between photos of more prepared and less prepared versions of a variety of healthy and unhealthy foods (e.g., veggie burger vs. beef burger, chicken breast vs. chicken wings). We also test this hypothesis using the IAT. We expect that people would be faster to identify stimuli (e.g., the words "French fries," "Brussels sprouts," "cooked," and "uncooked) as "either healthy/unprepared or unhealthy/prepared" compared with the time for identifying these words as "either healthy/prepared or unhealthy/unprepared." Such a pattern would indicate a mental association between healthy foods and a lack of preparation (e.g., Raghunathan et al., 2006).

Why do people mentally represent healthy foods in less prepared forms? *We hypothesized that perceiving health and taste as conflicting underlies the effect.* Therefore, in an Indian culture in which health and taste are less likely to be seen as conflicting goals, we would expect a smaller effect. Moreover, individuals who perceive health and taste as more conflicting goals should show a larger difference in mental representations of healthy versus unhealthy foods (i.e., statistical moderation effect).

In addition, we test health consciousness as an indirect moderator, predicting that individuals higher in health consciousness are less extreme in their perception of conflict between health and taste goals. Health-conscious individuals see the health and taste goals as complementing rather than conflicting with each other. Because they perceive less taste-health conflict, they should show less of a difference in mentally representing healthier foods as less prepared and unhealthy foods as more prepared.

We believe that shifting people's default representations of healthy food as relatively unprepared and bland can influence consumption. We hypothesized that *foods are perceived as tastier in their more prepared*

forms, regardless of healthiness. For example, we predict that images of the separated raw ingredients that make a meal will appear healthier and less tasty than an image of the combined cooked dish, regardless of the meal's healthiness.

Tastiness, in turn, is the most important factor driving consumption decisions for most people most of the time (Aggarwal et al., 2016; Glanz et al., 1998). This offers a solution for motivating healthy choices: remind people that healthy foods are prepared, mixed, and topped in ways that make them flavorful. Thus, we hypothesized that *providing additional information about the ways in which both healthy and unhealthy foods are prepared will increase preference for healthy foods.* Notably, because unhealthy foods are assumed to be prepared, they are less likely to appear more appealing when preparation is mentioned.

We tested these hypotheses in seven studies, summarized in Table 1. All the hypotheses and analytic plans were specified before the data were collected. We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the studies. For data and materials on all experiments, see the OSF: https://osf.io/ums7y/.

Table 1
Summary of Studies.

Study	Primary measures	Main finding
1A	Mental representation of healthier vs. less healthy versions of foods	People think of healthier versions of foods in less prepared forms than unhealthy versions of similar foods
1B	Mental representation of healthy and unhealthy popular foods	People think of healthy foods (e.g., vegetables, legumes) in less prepared forms but unhealthy foods (e.g., desserts, refined grains, processed meats) in more prepared forms
1C	Mental representation of healthy and unhealthy popular foods in India	Moderation by culture: Participants in India show less of a bias in mental representations than U.S. participants
2	IAT using healthy/unhealthy foods and raw/prepared words	People are faster to associate healthy-raw and unhealthy-prepared word pairs than vice versa
3	Mental representation of healthier vs. less healthy versions of similarly matched foods; perceived healthiness-tastiness overlap	Moderation: People who see healthy foods and tasty foods as non-overlapping categories show a larger effect of mentally representing healthy foods in less prepared forms
4	Perceived tastiness of foods	People think the prepared version of foods are tastier, regardless of whether healthy or unhealthy and controlling for actual ingredients
5	Appeal and likelihood of choosing foods from a restaurant menu	Consequential study: Describing the ways in which both healthy and unhealthy foods from a popular chain restaurant are prepared increases likelihood of choosing healthy foods only

2. Study 1: People mentally represent healthy food as less prepared

2.1. Study 1A: Methods

Study 1A (preregistered at https://aspredicted.org/fa7eu.pdf) measured whether people mentally represent healthier versions of food in a less prepared form than unhealthy versions of a similar matched food (e.g., cauliflower-crust pizza vs. wheat-crust pizza, whole wheat pasta vs. white pasta). Participants viewed photos of either a healthier version or less healthy version of food for 9 food pairs and clicked on the photo (a more vs. less prepared photo of that food) that looked more like the "first thing that came to mind" when they think of that food.

2.1.1. Participants

We opened the study to 260 U.S. participants from Amazon Mechanical Turk (MTurk) for $0.35.[1] We chose this sample size based on a power analysis in G*Power 3.1 that indicated that we would need approximately 200 participants to have 80% power to detect an odds ratio of 1.5 in a logistic regression (two-tailed, $\Pr(Y = 1|X = 1)$ H0 = 0.5) and anticipating a number of participants being excluded for failing attention checks. Our final sample included 217 participants who passed all attention checks (40.6% female, 59.4% male; $M_{age} = 37$, $SD = 10$). A sensitivity analysis with the same settings as our a priori power analysis indicated that the final analyzed sample had 80% power (alpha = 0.05) to detect an odds ratio of 1.48.

2.1.2. Procedure

In a mixed within/between design, participants randomly viewed either the healthier version or the less healthy version for foods. Participants viewed 9 foods, one at a time in random order. Due to randomization, across the 9 foods participants viewed some unhealthy versions of foods and some healthy versions of foods but never the healthy and the unhealthy versions of the same matched food (i.e., cauliflower-crust pizza or flour-crust pizza, but never both).[2]

For each food, two photos appeared (left/right randomized) – one depicting a less prepared version of that food and the other depicting a more prepared version of that food. Participants were instructed to click on one of the two photos in response to the question, "When you think of [food name], which picture looks more like the first thing that comes to your mind?" For example, when asked about pasta, participants chose between uncooked spaghetti and cooked spaghetti with sauce on a plate.

2.2. Study 1A: Results

Using the lmerTest package in RStudio (version 2021.09.2), the dependent variable (choice of less prepared or more prepared version) was predicted as a function of the fixed effect of food healthiness (0 = unhealthy, 1 = healthy) and random-intercept effects of participant and of food item in a mixed effects binomial logistic regression model. We report the primary outcome in terms of the odds ratio (OR) from the model estimate. This represents the odds that participants said that they

[1] One limitation of this research is that, with the exception of Study 1C, which we ran in India, all data was collected on MTurk. To address this limitation, we recruited participants so long as their MTurk approval rating was at or above 95%. We further included attention checks and excluded those who failed them (e.g., 16.5% of the participants in Study 1A). Notably, at the time the data was collected, MTurk was considered a reliable crowdsourcing platform for behavioral research (Albert & Smilek, 2023; Mortensen & Hughes, 2018).

[2] A separate sample of 147 MTurk participants rated the healthiness of all 18 foods (1 = very unhealthy, 6 = very healthy) and a paired *t*-test for each food pair confirmed that the healthier version was always perceived as significantly healthier than the unhealthy version of the similar matched food (Table S1).

think of the more (vs. less) prepared version depending on whether the food is healthy or unhealthy.

In support of the hypothesis, we found a significant negative effect of food healthiness on participants' odds of mentally representing the more prepared version of foods, $z = -7.63$, b = −0.88, 95% CI: [−1.12, −0.65], OR = 0.41, 95% CI: [0.33, 0.52], $p < 0.001$ (see Fig. 1). That is, across all foods, participants had 2.42 times higher odds (95% CI: 1.93–3.05) of indicating that they think of the more prepared form for unhealthy than healthy foods (e.g., for beef burgers vs. veggie burgers, grits vs. lentils, and whole wheat pasta vs. white pasta). Even though all foods used in this study should be cooked prior to consuming them, and even though all foods can be mixed, seasoned, or have toppings or sauces added, participants consistently held stronger mental representations of unhealthy foods as cooked, mixed, and topped than healthier versions of similar foods. Note that the effect of healthiness on mental representation was significant for six of the nine pairs, but it did not reach significance for the salmon/steak pair and was not different for the brown rice/white rice pair or the oatmeal/Cookie Crisp cereal pair (Table S2). In retrospect, the images we used for prepared rice were likely too minimally modified (plain steamed rice with nothing added or mixed) and "oatmeal" is a prepared oat dish.

2.3. Study 1B: Methods

Whereas study 1A compared healthier and less healthy versions of matched food pairs, study 1B (preregistered at https://aspredicted.org/w58n2.pdf) tested the degree to which people mentally represent healthiness as less prepared across a set of canonical healthy foods and canonical unhealthy foods. Participants viewed 12 healthy and 12 unhealthy foods and clicked on the photo (a more vs. less prepared version of the same food) that looked more like the "first thing that came to mind" when they thought of that food.

2.3.1. Participants

We opened the study to 130 participants from MTurk in exchange for $0.35. We chose this sample size based on a power analysis in G*Power 3.1 that indicated that in this within-subjects design, we would need 117 participants to have 80% power to detect an odds ratio of 1.75 in a logistic regression (two-tailed, Pr(Y = 1|X = 1) H0 = 0.5). Our final sample included 109 participants who passed all attention checks (43% female, 57% male; $M_{age} = 37$, $SD = 10$). A sensitivity analysis with the same settings as our a prior power analysis indicated that the final analyzed sample had 80% power (alpha = 0.05) to detect a minimum odds ratio of 1.79.

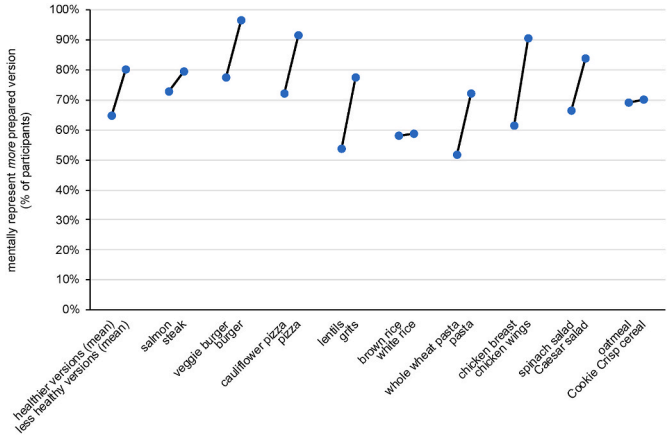

Fig. 1. Participants Think of Healthier Versions of Foods as Less Prepared Than Unhealthy Versions of Similarly Matched Foods
NOTE.– Plot depicts the percent of participants in study 1A (total $N = 217$) who indicated that they think of a given food in its more prepared state. Circles represent the percentage for a given food, and lines connect the healthier (left) and unhealthy (right) version of each similarly matched food pair.

2.3.2. Procedure

Participants viewed 12 healthy foods (e.g., carrots, zucchini) and 12 unhealthy foods (e.g., hot dogs, nachos), one at a time in random order (all images in Supplemental materials). For each food, two photos appeared (left/right randomized) – one depicting a less prepared version of that food and the other depicting a more prepared version of that food. Participants were instructed to click on one of the two photos in response to the question, "When you think of [food name], which picture looks more like the first thing that comes to your mind?" For example, when asked about beans, participants chose between raw beans and cooked beans with herbs and spices. When asked about pancakes, participants chose between cooked pancakes without toppings and cooked pancakes with butter and syrup. That is, in both versions the pancakes were fully cooked, but one version (i.e., "prepared") had them covered with toppings.

Notably, while the unhealthy foods in this study tended to include more ingredients than the healthy foods (e.g., pancakes vs. beans), we were simply interested in whether people mentally represent each in more or less prepared form. Further, although the level of preparation varied by stimuli out of necessity (i.e., some foods could be depicted as raw but some, like pancakes, could not) the two photos always showed a less prepared and a more prepared version of the given food. Increased levels of preparation were visually operationalized as showing the food as cooked and/or having sauces or seasonings added compared with the matched image of the less prepared version of the food. The dependent variable (choice of less prepared or more prepared version) was predicted as a function of the fixed effect of food healthiness (0 = unhealthy, 1 = healthy) and random-intercept effects of participant and of food item in a mixed effects binomial logistic regression model.

2.4. Study 1B: results

In support of the hypothesis, we found a significant negative effect of food healthiness on participants' odds of choosing the more prepared version of foods, $z = -7.81$, b = −2.48, 95% CI: [−3.14, −1.84], OR = 0.08, 95% CI: [0.04, 0.16], $p < 0.001$. Participants had 11.9 times higher odds of indicating that they think of the more prepared version for unhealthy foods than for healthy foods. Further, for each of the 12 healthy foods except salmon, less than half of participants indicated that they thought of the more prepared version ($M_{healthy} = 29.5\%$ thought of more prepared version, 95% CI: 22.1%–36.9%), whereas every unhealthy food had more than half of participants indicate that they thought of the more prepared version ($M_{unhealthy} = 75.3\%$ thought of more prepared version, 95% CI: 66.8%–83.8%; Fig. 2).

In study 1B, we found that healthy foods are mentally represented as less prepared and unhealthy foods are mentally represented as more prepared. Participants mentally represented healthy foods (e.g., vegetables and legumes) primarily as raw, uncooked and unmixed, and unhealthy foods (e.g., desserts, red meats, and refined carbohydrates), as fully cooked, with sauces and toppings added, ready to eat. Study 1B further generalizes the findings of Study 1A to common healthy and unhealthy foods and shows large differences between people's mental representations of healthy foods in less prepared and unhealthy foods in more prepared forms.

One potential alternative explanation is that participants were not thinking of vegetables in the context of food but rather in the context of plants. That is, when we asked participants what they think of when they think of carrots or broccoli, they thought about the plant growing in the ground rather than as food on a plate. If this were the case, it would not be inconsistent with our theory (that people think of healthy foods as less prepared) but would suggest that participants were not answering the question that we were asking. However, we find this unlikely given that the context of these studies was about foods and participants were

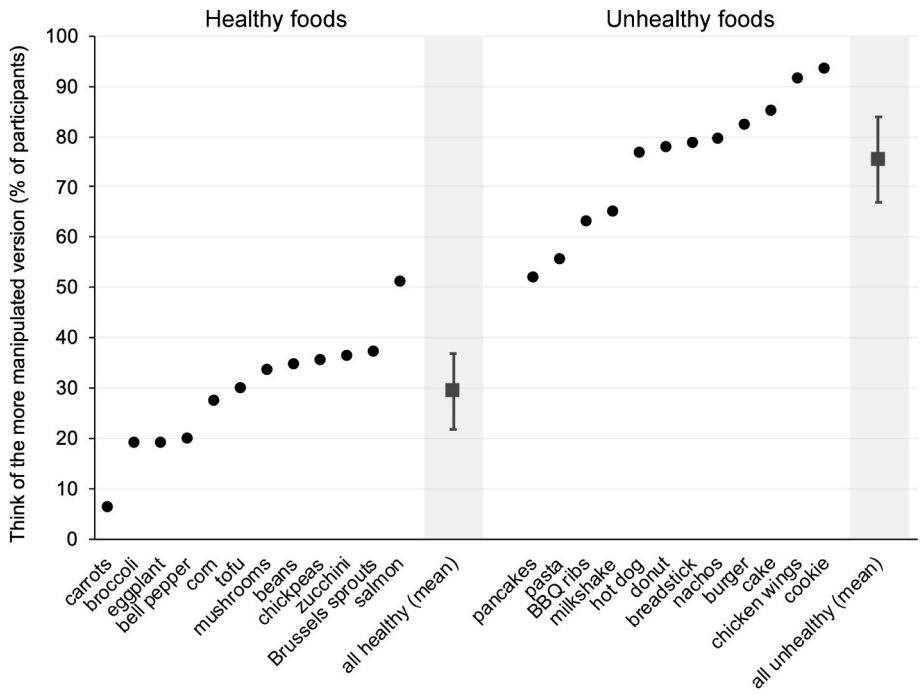

Fig. 2. Participants Mentally Represent Healthy Foods in A Less Prepared State and Unhealthy Foods in A More Prepared State
NOTE.– Plot depicts the percent of participants ($N = 109$) who indicated that they think of a given food in its more prepared version. Circles represent the percentage for a given food and squares represent the mean percentage across all 12 healthy foods (left) and across all 12 unhealthy foods (right), with error bars for 95% confidence interval shown.

informed prior to seeing the stimuli that they would be rating foods (not plants or things).

Another potential explanation for why participants chose less prepared versions of healthy foods is that participants were following directions quite literally. Choosing a raw, whole eggplant instead of a roasted eggplant with seasonings is a literal choice when asked what one thinks of when one thinks of eggplant. If this were the case, however, then we should have also observed participants choosing the more literal response for unhealthy foods. This is not what we observed. When we asked participants how they mentally represent a "hot dog", they did not choose the plain cooked hot dog. They chose the hot dog with mustard and ketchup.

2.5. Study 1C: methods

In Study 1C, we tested whether people in India mentally represent healthiness as less prepared. Indian culture has a rich tradition of eating heavily prepared plant-forward and vegetarian dishes, and therefore, we hypothesized that Indian participants would exhibit less of a difference in mental representations of healthier versus less healthy foods compared with the large difference observed in our U.S. population. Mirroring our approach in Study 1B, participants viewed 10 healthier and 10 less healthy foods that were culturally relevant in India, and clicked on the photo (a more vs. less prepared version of the same food) that looked more like the "first thing that came to mind" when they think of that food.

2.5.1. Participants

We opened the study to 150 enrolled students in Ashoka University in India. We chose this sample size based on the power analysis in Study 1B and expecting some attrition. Our final sample included 142 participants that provided consent, passed all attention checks, and responded to more than half of the stimuli (48.59% female, 45.07% male, 6.34% other or unknown; $M_{age} = 21.7$, $SD = 4.4$), yielding 80% power (alpha = 0.05) to detect an odds ratio of 1.65.

2.5.2. Procedure

Participants viewed 10 healthy foods (cabbage, cucumber, chickpeas, corn, eggplant, dal, beans, okra, cauliflower, and pepper) and 10 unhealthy foods (cake, gulabjamun, samosa, pakora, naan, vada, jalebi, papri, paneer, and kulfi), one at a time in random order (all images in Supplemental materials). These foods were selected after consultation with our partner at Ashoka University. For each food, two photos appeared (left/right randomized) – one depicting a less prepared version of that food and the other depicting a more prepared version of that food.

As in Study 1B, for each food, participants indicated which picture looks more like the first thing that comes to mind. For example, when asked about chickpeas (chana), participants chose between uncooked chickpeas and cooked chickpeas with herbs and spices. When asked about samosas, participants chose between an image of samosas with no background and a plate with samosas, a piece of lemon, and three bowls of sauce. Next, participants rated how healthy each food item was (1 = very unhealthy to 6 = very healthy) as a manipulation check. Indeed, participants rated the 10 healthy items as much healthier than the unhealthy items ($M_{healthy} = 5.31$, $SD = 0.56$; $M_{unhealthy} = 2.73$, $SD = 0.74$, $t(138) = 34.44$, $p < 0.001$).

The dependent variable (choice of less vs. more prepared version) was predicted as a function of the fixed effect of food healthiness (0 = unhealthy, 1 = healthy) and random-intercept effects of participant and of food item in a mixed effects binomial logistic regression model.

2.6. Study 1C: Results

In support of our hypothesis, the negative effect of food healthiness on participants' odds of choosing the more prepared version of foods was not significant, $z = -1.34$, b = −0.99, 95% CI:[−2.52, 0.53], OR = 0.37, 95% CI: [0.08, 1.70], $p = 0.182$. Although participants mentally represented healthier foods as directionally less prepared than unhealthy foods (38.0% of healthy items were thought of as the more prepared version, 95% CI: [18.6%, 57.3%]; 51.7% of items were thought

of as the more prepared version, 95% CI: [29.7%, 73.7%]; Fig. 3), the difference was not significant.

Notably, our mixed effects model is sensitive to the variance due to specific items, which was quite substantial in this study. If we were to average across food items, the difference between 38% of healthy items thought of as more prepared, and 51.7% of unhealthy items thought of as more prepared, would be significant (e.g., participants had higher odds of indicating that they think of the more prepared version for unhealthy foods than for healthy foods). Yet, this difference was smaller than in Study 1B.

Overall, we observe a similar tendency to represent healthy foods in less prepared form in the context of Indian cuisine, where healthy food is traditionally fully prepared (vs. raw in Western cuisine). Yet, the effect is smaller. Indeed, in Study 1B, unhealthy foods were 46 percentage points more likely to be represented as prepared, while in Study 1C, the difference between healthy and unhealthy foods was 14 percentage points. The difference between these studies could suggest that cultural learning determines the perception of health/taste conflict and hence, the presentation of healthy foods as less prepared.

Although asking participants to choose between two photos across Studies 1A-C holds some experimental advantages, these results are limited to explicit evaluations. Study 2 tested whether people further hold implicit associations between healthiness and lack of preparation.

3. Study 2: Implicit association between food healthiness and preparation

3.1. Methods

Study 2 (preregistered at https://aspredicted.org/8qc8y.pdf) used an IAT to test whether healthier foods are also implicitly associated with rawness or lack of preparation. The IAT measures the association between concepts (e.g., the unhealthy = tasty association, Raghunathan et al., 2006). Using this procedure, we were able to test the association between healthiness and lack of preparation more directly. Participants viewed the names of either healthy foods or unhealthy foods and qualities that signaled preparation or a lack thereof. We tested whether reaction times were faster when pairing the expected congruent pair (unhealthy foods and preparation words, healthy foods and raw words) compared with trials with an incongruent pair (unhealthy foods and raw words, healthy foods and preparation words).

3.1.1. Participants

We opened the study to 130 U.S. MTurk participants in exchange for $1.00. A power analysis in G*Power 3.1 (paired *t*-test) indicated that we would need 90 participants in this within-subjects design to have 80% power to detect an effect size of 0.3, and we expected that approximately 30% of participants would be dropped based on exclusion rates observed in previous IAT studies with MTurk participants (Carpenter et al., 2019). $N = 106$ participants passed all attention checks prior to the IAT (40.6% female, 59.4% male; $M_{age} = 39$, $SD = 11$). Our final analyzed sample (described below) was 89 participants, yielding 80% power (alpha = 0.05) to detect an effect size of $d = 0.30$.

3.1.2. Procedure

We followed procedures specified by Carpenter et al. (2019) for using the survey-based "Iatgen" IAT software integrated into the Qualtrics platform. Across seven trials, participants were presented with either food names (e.g., hot dog, Brussels sprouts) or attributes (e.g., cooked, uncooked) and asked to sort food names into "unhealthy" versus "healthy" categories and sort attributes into "prepared" versus "raw" categories. The stimuli and IAT procedure are depicted in Fig. 4.

Following established IAT procedures, participants completed seven blocks of stimuli sorting trials and they indicated sorting choices by pressing either the 'E' key or 'I' key on their keyboards to choose the left or right categories, respectively. We used an interstimulus interval of 250 ms between trials (Carpenter et al., 2019; Greenwald et al., 1998; Penke et al., 2006) and participants had to correct mistakes before proceeding (Greenwald et al., 2003). For all participants, Block 1 was a practice block of 20 trials involving sorting food names only (into "healthy foods" vs. "unhealthy foods") and Block 2 was a practice block of 20 trials sorting attributes only (into "prepared" vs. "raw" categories). Next for Blocks 3 (20 trials) and 4 (40 trials), participants were randomized to either the compatible combined blocks ("unhealthy + prepared" vs. "healthy + raw") or incompatible combined blocks ("unhealthy + raw" vs. "healthy + prepared"). Block 5 was a practice block (40 trials) for all participants in which they sorted only attributes (prepared, raw) with the sides reversed, to wash out left-right associations learned in earlier blocks. Then Blocks 6 (20 trials) and 7 (40 trials) represented the incompatible blocks for those who viewed the compatible blocks in Blocks 3 and 4 or the compatible blocks for those who previously viewed the incompatible blocks.

We analyzed data in the combined blocks (Block 3 + Block 4 and Block 6 + Block 7) to calculate a combined difference score (D-score; Greenwald et al., 2003), using the Iatgen tool (Carpenter et al., 2019). Positive D-scores indicate that participants are faster in the compatible blocks and negative D-scores indicate that participants are faster in the incompatible blocks. Using Greenwald et al.'s (2003) scoring procedure, individual trials that lasted longer than 10 s were excluded and participants that had more than 10% of trials faster than 300 ms were excluded, as this indicates random button-pressing. Because participants had to correct errors, there was no time penalty for errors added into calculations.

3.2. Results

Across 106 participants that passed all attention checks prior to the IAT, 17 (16.0%) were dropped due to preregistered criteria for excessive speed (Carpenter et al., 2019). The percent of trials dropped across all participants due to timeout (longer than 10 s to react) was less than 1% (0.21%). The error rate (percent of trials in which participants responded incorrectly) was 17.3%. The estimated internal consistency of the IAT based on split-half reliability with Spearman-Brown correction was high (reliability = 0.94; de Houwer & Bruycker, 2007).

For the 89 participants who produced valid IATs, the mean D-score was 0.40 (95% CI: [0.27, 0.52]), $SD = 0.60$, $t(88) = 6.250$, $p < 0.001$, Cohen's $d = 0.66$. This result supported our hypothesis that participants would be faster to associate healthy foods with raw words and unhealthy foods with prepared words than vice versa. Compared with related research on implicit associations between healthiness and tastiness or satiety, the effect size observed here was medium to large – about two-thirds as large as the unhealthy = tasty intuition (D-score = 0.65 in Raghunathan et al., 2006; D-score = ~0.48 in Mai & Hoffmann, 2015), slightly larger than the warm-is-calorie-rich intuition (D-score = 0.33 in Yamim et al., 2020), and twice as large as the healthy = less filling intuition (D-score = ~0.20, Suher et al., 2016).

Taken together with Study 1, we find that people implicitly and explicitly associate healthier foods with being in a less prepared form, while implicitly and explicitly associating unhealthy foods with being in a more prepared form (cooked, mixed, sauces and toppings added). This is despite the fact that many healthy and unhealthy foods are cooked when consumed. Indeed, in the case of many healthy foods in Study 1 and 2, participants thought of healthy foods in a form in which the foods are not edible or are rarely consumed (e.g., raw eggplant, raw beans, raw chickpeas, raw Brussels sprouts).

4. Study 3: Moderation of biased mental representations

4.1. Methods

We reasoned that the differences in mental representation between healthy and unhealthy foods result from the perception of conflict

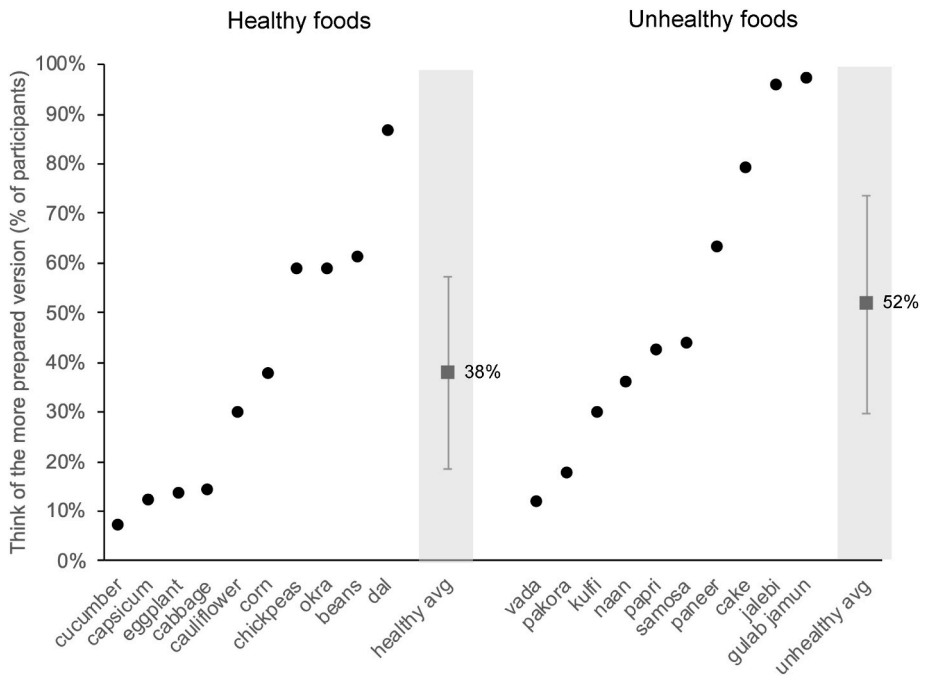

Fig. 3. Moderation of Mental Representations by Culture. Participants in India did not Mentally Represent Healthy Foods in a Significantly Less Prepared State than Unhealthy Foods.
NOTE.– Plot depicts the percent of participants ($N = 142$) who indicated that they think of a given food in its more prepared version. Circles represent the percentage for a given food and squares represent the mean percentage across all 10 healthy foods (left) and across all 10 unhealthy foods (right).

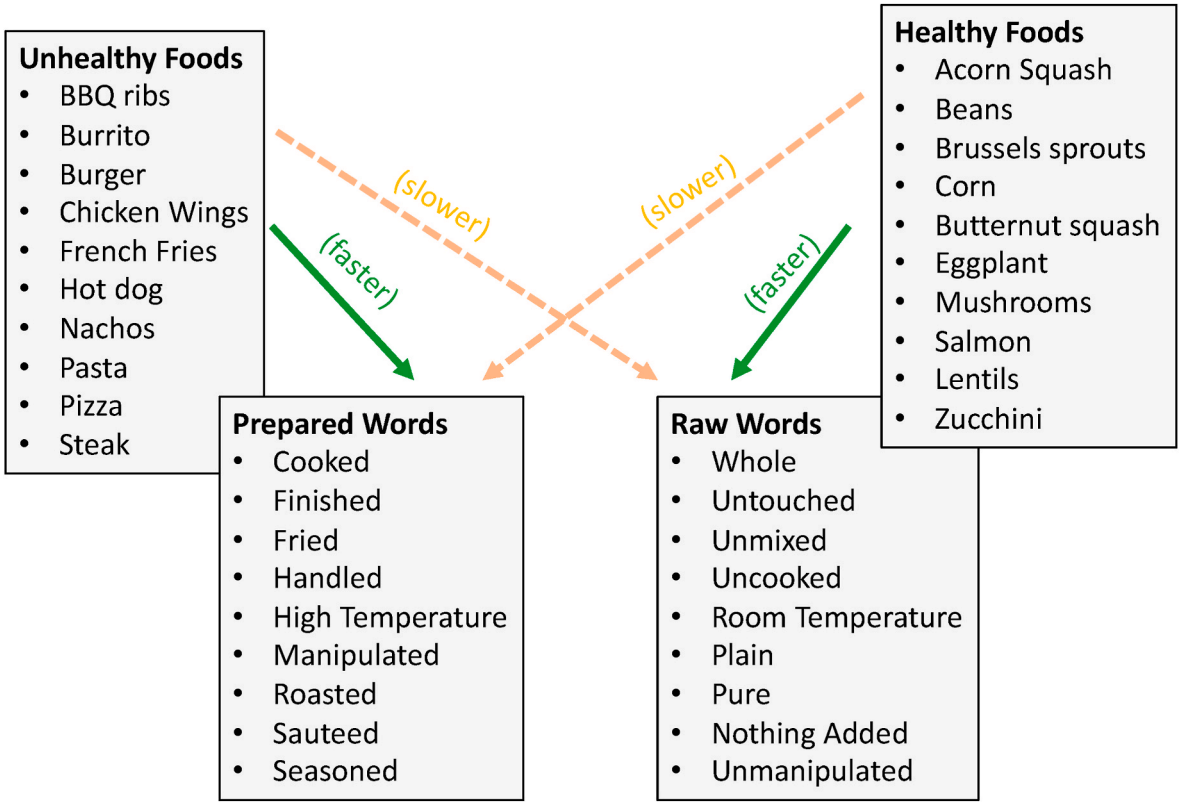

Fig. 4. Implicit association task (IAT) in Study 2
NOTE.—Participants were randomized to see unhealthy foods starting on left or right and whether the compatible blocks (3 and 4) or incompatible blocks (6 and 7) appeared first.

between health and taste. If people believe that tasty foods are unhealthy and healthy foods are not tasty (i.e., they perceive conflict) they will represent healthier foods in less prepared form. To explore this mechanism, Study 3 (preregistered at https://aspredicted.org/sb7hn.pdf) tested whether the difference in mental representation (healthy vs. unhealthy food) would be larger among people who perceive greater health-taste conflict. We measured healthy and unhealthy food representations, and the perceived overlap between taste and health, predicting that this overlap measure would moderate the effect of food presentation. We further tested for moderation by health consciousness, predicting that health-conscious individuals are those who see less conflict between health and taste and thus, will have smaller difference between representations of healthy versus unhealthy foods.

4.1.1. Participants

We opened the survey to 190 MTurk participants in exchange for $0.35. We powered this sample based on a logistic regression power calculation in G*Power indicating that 159 participants would be needed to have 80% power to detect an expected odds ratio of 1.6 (smaller than the effect size observed in Study 1A due to using a within-subjects design here). Accounting for expected participant attrition, we recruited 190 participants and screened out participants who could not consume meat or dairy. Our final sample of participants that passed all attention checks was 147 (36.7% female, 63.3% male; $M_{age} = 38$, $SD = 12$), yielding 80% power (alpha = 0.05) to detect a minimum odds ratio of 1.63.

4.1.2. Procedure

Participants completed the same procedure as in Study 1A, except this study was fully within-subjects (participants viewed all versions of all stimuli). In response to the question, "When you think of [food name], which picture looks more like the first thing that comes to mind?", participants chose between a more prepared and a less prepared version of the same food. The stimuli included the same photos of matched pairs of healthier and less healthy versions of similar foods used in Study 1A, with the exception of the brown rice/white rice pair and the oatmeal/Cookie Crisp cereal pair, which did not yield effects in Study 1A. Thus, participants in this study viewed each of 14 different foods (7 matched pairs of similar foods) in random order. At the end of the survey, participants responded to the moderator measures, which were standardized for analyses.

Our main moderator, healthiness-tastiness overlap, was measured in response to the question, "Which image below best shows how much healthy foods and tasty foods overlap?", where "1" shows healthy foods and tasty foods as two non-overlapping circles, and "7" shows healthy foods and tasty foods as two circles that overlap almost completely (adapted from the inclusion of other in the self (IOS) scale; Aron et al., 1992). To assess health consciousness as an exploratory moderator (Gould, 1988; Mai & Hoffmann, 2015), participants rated their agreement with (a) I think about my health a lot, (b) I'm very self-conscious about my health, and (c) I'm attentive to my inner feelings about my health (1 = strongly disagree, 5 = strongly agree). We averaged these items.

4.2. Results

We used a generalized linear mixed effects regression model that predicted food choice (0 = less prepared version, 1 = more prepared version) as a function of food healthiness (0 = unhealthy, 1 = healthy) × moderator variable, with random-intercept effects of participant and of food type (e.g., meats, pastas). First, we replicated the main effect from Study 1, with a similar effect size. Participants thought of healthy (vs. unhealthy) foods in their less prepared forms, $z = -9.20$, $b = -1.10$, 95% CI: [−1.35, −0.87], OR = 0.33, 95% CI: [0.26, 0.42], $p < 0.001$, translating to 3.0 times higher odds of mentally representing the more prepared form for unhealthy versions than healthier versions of foods.

Regarding our moderator measures, means and standard deviations were as follows: healthiness-tastiness overlap ($M = 4.31$, $SD = 1.69$), health consciousness ($M = 3.99$, $SD = 0.75$). Healthiness-tastiness overlap and health consciousness were moderately correlated, $r(145) = 0.27$, 95% CI:[0.11, 0.41], $p = 0.001$).

Supporting our main moderator hypothesis, healthiness-tastiness overlap (standardized) significantly interacted with food healthiness, $z = 2.43$, $b = 0.29$, 95% CI: [0.06, 0.53],[3] $p = 0.015$ (Fig. 5). Participants with greater healthiness-tastiness overlap were less likely to mentally represent healthy food as less prepared than unhealthy food.

Simple effects tests further showed that the interaction was driven by how participants think about healthy foods (with no effect for unhealthy foods). For healthy foods, the simple effect of healthiness-tastiness overlap, $z = 2.83$, $b = 0.31$, 95% CI: [0.10, 0.54], $p = 0.005$, indicated that those with higher overlap (less goal conflict) mentally represent healthy foods in more prepared forms. Individuals low in healthiness-tastiness overlap (−1 SD) mentally represented approximately 64% of healthier versions of foods in the more prepared form and those high in healthiness-tastiness overlap (+1 SD) mentally represented approximately 76% of healthier versions of foods in the more prepared form. There was no simple effect of healthiness-tastiness overlap for unhealthy versions of foods, $z = 0.09$, $b = 0.01$, 95% CI:[−0.22, 0.24], $p = 0.925$, indicating that participants think of unhealthy foods as mostly in their prepared forms regardless of taste-health goal conflict.

Health consciousness (standardized) also significantly moderated the effect of food healthiness on mentally representing foods as less prepared, $z = 2.39$, $b_{interaction} = 0.30$, 95% CI: [0.05, 0.55], $p = 0.017$. The moderation indicates that more health-conscious individuals were less likely to mentally represent healthy food as less prepared. We further find a simple effect of health-consciousness for healthy foods

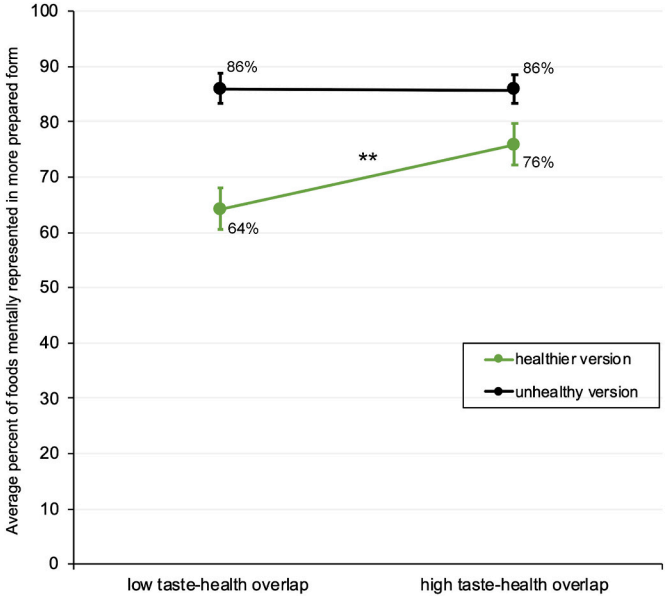

Fig. 5. Taste-health overlap moderates Mental Representations of Foods in Study 3

NOTE.—Plot depicts the proportion of healthier versions of foods (green line) and unhealthy versions of similarly matched foods (black line) that participants mentally represented in their more prepared form, split by low versus high taste-health overlap (−1 SD, +1 SD).

[3] Confidence interval calculated manually using standard error of the estimate because model would not converge using the "confint()" function for this generalized linear mixed effects model in R.

only. For healthy foods, the simple effect of health consciousness, z = 2.98, b = 0.32, 95% CI:[0.11, 0.53], p = 0.003, indicated that those higher in health consciousness thought of healthy foods in more prepared forms, whereas there was no simple effect of health consciousness for unhealthy foods, z = 0.15, b = 0.02, 95% CI:[−0.22, 0.25], p = 0.878.

In Study 3 we identified taste-health goal conflict and health consciousness as moderators of the differences in mental representations of healthy and unhealthy foods. Those who perceive less healthiness-tastiness conflict and who are higher in health consciousness have a smaller gap in thinking of unhealthy foods as more prepared than healthy foods. This moderation was driven by these groups showing a weaker tendency to think of healthy foods as unprepared, with little difference in how commonly they think of unhealthy foods as prepared (high for all groups). Even for people who perceive less healthiness-tastiness goal conflict (more overlap), however, the bias in mental representations was dampened, not eliminated. We replicated these results in Supplemental materials, Study 1S, where we further found similar attenuation among foodies, vegetarians/vegans and those who report eating a lot of vegetables.

5. Study 4: Are more prepared foods perceived as tastier?

5.1. Methods

What are the consequences of thinking of healthy foods as less prepared compared with unhealthy foods? Study 4 tested our hypothesis that people perceive (any) food as less tasty in its less prepared form. If healthy foods are represented in less prepared forms (Studies 1–3), and people believe that unprepared foods are less tasty, this could have implications for consumption of healthy foods. Study 4 tests the effect of mental representations on tastiness and health perceptions in the evaluation of dishes from a meal kit company (Blue Apron) which provides both images of all raw ingredients in a dish and the composed dish. We presented just one type of images (either raw ingredients or composed dish), predicting that foods would be perceived as tastier but as less healthy in their prepared compared with unprepared forms, and that this relationship would be true for both healthy and unhealthy foods.

5.1.1. Participants

We opened Study 4 (preregistered at https://aspredicted.org/C22_592) to 120 MTurk participants in exchange for $0.35, based on a power calculation (paired t-test) that we would need 89 participants to detect a small effect size of d = 0.3. We recruited only participants who could actually consume the depicted foods (e.g., no dietary restrictions). Our final sample of participants that passed all attention checks and indicated that they could consume meat and dairy was 94 (42.6% female, 56.4% male, 1.1% other; M_{age} = 34, SD = 9), yielding 80% power (alpha = 0.05) to detect a minimum effect size of d = 0.29.

5.1.2. Procedure

We presented participants with stimuli consisting of two photos of foods containing the exact same ingredients, presented as either separated and raw or as fully mixed and prepared. We used actual photos from Blue Apron meal service delivery kits for three healthy meals (marked with a "Wellness" light blue logo on the Blue Apron website, calories per serving for each dish = 450, 580, and 640 cal) and three less healthy meals (higher calorie meals not marked with any health logos on the Blue Apron website, calories per serving for each dish = 1,250, 1,050, and 920 cal). Participants were informed that they would be asked to view and rate 12 different recipes from a home delivery meal service kit. Participants then viewed 12 photos (one at a time in random order) of the three healthy dishes and three less healthy dishes in raw and prepared forms (see Supplemental materials). For each photo, they were asked "how tasty does this recipe look?" and "how healthy does this recipe look?" (1 = not at all tasty/healthy, 6 = extremely tasty/healthy).

5.2. Results

Confirming the hypothesis, we observed a significant effect of preparation on perceived tastiness. Mixed effects linear regression models with random-intercept effects of participant and of dish indicated that photos of prepared dishes were rated as being tastier recipes than photos of raw separated ingredients across all six recipes, t(1028) = 15.96, b = 0.91, 95% CI: [0.80, 1.02], p < 0.001 (Fig. 6). Subsetting and running separate models for healthy recipes and less healthy recipes showed that the positive effect of preparation on perceived tastiness was similar for both healthy recipes (t(469) = 10.61, b = 0.84, 95% CI: [0.68, 1.00], p < 0.001) and less healthy recipes (t(467) = 11.63, b = 0.98, 95% CI: [0.81, 1.14], p < 0.001), as there was no interaction of preparation × recipe healthiness on perceived tastiness, t(1027) = −1.19, b = −0.13, 95% CI: [−0.36, 0.09]; p = 0.236.

Consistent with our theorizing, we also observed a significant negative effect of preparation on perceived healthiness. Across all six recipes, photos of prepared dishes were perceived as significantly less healthy than photos of those same ingredients in raw form, t(1028) = −9.12, b = −0.49, 95% CI: [−0.60, −0.39], p < 0.001. Subsetting and running separate models for healthier and less healthy recipes showed that the effect of preparation on perceived healthiness was significantly

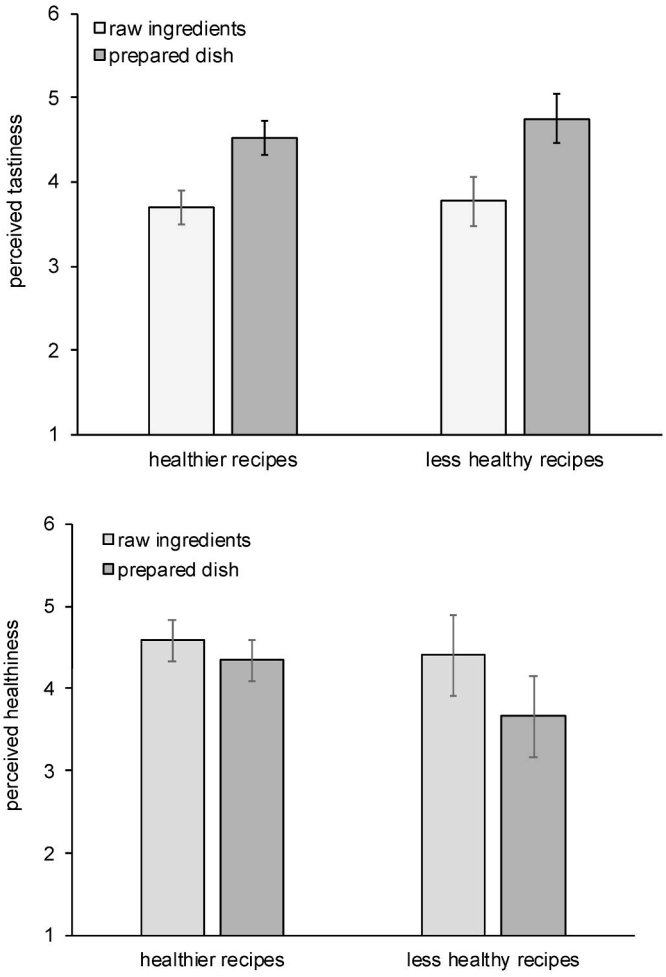

Fig. 6. Both healthy and less healthy recipes are perceived as tastier but less healthy in their more prepared (vs. less prepared) forms.
NOTE.— Plot depicts model estimates of perceived tastiness (top) and healthiness (bottom) of photos of healthier (left) and less healthy (right) Blue Apron recipes in either raw or prepared form in study 4. Error bars represent 95% CI.

negative for both healthier recipes ($t(467) = -3.43$, b = −0.24, 95% CI: [−0.37, −0.10], $p < 0.001$), and for less healthy recipes ($t(467) = -9.21$, b = −0.74, 95% CI: [−0.90, −0.59], $p < 0.001$). There was a significant interaction of condition preparation × recipe healthiness on perceived healthiness, $t(1027) = 4.76$, $b_{interaction} = 0.51$, 95% CI: [0.30, 0.72; $p < 0.001$. This indicated that preparation decreased perceived healthiness for less healthy recipes to a greater extent compared with healthier recipes.

In Study 4 we found that regardless of whether a food is healthy or unhealthy, the more prepared version of that food is perceived as tastier and less healthy than the less prepared version of that food. Both photos contained the same objective ingredients, demonstrating how preparation impacts judgments of a recipe using recipes and photos that people see when ordering meal kits. The findings suggest an important consequence for the findings of Studies 1–3. If people think of healthy foods in their least tasty forms and unhealthy foods in their most tasty forms, this may further exacerbate the difference in how appealing unhealthy foods are compared with healthy foods, particularly in moments of food choice.

6. Study 5: Effect of mental representations of food on choice

6.1. Methods

In Study 5, we manipulated the representation of food and measured the likelihood of ordering it. The result of people thinking of healthy foods in their less prepared form is that they think of less tasty versions of healthy foods than unhealthy foods. It follows that changing the way people think of healthy foods should increase the likelihood of choosing to eat these foods. Therefore, in Study 5, we tested whether people are more likely to choose healthier foods when additional language is added describing the ways in which they are prepared. We hypothesized that explicitly describing how healthy foods are prepared will lead to greater likelihood of ordering these foods. In contrast, people already mentally represent unhealthy foods in more prepared forms. Thus, we expected that adding additional language describing the ways in which unhealthy foods are prepared should have a lesser effect on food evaluations.

To test whether viewing additional information about the ways in which foods are prepared increases the evaluation of mainly healthy items, we presented participants with actual menu items from a popular restaurant (The Cheesecake Factory). Participants rated the dishes, expecting to enter a raffle for a gift card to order the dish that they rated most highly.

6.1.1. Participants

In Study 5 (preregistered at https://aspredicted.org/cu9ds.pdf), we opened the survey to 400 MTurk participants, based on a power analysis (unpaired *t*-test), indicating that 352 participants would be required to detect an effect size of $d = 0.3$ (80% power, alpha = 0.05) and assuming a similar level of attrition as in our prior studies. Because many of the dishes contained meat or dairy, we included in the study advertisement that those who do not eat meat or dairy would not be eligible to participate and we screened out participants at the beginning of the survey who indicated that they could not eat meat or dairy ($n = 82$). Our final sample included 383 participants (53.3% female, 46.2% male, 0.5% other or gender nonconforming; $M_{age} = 41$, $SD = 13$), yielding 80% power (alpha = 0.05) to detect a minimum effect size of $d = 0.29$.

6.1.2. Procedure

Participants were informed that they would be viewing and rating menu items from a popular American chain restaurant with many locations nationwide. To incentivize participants to rate items as truthfully as possible, we informed them that those who completed the study would be entered into a raffle to win a $15 gift card for the item that they rated the highest in the study. Participants were then randomized to either a basic condition or a descriptive condition. Participants in both conditions viewed four healthy items (artichokes, mushrooms, Brussels sprouts, salad) and four unhealthy items (pizza, pasta, burger, chicken wings), one at a time, in random order. The restaurant menu from the Cheesecake Factory has items specifically tagged as healthy because they were lower in calories ("Skinnylicious" menu), and we drew our sample of healthy menu items from this menu section. Unhealthy items represented high calorie items from the standard portion of the menu.

In the basic condition, the four healthy dish names were "artichokes", "mushrooms", "Brussels sprouts", and "salad" and the four unhealthy dish names were "pizza", "pasta", "burger", and "chicken wings." In the descriptive condition, the names provided additional information about how the dish was cooked, mixed, and topped (names based on descriptions from The Cheesecake Factory menu). For example, the artichoke dish was described "Chargrilled artichokes served with lemon-garlic aioli," and the pizza dish was described "Molto meat pizza with prosciutto, sausage, housemade meatball, pepperoni and smoked bacon with parmesan, mozzarella, and tomato sauce." All healthy dishes were from the healthy section of the menu and contained 570 calories or fewer. The unhealthy dishes were taken from the rest of the menu and contained more than 1120 calories. The two dependent variables were appeal (How appealing does this dish sound?, 1 = not appealing, 6 = extremely appealing) and likelihood of ordering (How likely are you to order it?, 1 = not at all likely, 6 = extremely likely). Participants rated these two questions while viewing each dish name before proceeding to the next dish.

In a pilot test, a separate group of 82 participants were asked to rate the extent to which they expected each dish to be prepared (42 participants rated the 8 basic dishes and 40 participants rated the 8 descriptive dishes). These participants were asked how likely they thought it was that each dish (a) has sauces or condiments added, (b) has herbs and spices added, (c) mixed different ingredients together, and (d) is cooked, roasted, grilled, or fried (1 = not at all likely, 5 = very likely). Expected preparation level was then calculated as the mean score of these four different preparation methods, except for the salad item which removed the question about being cooked. Pilot participants who viewed the descriptive version name of each healthy dish perceived it to be more prepared than those who viewed the basic version name of each healthy dish (Table S3). For each of the unhealthy dishes however, pilot participants who viewed the descriptive version did not perceive it as more prepared than the basic version (Table S3), supporting our hypothesis (i.e., in the absence of further information, even for a restaurant setting, participants expect healthy foods to be in a less prepared form until informed otherwise, whereas unhealthy foods are assumed to be prepared regardless of additional explicit information about preparation level).

6.2. Results

We used mixed effects linear regression models to predict the outcome (e.g., appeal, likelihood of ordering) as a function of the interaction of food healthiness (less healthy = 0, healthy = 1) × condition (basic = 0, descriptive = 1) with random-intercept effects of participant and of dish. First, there was a significant interaction of food healthiness (0 = unhealthy, 1 = healthy) × condition (0 = basic, 1 = descriptive) on how appealing the menu items were perceived, $t(2668) = 10.32$, b = 0.99, 95% CI: [0.80, 1.17], $p < 0.001$. Participants who viewed healthy items with a prepared description rated them as significantly more appealing than participants who viewed the same healthy items with no description, $t(381) = 6.78$, b = 0.80, 95% CI:[0.61, 1.00], $p < 0.001$. In contrast, participants who viewed unhealthy menu items with a prepared description rated them as no more or less appealing than participants who viewed the same unhealthy items with no description, $t(381) = 1.77$, b = −0.18, 95% CI: [−0.38, 0.02], $p = 0.078$.

Moving to the order outcome, as hypothesized, the same pattern of results was observed (healthiness × condition interaction on participants' likelihood of ordering menu items: $t(2668) = 8.68$, b = 0.89, 95%

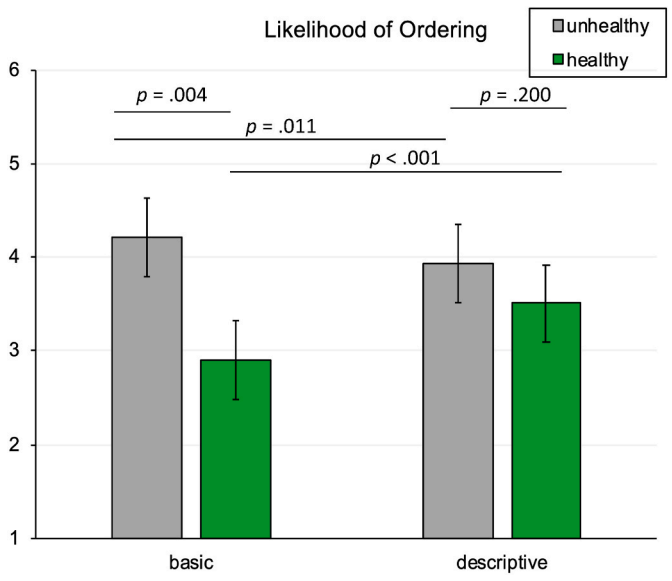

Fig. 7. Menus that describe how all foods as prepared increased preference for healthy menu items only (Study 5).
NOTE.— Plot depicts the likelihood of ordering unhealthy (gray) vs. healthy (green) menu items in the basic condition or in the condition that describes how all items are prepared. Error bars represent 95% confidence intervals.

CI: [0.69, 1.09], $p < 0.001$; Fig. 7). This interaction was driven by the change in ordering behavior for healthy items. Participants who viewed healthy items with a prepared description indicated that they were significantly more likely to order them than participants who viewed the same healthy items with no description, $t(381) = 4.83$, b = 0.61, 95% CI: [0.39, 0.83], $p < 0.001$.

Using actual menu items from a top-grossing casual dining U.S. restaurant chain, Study 5 demonstrated the consequence of differing mental representations of healthy and unhealthy foods on food decisions. Adding descriptions of how items are prepared increases the appeal and likelihood of ordering only healthy items compared to a menu that does not provide descriptions of the preparation of any items. For healthy foods, descriptions always increased the appeal of dishes, indicating that descriptions of various types of preparations improved how appealing participants were imagining the healthy dishes to be compared to what participants envisioned when no description was present. Although we found that The Cheesecake Factory's descriptions mention preparation in ways that increased preference for healthy foods, previous analyses of chain restaurant menus in the U.S. found that healthy menu items are described as less appealing than standard menu items in a variety of ways (e.g., mentioning mainly healthiness, not mentioning textures, flavors, engaging with your hands, or excitement; Turnwald, Jurafsky, et al., 2017). Thus, applied more broadly, this intervention of describing healthy menu items as more prepared is one way in which chain restaurants could close part of the gap in how appealing healthy and unhealthy menu items are described, which these results suggest could potentially encourage healthier choices.

7. General discussion

The present research explored differences in how people mentally represent healthy versus unhealthy foods in terms of a novel variable—the level of preparation. It also explores the implications for food decisions. We find that people both implicitly and explicitly represent healthier foods in less prepared forms. Not only did participants consistently think of healthy foods as being less prepared than unhealthy foods, but the images that participants chose in Study 1 indicated that healthy foods are often represented in forms that are not edible (e.g., raw beans, raw corn on the cob, raw eggplant). Results of an implicit associations test in Study 2 indicated that the effect size of this difference in mental representations is somewhere in between effect sizes observed in IATs testing the unhealthy = tasty intuition (Mai & Hoffmann, 2015; Raghunathan et al., 2006) and the unhealthy = filling intuition (Suher et al., 2016).

These mental representations result from perceiving conflict between health and taste. Thus, the effect is smaller among people in India and more health-conscious individuals in the U.S. These mental representations further influence consumption decisions. Because taste is a primary driver of food choice (Aggarwal et al., 2016; Glanz et al., 1998), and people are more likely to simulate eating and salivate more for tastier foods compared with less tasty foods (Papies et al., 2017), thinking of foods in more prepared forms make people more likely to choose those foods. Indeed, descriptions of how all foods on a menu are prepared shifted how likely participants said they were to order healthy dishes compared with unhealthy ones (Study 5). This strategy effectively closed the gap in preference for unhealthy foods over healthy foods by approximately half in the descriptive condition compared with the basic condition.

So, are people correct to mentally represent healthy foods as less prepared? Preparation often implies adding sauces, seasonings, or cooking methods that contain additional calories compared with a less prepared version of that food. Thus, preparation may make healthy foods less healthy. However, not all preparations are made equal, and there are many ways to flavorfully prepare healthy foods in ways that do not undermine health benefits. We find that people's mental representations of healthiness exaggerate the degree to which foods are unprepared and not ready to eat, overgeneralizing to a degree that can undermine their choice and enjoyment of healthy foods.

7.1. Theoretical and practical implications

The present research contributes to the rich literature on goal conflict, specifically as it applies to the (seemingly) competing goals of healthiness and tastiness (Fujita & Han, 2009; Hennecke & Bürgler, 2020; Hofmann et al., 2012; Kunz et al., 2023; Papies et al., 2015). Taste and health are positively correlated in the natural world, yet the presence of salient health and taste goals that guide the selection of food within a given choice set results in categorizing foods into healthy versus tasty and inferring that food that is healthy is less likely to be tasty, and food that is tasty is probably unhealthy. This leads people to mentally represent healthiness in opposition to preparations intended to make foods tastier. Moreover, it presents a barrier to enjoying healthy foods and represents a restrictive way of thinking about healthy eating.

We note that culture plays a role in the mental representation of healthy food. Indeed, we found a smaller effect of thinking of healthy food as unprepared in India. Further, certain groups (e.g., foodies, vegetarians, Supplemental materials, Study 1S) hold a diminished shared belief in healthiness-tastiness conflict via life experience and group-level norms.

This work also has important methodological implications. Presenting people with a healthier and less healthy food choice, or photos of healthier and less healthy foods, is a common dependent variable in lab studies. Lab studies that compare healthy foods to unhealthy foods typically use raw healthy foods but fully prepared unhealthy foods (e.g., some studies used images of healthy foods with no background and images of unhealthy foods served on a plate). These stimuli are likely portraying healthy foods and unhealthy foods as close to a category ideal as possible. However, it may exacerbate the reported differences in healthiness or tastiness, choice, or consumption. Such differences may not reflect how people actually consume healthier foods in the home as part of meals, in which healthy foods are more likely to be prepared.

This research further has implications for advising people on how to eat healthily. Photos of foods in varying degrees of preparation are ubiquitous in everyday lives, spanning physical spaces, online platforms,

advertisements, and media. Thus, the decision of how to depict foods holds the potential for broad impact. Our findings suggest that firms can cater to people with different health or taste goals by showing foods as more or less prepared, regardless of how prepared the foods being served actually are. For example, supermarkets, public health agencies, fitness studios, packaged food brands, or wellness-themed restaurants can present foods in less prepared forms to signal this value. However, if society starts presenting healthy foods as more prepared, mental representations may follow, akin to how recent marketing campaigns that expand the diversity of models' body sizes for beauty products may change the public's mental representations of beauty to be more inclusive and diverse.

To motivate people to want to eat healthier foods and feel like their taste buds will be satisfied, one could try showing healthy foods in their more prepared, more palatable forms. This would call for a change in how foods are depicted in many promotional materials, changes in describing healthy foods as more prepared on menus, and changes in education about how to prepare healthier foods. Depicting raw foods may communicate healthiness, but it also implies that the moment people start to prepare these foods to eat, they seem less healthy. Ironically the act of preparing healthy foods to eat conveys that they are not healthy anymore.

In recent years, this sentiment has gained traction in the public among those searching for the healthiest possible diet (e.g., raw food movement). Yet, if healthier foods were more enjoyable to eat, the increased intrinsic motivation to eat them (Woolley & Fishbach, 2016) may carry more benefits of sustaining healthier eating over the long term compared with consuming unprepared food in its pure form.

8. Conclusions

We find that people mentally represent healthier versions of foods and healthy foods (e.g., vegetables, legumes, and plant-based products) in less prepared forms than unhealthy versions of foods and unhealthy foods (e.g., red meats, desserts, refined carbohydrates). These differences emerged both implicitly and explicitly (Studies 1–2). The effect results from perceiving goal conflict between health and taste. It is stronger among participants from the U.S. versus India. Further, this effect was mitigated but not eliminated among people who perceive more overlap between tasty and healthy foods, and among individuals higher in health consciousness (Study 3).

The mental representations of healthy and unhealthy foods influence consumption decisions. Photos of more prepared foods were perceived as tastier (Study 4), and when a menu described how all dishes were prepared, people were more likely to select healthy options (Study 5).

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Ethical statement

Ethical approval was gained from the University of Chicago institutional review board (protocol IRB21-1156). All participants provided informed consent prior to participation.

CRediT authorship contribution statement

Bradley P. Turnwald: Writing – original draft, Formal analysis, Data curation, Conceptualization. **Ayelet Fishbach:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

Declarations of interest: none.

Data availability

For surveys and data, see https://osf.io/ums7y/.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107510.

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