



## Why do we eat cereal but not lamb chops at breakfast? Investigating Americans' beliefs about breakfast foods

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### ABSTRACT

Healthy breakfast consumption has a multitude of positive benefits. However, typical American breakfasts are notoriously unhealthy. We hypothesize that the resistance to include nutritious foods at breakfast is due in part to misconceptions about what “breakfast” should be. Consistent with this proposal, results from three studies ( $N = 1097$ ) suggest that American adults perceive typical breakfast foods as particularly well suited for breakfast and believe that more nutritious alternatives consumed at lunch or dinner are less appropriate for breakfast. As a result, people are unwilling to add more nutritious alternatives to their breakfast repertoire. To counter this rigidity, we devised an intervention passage emphasizing that (1) many foods became breakfast staples because of intensive marketing campaigns, and that (2) people in other cultures readily include lunch or dinner foods on their breakfast plate. This approach effectively revised people's beliefs about breakfast foods, and improved their motivation to adopt a healthier breakfast diet. Our findings demonstrate the power of a conceptually rich framework in undermining mistaken beliefs and boosting healthy eating behaviors.

For many years, nutrition scientists have emphasized the benefits of starting a day with healthy foods, which helps to improve cognitive function and well-being, prevent weight gain and obesity, and reduce the risk of developing chronic diseases (e.g., Rampersaud, Pereira, Girard, Adams, & Metz, 2005). Despite this, the traditional American breakfast is largely comprised of sugary and high caloric foods, often basically “disguised desserts” (Belluz & Zarracina, 2018). For example, cold cereal ranks first on the list of the most common foods Americans have for breakfast (Langer, 2005). Other sugar-laden or high carbohydrate foods, such as fruit juice and bread, are among the top food items Americans order for breakfast (The NPD Group, 2013). Such dietary behaviors seem to be established in childhood. A survey conducted by Public Health England (2016) reported that children under age ten are currently consuming more than 50% of the recommended daily allowance of sugar at breakfast in the form of sweetened cereals, sugary drinks and spreads. More strikingly, parents of these children are unaware of the sugary content of their children's breakfast; rather, they believe that this meal is healthy and beneficial (PHE, 2016).

This tension between the need to eat nutritious foods and actual dietary behaviors naturally gives rise to the question: Why are people willing to consume unhealthy food for breakfast? In fact, breakfasts in many other countries, such as Japan and Turkey, are nourishing, well-balanced and indistinguishable from their dinner foods (e.g., Sproesser

et al., 2018; Walloga, 2015). Here, we propose that one's *beliefs* about what the first meal of the day should be is having a deleterious impact on what they choose to eat at breakfast. Even though many foods have become the default breakfast items because of historical reasons (e.g., marketing campaigns), we argue that Americans have been misled to believe that some deep, essential properties of these foods, such as they are light and easy to digest, make them particularly well suited for breakfast.

The present studies, for the first time, investigate Americans' beliefs about what should be eaten at breakfast as well as their intention to pursue a healthy breakfast diet. It is important to document these beliefs for both practical and theoretical reasons. Evidence that believing traditional breakfast foods are more suitable than others for the first meal of the day would help explain why people resist improving their diet and, thereby, provide insights on how to devise effective interventions. This is in contrast to the commonly used interventions that target healthy eating behaviors by focusing on presenting simple facts to reveal the nutritional values of food items, but they have achieved less than satisfactory effects in changing people's dietary behaviors (e.g., Rekhy & McConchie, 2014). For example, despite the visibility of these fact-based interventions, American's actual average intakes of fruits and vegetables are consistently lower than the recommended levels (Moore & Thompson, 2015). Thus, we suspect that simply telling

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people which foods should be eaten at breakfast is not likely to be successful. As in other health domains, (e.g., Horne, Powell, Hummel, & Holyoak, 2015; Scott, Inbar, Wirz, Bossard, & Rozin, 2018), mistaken beliefs about breakfast could lead to problematic health behaviors. Here, we propose that the misconceptions that some foods are more appropriate for breakfast than others impede people from adopting a healthy morning diet. Examining these beliefs will improve our understanding of how to intervene to improve people's willingness to follow a healthy morning diet and to minimize the risk for serious health conditions.

Our interventions focus on revising people's misconceptions about breakfast foods. In particular, we devised short essays presenting two key messages. First, we highlight the extrinsic contextual factors leading people to believe that the commonly consumed breakfast items are well suited for breakfast. Specifically, the intervention passage shows how cereal and orange juice became breakfast staples through extensive marketing campaigns. If people's rigidity about what to eat for breakfast is a result of their misconceptions about the appropriateness of the breakfast foods, evidence suggesting that the current breakfast traditions are the result of advertising campaigns could effectively undermine these misconceptions, and increase people's willingness to consume healthy foods at breakfast. Second, we present cases demonstrating that, unlike Americans, people in other parts of the world do not draw a distinct line between breakfast foods and other foods; instead, they include a variety of nutritious foods on their breakfast plates. These cases highlight that there is no valid health reason to stick to the prototypical American breakfast.

Additionally, this work could speak to a potential cognitive mechanism that may contribute to people's misconceptions of breakfast foods. The fact that people believe that typical breakfast foods are particularly well suited for breakfast and other nutritious alternatives consumed at lunch or dinner are less appropriate for breakfast might be a product of the inheritance heuristic bias (Cimpian & Salomon, 2014) – a cognitive bias that leads people to explain observed and even arbitrary regularities in terms of postulated inherent features of the entities involved. To elaborate, people in general are motivated to generate explanations for observed regularities (e.g. girls wear pink). These explanations are often comprised of the most accessible information about the entity being explained (e.g., Kahneman, 2011; Wilson & Keil, 1998), which usually concerns the entity itself, the so-called “inherent information” (e.g., pink is soft and feminine; e.g., Hussak & Cimpian, 2018; McRae, Cree, Seidenberg, & McNorgan, 2005). However, using postulated inherent features to explain patterns is often mistaken, as many of these patterns result from historical developments. Take color/gender mapping as an example. Pink was a gender-neutral color during the nineteenth and early twentieth centuries (Paoletti, 2012). If one gender was favored over the other, pink was suggested to be used for boys than for girls occasionally (Hooper, 1890). And yet, the explanatory bias skews people's explanations for the observed regularities towards inheritance rather than their history, social contexts or relations with other entities. Equipped with these inherent explanations, it becomes reasonable to conclude that the regularities are natural and ought to be the way they are (“girls *should* wear pink”). Vice versa, transforming the current pattern to a different outlook seems undesirable and inappropriate (“it would be weird if boys wore pink”).

We propose that, people's reliance on the inheritance heuristic could lead them to view American breakfast traditions as being natural and appropriate. For example, to explain why cereal is commonly eaten for breakfast, someone might say “Cereal is filling and can sustain one until lunch,” or “Cereal is light and you should avoid heavy foods in the early morning.” In fact, cereal became a predominant breakfast choice because of extensive advertising and marketing campaigns initiated by the Kellogg family in the 1900s (Severson, 2016). Further intuitions are likely to follow the inherent explanations: If people eat cereal for breakfast because it is assumed to be filling (or light, or easy to digest) rather than some arbitrary factors, then it is reasonable to keep it as a

breakfast staple. Moreover, foods that are not typically consumed at breakfast may be assumed to lack the inherent properties that make them especially appropriate for the first meal of the day. As a result, it is legitimate to exclude these alternatives from the breakfast repertoire. For example, lamb chops could be perceived as too substantial to be suited for breakfast.

## 1. Overview of studies

Overall, the present research investigated three main questions. First, we examined people's prescriptive judgments about typical vs. atypical breakfast foods. Are foods typically consumed at breakfast judged to be more appropriate for breakfast than other foods (Studies 1–3)? Second, we assessed to what extent people are motivated to include nutritious alternatives to their breakfast menu (Studies 1–3). Lastly, we devised interventions targeting people's beliefs about what should be consumed at breakfast (Studies 2 and 3). In addition to testing the effectiveness of our interventions about people's misconceptions about breakfast foods, we explored the role of the inheritance bias in people's explanations.

Together, the three studies reported here present evidence showing that people assign mistaken value-laden judgments to breakfast foods, which has a negative downstream effect on their willingness to include nutritious foods to their breakfast repertoire. Despite this natural rigidity, by informing people about the marketing campaigns and cultural differences in breakfast foods, we were able to shift people's ideas about breakfast foods and motivate them to expand their breakfast menu.

## 2. Study 1

In this study, we presented participants with some food items that are typically consumed at breakfast and some other food items that are typically consumed at other times of the day, and assessed the perceived suitability of each food for breakfast. We also measured participants' willingness to include a set of nutritious lunch or dinner foods to their breakfast repertoire. Our main prediction is that the typical breakfast foods should be evaluated as more appropriate for breakfast than the atypical breakfast foods. In addition, people's evaluations of typical vs. atypical breakfast foods should predict their willingness to expand their breakfast menu: people who evaluate the typical foods more positively than the atypical foods should be less willing to try other nutritious alternatives at breakfast.

### 2.1. Method

#### 2.1.1. Participants

Participants ( $N = 100$ ;  $M_{\text{age}} = 34.69$ ; 50 women, 50 men) were recruited from Amazon's Mechanical Turk service. The sample size was determined with power analyses using effect sizes from studies on related topics (e.g., Hussak & Cimpian, 2015; Tworek & Cimpian, 2016). Participants were paid \$0.75 for participation. On average, participants have been living in the United States for 33 years and 4 months.

Seventy-eight percent of the participants were non-Hispanic White, 6% Asian American, 9% Black or African American, 4% Hispanic or Latino and 3% other. The median yearly household income was \$30,001 to \$50,000. Fifty-seven percent of the participants in the sample had at least a Bachelor's degree.

#### 2.1.2. Procedure and materials

Participants were directed to an online Qualtrics survey. After a brief demographic questionnaire, they were asked to answer some questions about “breakfast foods”. Next, participants received two measures in counterbalanced order, assessing their prescriptive judgments about breakfast foods and their willingness to try alternatives at breakfast.

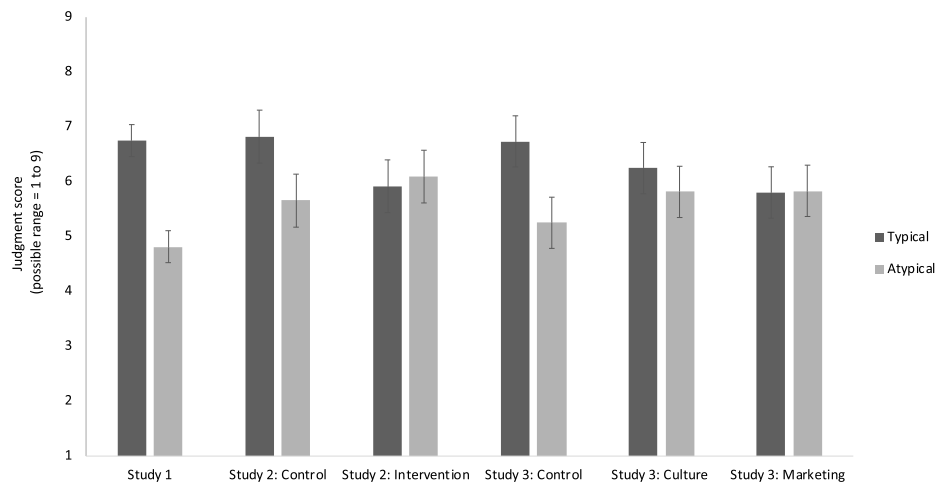


Fig. 1. People's prescriptive judgments of typical vs. atypical breakfast food items in the experimental (Study 2: intervention; Study 3: culture and marketing) and control conditions, across Studies 1–3. Error bars represent 95% confidence intervals.

In the judgment measure, participants were presented with three food items that are usually consumed at breakfast (i.e., orange juice, cereal, and protein bars) and three other food items that are usually consumed at other times of the day (i.e., chili, lamb chops, and macaroni and cheese). Half of the participants saw the typical items first, and half of them saw the atypical items first. Within each block, the food items were presented one at a time in a randomized order.

For each item, participants answered three questions adopted from Tworek and Cimpian (2016) that gauged their prescriptive judgments (e.g., “Is it right or wrong to have orange juice for breakfast?”; 1 = “extremely bad” to 9 = “extremely good”; see Table S1). These questions were averaged into an overall judgment score for each food item.

We also asked participants to provide justifications for their answers to these items. Justifications were collected for two purposes. First, they were intended to encourage thoughtful responses to the questions. Second, we used these justifications to examine the role of inference heuristics in forming misconceptions about breakfast foods (e.g., Cimpian & Salomon, 2014). Thus, we coded each response for its inference. An inherent response is one that refers to the features of breakfast or the food item itself (e.g., “cereal is a light meal with carbs to start the day”, “chili is a heavier food and breakfasts shouldn't be so heavy”), without making reference to external factors, historical events or personal preferences. Participants received 1 if they provided any inherent responses, and 0 otherwise. All responses were coded for inference by the first author, and a trained research assistant who was blind to the hypothesis. The intercoder agreement was 84.0%.

In the willingness measure, participants' tendency to expand their breakfast repertoire was measured. In particular, three new items (stew, salad, a bowl of soup) were presented one at a time in a randomized order. For each item, participants were asked to what extent they would like to try each food for breakfast (1 = “Definitely no” to 9 = “Definitely yes”).

### 2.1.3. Analytic strategy

The data and analytic code for this study, as well as all other studies reported here, are available on Open Science Framework: [https://osf.io/tzcx/?view\\_only=7fc9b303da7c43afa9a4a14d73ee7af4](https://osf.io/tzcx/?view_only=7fc9b303da7c43afa9a4a14d73ee7af4).

In all three studies, the data were analyzed with R for consistency. To test for main effects and interactions, we performed mixed-effects models using the *lme4* package in R (Bates, 2007). Unless otherwise noted, these mixed-effects models included random intercepts for both items and subjects. To test for mediation in Studies 2 and 3, we conducted mediation analyses using the *mediate* package in R (Tingley, Yamamoto, Keele & Imai, 2013). Note that this was a departure from

the pre-registration, in which we intended to test the mediation effects using the Model 4 in PROCESS in SPSS (Hayes, 2013). For completeness, however, we also conducted these pre-registered analyses (see Figs. S2–S3); their results are in agreement with the results produced by the *mediate* package.

## 2.2. Results and discussion

In this study, we tested three predictions: First, participants should evaluate the foods typically eaten in the morning as better suited for breakfast than foods typically eaten at other times of the day. Second, the prescriptive judgments about typical vs. atypical breakfast foods should be predicted by people's tendency to use inherent features to explain the breakfast traditions. Lastly, the difference in people's judgments about the suitability of typical vs. atypical breakfast foods should predict their motivation to include nutritious alternatives into their breakfast menu.

To test the first two predictions, we performed a multilevel mixed-effects linear regression on participant's judgment score about each food item (level 1), nested within participant (level 2). The model included typicality (0 = typical, 1 = atypical; level-2 predictor) and inference of each item (0 = non-inherent, 1 = inherent; level-2 predictor), plus the interaction between the two predictors as fixed effects and random intercepts by item and by participant. Consistent with our first prediction, the results revealed a significant effect of typicality on prescriptive judgments of foods eaten at breakfast. Specifically, people evaluated the traditional breakfast foods ( $M = 6.75$ ,  $SE = 0.15$ ) as better suited for breakfast and should be eaten at breakfast than traditional “lunch” or “dinner” food ( $M = 4.82$ ,  $SE = 0.15$ ),  $b = 1.24$ ,  $SE = 0.16$ ,  $t = 7.64$ ,  $p < .001$  (see Fig. 1). This main effect was qualified by an interaction between typicality and inference,  $b = 2.54$ ,  $SE = 0.33$ ,  $t = 7.81$ ,  $p < .001$ . Compared to people who applied extrinsic reasons to justify the suitability of a particular food for breakfast, people who endorsed an inherent explanation were more likely to believe that the typical breakfast foods were better and more desirable than the atypical breakfast foods. This is consistent with the possibility that inference heuristic underpins the tendency to justify the current breakfast traditions.

Does people's prescriptive judgment of typical vs. atypical breakfast foods predict their willingness to try other nutritious alternatives? We performed a multilevel mixed-effects linear regression on participant's willingness score averaged across the three items (level 1), nested within participant (level 2). The model included the difference score in people's judgments about typical vs. atypical breakfast foods (level-2 predictor) as a fixed effect and a random intercept by participant.

Consistent with our prediction, people's prescriptive judgment of typical vs. atypical breakfast foods negatively predicted their willingness to eat healthy lunch or dinner food for breakfast,  $b = -0.48$ ,  $SE = 0.10$ ,  $t = -5.02$ ,  $p < .001$ . People who believe that the traditional breakfast foods are better suited for breakfast than the non-traditional ones are also less willing to try other nutritious alternatives at breakfast.

### 2.3. Conclusion

As predicted, people tended to be relatively rigid about what should be consumed at breakfast. They assign value-laden judgments to food items, perceiving the foods typically consumed at breakfast as better suited for breakfast than other foods, which predicts their decisions to reject atypical breakfast foods that are healthier and more nutritious.

## 3. Study 2

Study 2 was preregistered on the Open Science Framework: [https://osf.io/fnyhs/?view\\_only=d9379de1cd544463835da1ede6a83d63](https://osf.io/fnyhs/?view_only=d9379de1cd544463835da1ede6a83d63). Our goal was to devise an intervention targeting people's misconceptions about breakfast foods and facilitating their motivation to consume nutritious alternatives at breakfast. To achieve this goal, we designed an essay incorporating two key messages: (1) the role of marketing campaigns in forming breakfast eating traditions and (2) the variation of breakfast foods in other parts of the world. We presented these messages, because in other domains providing extrinsic reasons or counterexamples for regularities has been demonstrated to effectively reduce the inherence bias in explanations, which in turn loosens people's adherence to social norms and conventions (e.g., Cimpian & Salomon, 2014; Hussak & Cimpian, 2015; Tworek & Cimpian, 2016).

### 3.1. Method

#### 3.1.1. Participants

Participants ( $N = 399$ ;  $M_{\text{age}} = 37.15$ ; 196 women, 201 men and 1 reported "other") were recruited from Amazon's Mechanical Turk service. The sample size for this study, as well as Study 3, was determined to achieve 80% power based on pilot results, in order to detect a condition effect on people's prescriptive judgments and willingness. They were paid \$1.00 for participation. On average, participants have been living in the United States for 35 years and 7 months.

Seventy-five percent of the participants were non-Hispanic White, 6.5% Hispanic or Latino, 11% Black or African American, 0.5% Native Hawaiian or other Pacific Islander, 4% Asian American, 3% Native American and 1% other. The median yearly household income was \$30,001 to \$50,000. Sixty-three percent of the participants in the sample had at least a bachelor's degree.

#### 3.1.2. Procedure and materials

Participants were randomly assigned into either a control or an intervention condition. Participants in the intervention condition (but not the control condition) read an essay with two key messages. First, the essay presented a history of how orange juice and cereal became common breakfast foods, illustrating that the current breakfast traditions were a result of successful marketing campaigns. Second, the essay depicted the typical breakfast foods in Japan and Egypt, suggesting that people in other parts of the world value quality in making breakfast food choices and they routinely consume healthy lunch or dinner foods for breakfast (for the full text, see Table S2 in the online supplemental material). After reading, we asked participants to summarize the main points of the essay to check for comprehension.

After the reading phase, the procedure was similar to that of Study 1, with two major changes to the measures. First, we used "hummus and pita bread" to replace the item "macaroni and cheese", which was perceived as unhealthy by 90% of the participants who considered

nutritional value in making their judgments in Study 1. Therefore, across all the items, the healthfulness of the food was pitted against its typicality for breakfast. This change strengthened our manipulation, allowing us to examine if typicality was given more weight than nutritional value when considering the appropriateness of certain foods for breakfast. Second, we elicited justifications from participants in the willingness measure as well.

As in Study 1, people's justifications were coded for inherence by the first author (without knowledge of the condition), and a trained research assistant who was blind to both the condition and the hypothesis. The intercoder agreement was 91.5%.

### 3.2. Results and discussion

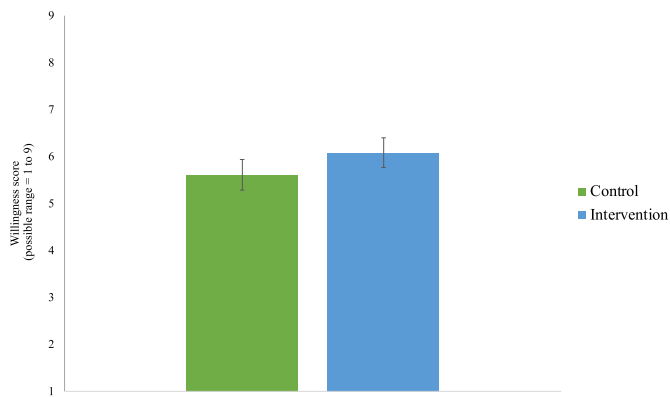
#### 3.2.1. Prescriptive judgment

We expected our intervention essay to lower people's rigidity about breakfast foods, undermining their tendency to prefer typical over atypical breakfast foods in their evaluations. To test out this prediction, we submitted the data to a multilevel mixed-effects linear regression on participant's judgment score of each food item (level 1), nested within participant (level 2). The model included condition (0 = control, 1 = intervention; level-2 predictor), typicality (0 = atypical, 1 = typical; level-2 predictor), inherence of each item in the judgment measure (0 = non-inherent, 1 = inherent; level-2 predictor), and the two-way and three-way interactions between the predictors as fixed effects and random intercepts for participant and item. As predicted, the results revealed a significant interaction between condition and typicality,  $b = -1.05$ ,  $SE = 0.16$ ,  $t = -6.51$ ,  $p < .001$  (see Fig. 1). We replicated our previous results in the control condition, in which typical breakfast foods ( $M = 6.82$ ,  $SE = 0.25$ ) were perceived as more appropriate for the morning meal than the atypical breakfast foods ( $M = 5.66$ ,  $SE = 0.25$ ),  $p = .026$ . As predicted, the intervention passage corrected people's misconceptions about breakfast foods, leading them to rate the atypical breakfast foods ( $M = 6.09$ ,  $SE = 0.24$ ) as not significantly different from the typical breakfast foods ( $M = 5.92$ ,  $SE = 0.24$ ) in terms of their suitability for breakfast,  $p = 1.00$ . Note that, the intervention group ( $M = 6.26$ ) evaluated protein bars, which did not overlap with the examples in the intervention passage, less appropriate for breakfast than the control group ( $M = 6.70$ ),  $p = .011$ , suggesting that our intervention has some potential to change people's prescriptive judgments about breakfast foods in general.

To further test the effect of the intervention passage on people's prescriptive judgments, we also examined the control vs. intervention differences, separately for the typical items and atypical items. Consistent with our prediction, the intervention group evaluated the typical but unhealthy breakfast foods less positively than the control group,  $p < .001$ ; by contrast, the intervention group evaluated the atypical but healthy breakfast foods more positively than the control group,  $p = .002$ . Thus, the intervention essay successfully altered people's attitudes about breakfast foods, leading them to weigh quality over traditions when making judgments about the suitability of foods.

Additionally, the model also uncovered a three-way interaction among condition, typicality and inherent reasoning,  $b = -0.97$ ,  $SE = 0.31$ ,  $t = -3.16$ ,  $p = .002$ , suggesting that inherent reasoning moderated the condition effect on people's prescriptive judgments about typical vs. atypical breakfast foods. In particular, the intervention was more effective in changing inherent reasoners' attitudes about typical vs. atypical breakfast foods. Compared to the control group, inherent reasoners in the intervention group rated the typical breakfast foods less appropriate for breakfast ( $M_{\text{control}} = 7.38$ ,  $SE = 0.27$ ,  $M_{\text{intervention}} = 6.14$ ,  $SE = 0.28$ ,  $p < .001$ ), and the atypical items more appropriate for breakfast ( $M_{\text{control}} = 4.94$ ,  $SE = 0.27$ ,  $M_{\text{intervention}} = 5.73$ ,  $SE = 0.26$ ,  $p < .001$ ). In contrast, the intervention lowered extrinsic reasoners' evaluations about typical breakfast foods ( $M_{\text{control}} = 6.58$ ,  $SE = 0.25$ ,  $M_{\text{intervention}} = 5.82$ ,  $SE = 0.25$ ,  $p < .001$ ), but did not change their beliefs about atypical breakfast foods





**Fig. 2.** People's willingness to include healthy alternatives at breakfast, by control vs. intervention condition in Study 2. Error bars represent 95% confidence intervals.

significantly ( $M_{\text{control}} = 5.96$ ,  $SE = 0.25$ ,  $M_{\text{intervention}} = 6.25$ ,  $SE = 0.25$ ,  $p = .075$ ).

### 3.2.2. Willingness

Another main prediction of our account is that, our intervention should promote people's willingness to consume healthy foods as opposed to crafting their breakfast menus to obey long-existing traditions. To examine the effect of the intervention on people's tendency to sample other alternatives, we performed another multilevel mixed-effects linear regression on participants' willingness score of each food item (Level 1), nested within participant (Level 2). The model included condition (0 = control, 1 = intervention; level-2 predictor) as a fixed effect, and random intercepts for participants and items. Consistent with our prediction, the main effect of condition was significant,  $b = 0.47$ ,  $SE = 0.21$ ,  $t = 2.23$ ,  $p = .026$  (see Fig. 2). After reading the intervention essay, people became more willing to expand their breakfast menu ( $M_{\text{control}} = 5.61$ ,  $SE = 0.17$ ,  $M_{\text{intervention}} = 6.08$ ,  $SE = 0.16$ ).

### 3.2.3. Judgment as a mediator for willingness

We also took a step to investigate whether people's judgments about the suitability of foods mediates the relation between condition and their willingness to expand their breakfast menu. We used standardized composite scores on the judgment and willingness measures. First, a mediator linear regression model was fitted to predict judgment scores for typical vs. atypical breakfast foods by condition (control vs. intervention). Second, an outcome linear regression model was fitted to predict willingness scores by judgment difference scores and condition (control vs. intervention). A mediation analyses was then performed with these two models using the "mediate" package in R (Tingley, Yamamoto, Keele & Imai, 2013) with a bootstrap method with 10,000 iterations. The results showed that the total effect was significant (mean total effect = 0.22,  $p = .026$ , 95% CI of bootstrapped samples = [0.03, 0.41]). Judgments about food suitability fully mediated this relationship (mean indirect effect = 0.24,  $p < .001$ , 95% CI of bootstrapped samples = [0.15, 0.34]), so that the effect of the direct path in the mediation model became insignificant (mean direct effect =  $-0.02$ , 95% CI of bootstrapped samples = [ $-0.21$ , 0.18],  $p = .867$ ; see Fig. 3). This suggests that the intervention influences people's perceived suitability of different foods, which has a downstream effect on their willingness to try nutritious lunch or dinner foods at breakfast, although we acknowledge that mediation analysis is a correlational technique and therefore cannot provide ultimate evidence for causality.

### 3.2.4. Inherent reasoning as mediator for judgment or willingness?

We examined if the effect of our intervention on people's judgments and willingness to eat atypical breakfast foods was mediated by their

inherent reasoning. First, we tested whether inherent reasoning mediates the effect of condition on perceived suitability of typical vs. atypical foods for breakfast. Two linear regression models were fitted: one was fitted to predict the composite inherence scores across six judgment items by condition (control vs. intervention), and the other was fitted to predict composite judgment scores by inherence scores and condition (control vs. intervention). The results showed that from the total effect of condition on prescriptive judgments (mean total effect =  $-0.68$ ,  $p < .001$ , 95% CI of bootstrapped samples = [ $-0.87$ ,  $-0.50$ ]), only 1.8% of the total variance was mediated by inherent reasoning (mean indirect effect =  $-0.012$ ,  $p = .67$ , 95% CI of bootstrapped samples = [ $-0.07$ , 0.04]), with the direct effect remaining significant (mean indirect effect =  $-0.67$ ,  $p < .001$ , 95% CI of bootstrapped samples = [ $-0.84$ ,  $-0.49$ ]). Thus, inherent reasoning did not mediate the condition effect on prescriptive judgments.

Next, we tested whether inherent reasoning mediates the effect of condition on willingness to eat atypical foods at breakfast. A mediator linear regression model was first fitted to predict the composite inherence scores across three items in the willingness measure by condition (control vs. intervention). Next, an outcome linear regression model was fitted to predict willingness scores by inherence scores and condition (control vs. intervention). Similarly, the mediation model was insignificant. From the total effect of condition on willingness (mean total effect = 0.21,  $p = .038$ , 95% CI of bootstrapped samples = [0.01, 0.40]), less than 0.1% of the total variance was mediated by inherent reasoning (mean indirect effect =  $-0.002$ ,  $p = .94$ , 95% CI of bootstrapped samples = [ $-0.04$ , 0.04]), and the direct effect remained significant (mean indirect effect = 0.21,  $p = .031$ , 95% CI of bootstrapped samples = [0.02, 0.40]). This suggests that inherent reasoning did not mediate the condition effect on willingness to expand breakfast repertoire.

Overall, participants' weaker preference for the typical over atypical breakfast foods and their stronger willingness to include nutritious alternatives at breakfast in the intervention condition was not due to their diminished preference for inherent explanations. However, our manipulation effect was particularly salient for people who relied on inherent reasons in explaining the breakfast traditions, presumably because the gap in their judgments about typical vs. atypical breakfast foods was wide enough to allow for a more sensitive detection of the intervention effect.

### 3.2.5. Conclusion

By simply reading an essay suggesting that the American breakfast traditions are arbitrary consequences of marketing campaigns and differ from other cultures, people revised their misconceptions about breakfast foods and became more willing to include healthy lunch or dinner foods at breakfast. In other words, this essay led people to perceive the atypical but healthy breakfast foods as more appropriate, and the typical but unhealthy breakfast foods as less appropriate than they had before, which in turn explained their stronger intention to adopt a healthy morning diet.

## 4. Study 3

Study 2 provides support for the effectiveness of a conceptually rich intervention in revising people's beliefs about typical vs. atypical breakfast foods, which in turn facilitates the motivation to add nutritious alternatives to their breakfast menu. Because the intervention essay conveys two distinct messages, we wanted to examine to what extent each message exhibited an independent effect in shaping people's beliefs. Thus, in Study 3, we broke down the integrative essay to two short passages. One passage showed that people in other parts of the world often cross the boundary between breakfast foods and lunch or dinner foods so that a richer variety of foods are included in their breakfast menu. The other passage suggested that the misconceptions about breakfast foods are a result of marketing campaigns, not because

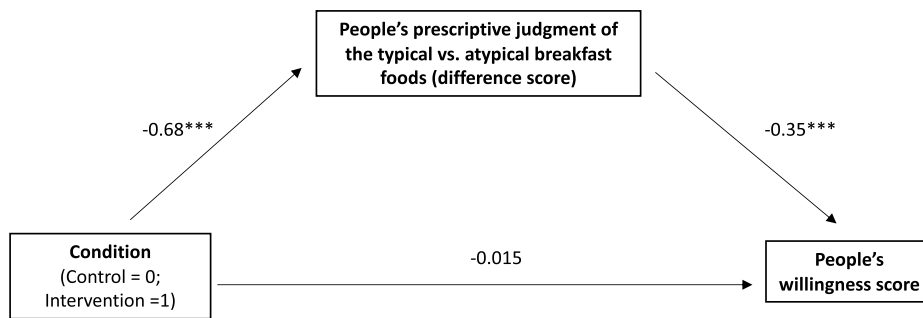


Fig. 3. The effect of condition (control vs. intervention) on people's willingness to include healthier alternatives at breakfast was mediated by the difference in people's prescriptive judgments toward typical vs. atypical breakfast foods. The mediator and the dependent variable were standardized prior to entering in the mediation analysis. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

these foods are especially suitable for breakfast. Study 3 was pre-registered on the Open Science Framework: [https://osf.io/6rc9v/?view\\_only=dc52811e8f914b4cb0213314b4edc5cf](https://osf.io/6rc9v/?view_only=dc52811e8f914b4cb0213314b4edc5cf).

#### 4.1. Method

##### 4.1.1. Participants

Participants ( $N = 598$ ;  $M_{\text{age}} = 36.59$ ; 346 women, 252 men) were recruited from Amazon's Mechanical Turk service. On average, they have been living in the United States for 35 years and 2 months. They were paid \$0.75 for participation.

Seventy-two percent of the participants were non-Hispanic White, 7% Hispanic or Latino, 11% Black or African American, 7% Asian American, 1% Native American and 2% other. The median yearly household income was \$50,001 to \$70,000. Sixty-two percent of the participants in the sample had at least a Bachelor's degree.

##### 4.1.2. Procedure and materials

The procedure and measures of Study 3 were essentially identical to those of Study 2, except that participants were randomly assigned into one of three conditions: control, culture, or marketing conditions. Participants in the culture condition read an essay stating that breakfast traditions from other parts of the world value quality over the issue of timing. Participants in the marketing condition read another essay stating that people were misled to think some foods are suitable for breakfast because of successful marketing campaigns (for the full passages, see Table S3 in the online supplemental material). Participants in the control condition were not exposed to these messages.

The first author (unaware of the condition) and a trained research assistant (blind to both the condition and hypothesis) coded people's justifications for inhere. The intercoder agreement was 90.6%.

#### 4.2. Results and discussion

##### 4.2.1. Prescriptive judgment

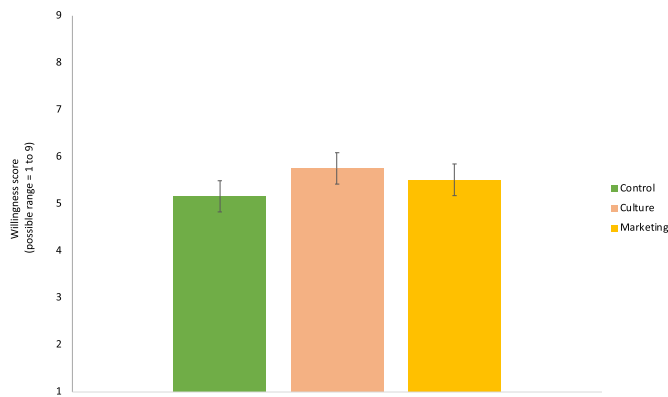
As in Study 2, we first submitted the data to a multilevel mixed-effects linear regression on participant's judgment score of each food item (level 1), nested within participant (level 2). The model included condition (0 = control, 1 = culture, 2 = marketing; level-2 predictor), typicality (0 = typical, 1 = atypical; level-2 predictor), inhere of each item in the judgment measure (level-2 predictor), and the two-way and three-way interactions between the predictors as fixed effects and random intercepts for participant and item. The results revealed a significant interaction between condition and typicality,  $F(2, 3007) = 73.08$ ,  $p < .001$  (see Fig. 1). Again, the pattern of the results in the control condition paralleled that of the first two studies, in which people perceived the typical foods as more appropriate than the atypical breakfast foods ( $p < .001$ ), but this difference in judgment became insignificant in the culture ( $p = .540$ ) and marketing conditions ( $p = 1.00$ ). We also tested the condition effect for typical and atypical items separately. Consistent with our prediction, the culture group ( $M = 6.25$ ,  $SE = 0.24$ ) and the marketing group ( $M = 5.80$ ,  $SE = 0.24$ ) expressed lower positive attitudes towards the typical breakfast foods

than the control group ( $M = 6.74$ ,  $SE = 0.24$ ; culture vs. control:  $p = .003$ ; marketing vs. control:  $p < .001$ ). As for the atypical breakfast food items, people in both and the culture ( $M = 5.82$ ,  $SE = 0.24$ ) and the marketing conditions ( $M = 5.84$ ,  $SE = 0.24$ ) displayed more positive attitudes than people in the control condition ( $M = 5.25$ ,  $SE = 0.24$ ; culture vs. control:  $p < .001$ ; marketing vs. control:  $p < .001$ ). Thus, both essays were proved to be effective in changing people's attitudes about breakfast foods. When comparing the two intervention essays, we found that both essays were similarly effective in enhancing people's positive attitudes about atypical breakfast foods,  $p = 1.00$ , but the marketing essay had a stronger effect in undermining people's positive attitudes about typical breakfast foods than the culture essay,  $p = .022$ . This condition difference was not entirely surprising, as the marketing essay explicitly claimed that many typical breakfast foods, such as cereal and orange juice, became breakfast staples through extensive marketing campaigns as opposed to entailing inherent facts, whereas the culture essay provided cases distinct from the American breakfast traditions without explicitly explaining the reasons underlying the variations.

The model also uncovered several other significant results revealing that inhere moderated the intervention effect on people's judgments about breakfast foods. First, there was an interaction between typicality and inhere,  $F(1, 3263) = 77.23$ ,  $p < .001$ . People attributing the breakfast traditions to inhere judged the typical breakfast foods ( $M = 6.53$ ,  $SE = 0.23$ ) more appropriate than the atypical foods ( $M = 5.18$ ,  $SE = 0.23$ ),  $p < .001$ ; In contrast but as predicted, people who did not endorse these inherent attributions perceive the typical ( $M = 6.12$ ,  $SE = 0.23$ ) and atypical food items ( $M = 5.88$ ,  $SE = 0.23$ ) as not significantly different in their suitability for breakfast,  $p = .877$ . Second, replicating Study 2, we found a three-way interaction among condition, typicality and inherent reasoning,  $b = -0.97$ ,  $SE = 0.31$ ,  $t = 3.16$ ,  $p = .002$ , suggesting a moderation effect of inherent reasoning. In particular, the two intervention essays were more effective in changing inherent reasoners' attitudes about typical vs. atypical breakfast foods. Inherent reasoners in the culture ( $M = 6.45$ ,  $SE = 0.26$ ,  $p < .001$ ) and the marketing conditions ( $M = 5.90$ ,  $SE = 0.27$ ,  $p < .001$ ) rated the typical breakfast foods as less appropriate for breakfast than the control group ( $M = 7.21$ ,  $SE = 0.26$ ); On the contrary, inherent reasoners in the culture ( $M = 5.53$ ,  $SE = 0.26$ ,  $p < .001$ ) and marketing conditions ( $M = 5.51$ ,  $SE = 0.26$ ,  $p < .001$ ) rated the atypical breakfast foods as more suitable for breakfast than the control group ( $M = 4.52$ ,  $SE = 0.25$ ). These effects became weaker to insignificant in extrinsic reasoners.

##### 4.2.2. Willingness

Next, we investigated if each essay promoted people's willingness to consume healthy foods. We performed another multilevel mixed-effects linear regression on participants' willingness score of each food item (Level 1), nested within participant (Level 2), as a function of condition (0 = control, 1 = culture, 2 = marketing; level-2 predictor) as a fixed effect and random intercepts for participants and items. The main effect of condition was significant,  $F(2, 596) = 3.71$ ,  $p = .025$  (see Fig. 4). In particular, compared to the control group ( $M = 5.16$ ,  $SE = 0.17$ ), the



**Fig. 4.** People's willingness to include healthy alternatives at breakfast, by control vs. culture vs. marketing condition in Study 3. Error bars represent 95% confidence intervals.

essay emphasizing culture variation ( $M = 5.76$ ,  $SE = 0.17$ ) enhanced people's willingness to try healthy alternatives at breakfast,  $p = .006$ . The effect of the marketing essay ( $M = 5.51$ ,  $SE = 0.17$ ) on people's willingness trended in the same direction but did not reach significance,  $p = .112$ , suggesting presenting examples contradictory to the breakfast traditions were particularly effective in promoting people's willingness to adopt a healthy diet in the morning.

#### 4.2.3. Judgment as a mediator for willingness

We examined whether people's judgments about the suitability of foods mediates the relation between the control vs. culture conditions and their willingness to expand their breakfast menu. First, a mediator linear regression model was fitted to predict judgment scores for typical vs. atypical breakfast foods by condition (control vs. culture). Second, an outcome linear regression model was fitted to predict willingness scores by judgment difference and condition (control vs. culture). A mediation analyses was then performed with these two models using the "mediate" package in R (Tingley, Yamamoto, Keele & Imai, 2013) using a bootstrap method with 10,000 iterations. The results showed that the total effect was significant (mean total effect = 0.27,  $p = .006$ , 95% CI of bootstrapped samples = [0.07, 0.47]). Judgments about food suitability fully mediated this relationship (mean indirect effect = 0.25,  $p < .001$ , 95% CI of bootstrapped samples = [0.15, 0.35]) so that the effect of the direct path in the mediation model became insignificant (mean direct effect = 0.02, 95% CI of bootstrapped samples = [-0.16, 0.20],  $p = .822$ , see Fig. 5a). This suggests that the passage emphasizing the variation of breakfast foods enhanced people's intention to try healthy alternatives at breakfast, in part because it corrected people's tendency to view typical breakfast foods as more appropriate and desirable than the atypical ones for the morning meal.

Next, an analogous set of analyses contrasting the control and marketing conditions revealed a similar pattern of findings. The total effect was insignificant (mean total effect = 0.16,  $p = .116$ , 95% CI of bootstrapped samples = [-0.04, 0.36]), but there was an indirect effect of condition on willingness via judgment (mean indirect effect = 0.37,  $p < .001$ , 95% CI of bootstrapped samples = [0.26, 0.49]) so that the effect of the direct path in the mediation model became negative (mean direct effect = -0.21, 95% CI of bootstrapped samples = [-0.39, -0.02],  $p = .031$ , see Fig. 5b). This suggests that the messages suggesting the breakfast traditions are a result of marketing campaigns decrease the difference in people's judgments about typical vs. atypical breakfast foods, which in turn increases their willingness to try healthy alternatives.

#### 4.2.4. Inherent reasoning as mediator for judgments or willingness?

A set of mediation analyses analogous to that conducted in Study 2 provided no support for the mediating effect of inherent reasoning on

prescriptive judgments or willingness. We first contrasted the culture and control conditions. The indirect effect of condition on prescriptive judgments via inference was insignificant (mean indirect effect = -0.03,  $p = .27$ , 95% CI of bootstrapped samples = [-0.10, 0.02]). Similarly, the mediating effect of inference from condition on willingness was insignificant as well (mean indirect effect = 0.03,  $p = .30$ , 95% CI of bootstrapped samples = [-0.02, 0.08]).

Parallel results revealed when we contrasted the marketing and control conditions. Inherent reasoning did not mediate the condition effect on prescriptive judgments (mean indirect effect = -0.04,  $p = .13$ , 95% CI of bootstrapped samples = [-0.11, 0.01]), or willingness (mean indirect effect = 0.03,  $p = .18$ , 95% CI of bootstrapped samples = [-0.02, 0.09]). Therefore, consistent with Study 2, reliance on inherent reasoning did not mediate the effect of our intervention on people's evaluations of breakfast foods or their willingness to consume nutritious alternatives at breakfast. Rather, the effect of our intervention essays was heightened for people who tended to explain breakfast traditions via inherent features.

#### 4.2.5. Conclusion

Our findings suggest that messages emphasizing the arbitrariness of current breakfast traditions or the variations of breakfast foods around the world have independent effect in shaping people's beliefs. As in the previous study, each message led people to perceive the atypical but healthy breakfast foods as more appropriate, and the typical but unhealthy breakfast foods as less appropriate than they had before, and these differences predicted their stronger intention to adopt a healthy morning diet.

## 5. General discussion

The present research provides the first investigation of Americans' beliefs about which food items should be consumed at breakfast. The three studies reported here present consistent evidence showing that American adults are relatively rigid about breakfast foods. The perceived suitability of a food for breakfast is closely related to its typicality at breakfast, as opposed to the food quality. Specifically, people believe that typical breakfast foods are particularly well suited for breakfast, whereas more nutritious alternatives consumed at lunch or dinner are less appropriate for breakfast. As a result, people are unwilling to add healthy alternatives to their breakfast repertoire, setting up barriers for pursuing a healthy diet overall.

To rectify this rigidity and boost the motivation to eat healthy foods, we adopted a conceptually based approach, which is distinct from the commonly used approaches that target healthy eating behaviors by presenting simple facts to reveal the nutritional values of food items or advising people on what they should eat. These existing approaches have achieved less than satisfactory effects in changing people's dietary behaviors (e.g., Rekhly & McConchie, 2014). Given that people's reluctance to eat nutritious alternatives at breakfast is in part due to their mistaken beliefs about breakfast foods, our intervention focuses on correcting the misconceptions by emphasizing two key messages. In particular, the intervention presents cases indicating that (1) breakfast traditions are a result of intensive marketing campaigns, and (2) people in other cultures include a variety of foods on their breakfast plate. Each message was found to be effective in revising people's lay theories about breakfast foods. This intervention generalized to judgments about the one test item (i.e., protein bars) that was not mentioned in the intervention, but future work is needed to chart the scope of this generalization across a variety of food items. Moreover, the passage emphasizing the cultural variation in breakfast food choices was particularly effective in promoting people's intention to eat healthy morning meals. Given these positive results on people's self-report of their willingness to expand the repertoire of what they would eat for breakfast, it would be important to extend this work to document actual changes in people's breakfast choices which would bolster the external validity of our

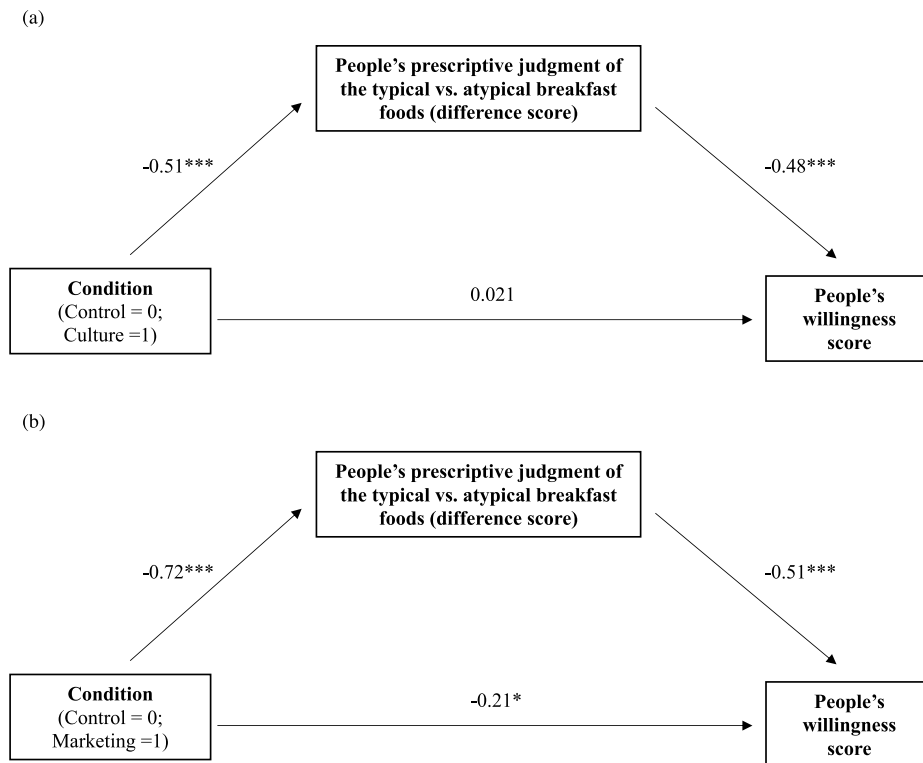


Fig. 5. The effect of condition (a: control vs. culture; b: control vs. marketing) on people's willingness to include healthier alternatives at breakfast was mediated by the difference in people's prescriptive judgments toward typical vs. atypical breakfast foods. The mediator and the dependent variable were standardized prior to entering in the mediation analysis. \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

interventions and conclusions. Moreover, although we are confident that our interventions prompt people to expand their breakfast menu, and in this case were more open to selecting healthier alternatives, it is a remaining question about how much the intervention motivates people to consider the nutritional quality of foods to choose for breakfast. Future research assessing people's attitudes towards both healthy and unhealthy alternatives would provide more definitive evidence.

These studies also advance theorizing on the cognitive mechanism underlying people's healthy eating behaviors. In particular, we found that the inherence bias, a bias that leads people to explain the observed regularities in terms of the inherent features of the entities involved (Cimpian & Salomon, 2014), predicts the tendency to assign value to typical vs. atypical breakfast foods. People who rely heavily on the inherence bias when reasoning about breakfast traditions also tend to evaluate the typical breakfast foods more positively than the atypical items. However, the inherence bias did not mediate the effect of our intervention on people's prescriptive judgments or willingness to eat nutritious alternatives at breakfast, because the intervention essays did not undermine people's preference for inherent explanations when reasoning about breakfast foods. Instead, the inherence heuristic moderates the effect of our intervention. Our intervention altered people's attitudes about breakfast foods and promoted their intention to consume nutritious alternatives at breakfast in general, and this effect was particularly salient for people who attributed the breakfast traditions to inherent reasons. These findings suggest that it could be useful to identify and utilize people's pre-existing cognitive biases to encourage them to adopt a healthy diet.

Given that dietary behaviors seem to be established in childhood, it is particularly important to examine children's evaluations about various foods for breakfast. Research has shown that young children tend to rely on the inherence heuristic when making sense of their observed regularities (e.g., Hussak & Cimpian, 2015; Tworek & Cimpian, 2016), thus it is possible that they have endorsed inherent facts to explain breakfast traditions from early on. Future research should identify the developmental pattern of these beliefs as well as their cognitive basis,

which could provide insights into how to foster a healthy morning diet in early childhood. Previous work has demonstrated the power of implementing an explanatory framework in boosting healthy behaviors in children (e.g., Au et al., 2008; Gripshover & Markman, 2013; Kelemen, Emmons, Seston, & Ganea, 2014; Zamora, Romo, & Au, 2006). For example, after learning a detailed and coherent theory about why it is necessary to eat a variety of foods, preschoolers developed a rich understanding of food as a nutrition source and increased their vegetable consumption at snack time (Gripshover & Markman, 2013). This leaves us hopeful that using a theory-based approach to educate children that breakfast staples are constructed by the society rather than some natural features of these items could be effective in motivating children to eat healthier foods, which may eventually decrease the risk of developing health issues in adulthood.

In sum, we have shown that people hold misconceptions that foods typically eaten at breakfast are more appropriate and suitable for the first meal than foods typically eaten at other times of the day. These mistaken beliefs impede people from following a healthy morning diet. However, we demonstrate that a conceptually-rich framework, highlighting the role of marketing campaigns in forming breakfast traditions and the variation of breakfast foods in other countries effectively undermines these beliefs and promotes the willingness to eat healthier foods at breakfast.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2019.104458>.

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