Are You Making The Right Choice?

How Deciding Impacts Food Evaluation and Judgment

Ke Lai (Taylor)

Primary Mentor: Dr. Jennifer Trueblood, Eeshan Hasan

Secondary Mentor: Dr. Ashleigh Maxcey

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Abstract

Traditional approaches in studying decision making typically use artificial or well-defined lab stimuli to investigate changes in the perception of choices. However, the processes of how people generate, evaluate, and integrate attributes of real-world choices are less-studied and understood. In this study, we used food as an example of the real-world stimuli to investigate how deciding between options can accentuate the differences in the perception of their attributes. Specifically, we examined whether making decisions would accentuate the differences between food items and increase the differences in subsequent judgments of pleasure, healthiness, and overall value for similar food pairs. We found that the accentuation effect only occurred for pleasure and overall value judgments of the food but not for healthiness judgment. We propose multiple explanations to account for these results.

Are You Making the Right Choice? How Deciding Impacts Food Evaluation and Judgment

In the modern world, poor diet is responsible for rising rates of certain diseases such as obesity and diabetes and has also been implicated in some terminal diseases such as cancer (Hruby et al., 2016; Zhang et al., 2019). Therefore, it is important for us to understand how people make everyday food decisions to reduce health problems and improve food decision making.

Suppose you are choosing between two things to eat - a banana bread and an indulgent brownie. The banana bread is the healthier option. However, the brownie is clearly more pleasurable. Traditional approaches to multiattribute choice have assumed that people place these attributes in an object-by-attribute matrix. That is, people observe the attribute value on each of the attributes from the matrix, assign a weight to each attribute according to its importance, and add the weighted value of each attribute together to form a utility for each option. The choice is then based on these calculated utilities, where options with higher utilities are selected more often. Interestingly, it has been shown that the act of choosing depends on the context. It is a dynamic process in which the different options are compared to each other while making a decision.

In the naturalistic context, when deciding between real world objects, attributes are often not provided. People tend to generate attributes when they process context and option information. In decisions between food items, one might evaluate them on attributes such as healthiness and pleasurableness before making the decision. We choose to evaluate the two attributes and make the evaluations because our past experience has taught us these attributes are key attributes for food. However, these processes of generating and evaluating options might also be context dependent. Indeed, in decisions from experience, with risky gambles, it has been

shown that the processes of valuing and weighting attributes are dependent on the choice set (Spektor et al., 2019). Moreover, the judgment has also been found to be dependent on the processing goal. Specifically, the goal of discriminating leads people to give price judgments more different from each other, while the goal of generalization leads people to give price judgment closer to each other (Cunha & Shulman, 2011).

It is important to understand how the dynamics of decision-making might influence our perceptions of different attributes. Specifically, while previous studies have shown that people generate and evaluate attributes when making decisions in naturalistic contexts, it remains unclear how the act of making a choice might impact these processes. Thinking of the comparison process may be stronger when people are making choices than making judgment, we wonder whether this stronger comparison motive, or the presence of a discriminating goal, would accentuate the perception of differences between options at attribute level. We started with simple two-item comparison and were interested in how the effect of deciding may influence people's evaluation and judgment process.

In this section, we first review previous decision-making theories related to how people decide between options with different attributes, or "multi-attribute choice," and possible effects produced by different decision environments. We also investigate how we might study decisions in naturalistic settings when attributes are not explicitly provided. Finally, we propose an experiment that looks at how judgments might be sensitive to context and choice.

By examining how the comparison motive of choice affects people's evaluations and judgments of food items with different attributes, present study aims to contribute to a deeper understanding of how people process food information in naturalistic settings. We hope our

findings can shed light on the role of context in decision-making and provide insights that may inform interventions aimed at promoting healthier food choices.

Multiattribute Choice

The traditional view of decisions based on attributes is as follows: There are multiple attributes one might consider when thinking about food. People use packaging to gain information about a foodstuff's health value (nutrition), taste, effect on the environment and animal welfare, safety, naturalness, price, country of origin, brand, and certifications (Caputo et al., 2016; Hughner et al., 2007; Lee & Yun, 2015; Prentice et al., 2019). Attributes remain fixed for a given food item. However, preferences might vary due to differences in how individuals value or weigh each of the attributes. Also, these values might depend on contexts (Kahneman & Tversky, 1984).

People often face trade-offs when considering multiple options. When choosing a food, for example, healthiness and organicness may be inversely related to cost. Multiattribute choice field theory looks at these trade-offs by quantifying different attribute weights (Roe et al., 2001). In multiattribute choice studies, the attributes of interest are typically visualized in an attribute-by-object matrix to compare options. Based on this matrix, various choice strategies can be simulated to discern the best option (Barthélemy & Mullet, 1986).

Context Effect on Multi-Attribute Choice

According to theories focused on rationality, adding or removing irrelevant options from choice sets should not affect decisions (Sen, 1971). However, preferences have been found to be systematically reversed when certain novel, but irrelevant alternatives are added to a choice set (Huber et al., 1982; Simonson, 1989; Tversky, 1972). A *context effect* is this dependency of preferences on choice sets.

One type of context effect, the attraction effect, occurs when adding an option *z* that has very similar but inferior attributes to option *x* in the choice set of *x* and *y* increases people's preference for *x* relative to *y* (Huber & Puto, 1983; Wollschlaeger & Diederich, 2020). For example, Huber and Puto used two six packs of beer as the stimuli, with one being cheap and of low quality and the other being expensive and of high quality. When people were given a third alternative, a six pack of beer that is as cheap as the first one while having even lower quality, the probability of choosing the first option over the second was higher compared to when the third alternative was not present. They concluded that the attraction effect occurred because the third alternative drew people's attention to the comparison between the third and the first options, thus increasing the latter's probability of being chosen.

This explanation was also adopted in several cognitive models, such as the multiattribute linear ballistic accumulator model (MLBA) and multiattribute decision field theory (MDFT), to account for variations in people's choice behavior (Trueblood et al., 2014; Roe et al., 2001). The MLBA model, for example, models this effect through different attention weights, giving higher weights to the comparison between choice *x* and the third alternative *z*, as psychologically, the two similar options will make it harder to discriminate between them and will thus draw more attention to the comparison between the two.

The presence of the attraction effect, along with the fact that these cognitive models were constructed to account for such aberrations in rational theories, suggests that an additional, irrelevant alternative may negatively influence similar choices more than dissimilar choices. This is because its addition changes decision-makers' weighting of various attributes (Tversky, 1972; Tversky & Kahneman, 1992).

Decisions with Naturalistic Stimuli

Most experiments that study decisions involving multiattribute choice are based on attribute-by-options matrices or predefined attributes. In everyday situations, however, people often face decisions that are not well structured but are instead made based on experience (Ettlin et al., 2014; Spektor et al., 2019). For example, if someone has a choice between a cup of fruit juice and black tea in a café, there are no matrices presented that list all comparable attributes. Considering this lack of predefined structured attributes, it is not clear how option utility is calculated. People might want to buy a "healthier" drink, which would be the black tea, but will probably end up choosing fruit juice. This may be because their previous experience taught them the more vibrant picture of the juice on the menu page signals "naturalness", thus leading them to perceive it as "healthier."

The research paradigm for experience-based decision making usually involves participants being provided only with the information related to the identity of the alternatives, while the attributes of the options or other related information to the options requires them to make inferences based on the available information or from their past experience (e.g., Brevers et al., 2013). Compared to the artificially defined attribute-by-options matrix paradigm, this model simulates real-life decision-making scenarios more closely.

Interestingly, the two different approaches have led to divergent findings in the literature on decision-making. For example, the attraction effect mentioned in the previous section has been found to be sensitive to comparison processes and was absent when choices were made from naturalistic stimuli (Cataldo & Cohen, 2018; Trendl et al., 2021). Specifically, Cataldo and Cohen (2018) retained the practice of using the attribute-by-options matrix method but with different emphasis on comparison across alternatives or comparison within attributes on display.

They found that the attraction effect is salient for attribute-wise comparison but stays null in alternative-wise comparison. Additionally, Trendl et al. (2021) used movies as naturalistic stimuli while retaining all crucial assumptions for attraction effect, but there was no significant result found.

Compared with the explicit information provided for multiattribute choice, it is possible that choice based on experience is more susceptible to context because that scenario tends to rely more on the comparison process rather than scenario-independent attribute utility value (Spektor et al., 2019). Therefore, studying from the perspective of experience-based choice would provide crucial insights into how decision context shapes the perception of choices.

The Context Effect in Experience-Based Decisions

Just as the multiattribute choice literature uses attention weights to model people's attribute comparison behavior regarding attraction effect, context factors in experience-based decisions also consider how attention plays a role in the comparison of an option's overall judgment. Unlike the description-based paradigm, in which each attribute values are independent of each other, Spektor et al. (2019) proposed the accentuation of difference (AOD) model to simulate how people pay attention to the similar and dissimilar options in an outcome comparison process in which the perception of each option interacts with each others. Similar to how saliency captures attention, the AOD model proposes that, in the comparison process, similar options inhibit each other, while dissimilar options are likely to stand out, making them relatively more attractive (Spektor et al., 2019).

Similarly, studies also show that the accentuation effect is present in price evaluation (Cunha & Shulman, 2011). Specifically, when subjects were given a price range for the product set, lowering the price of the cheapest product increased people's perception of the

expensiveness of the highest-priced product. When people were given the price mean or the price distribution of the product set, lowering the price of the cheapest product decreased perception levels of the expensiveness of the highest-priced product (Cunha & Shulman, 2011). The moderator is the processing goal: If people tend to discriminate between choices, the perceived difference between prices will be accentuated; if people tend to generalize the choices, the perceived difference will be assimilated.

Aims and Hypotheses for the Current Study

We hypothesize that when people are given a set of similar food items, making choices will accentuate perception of differences in their attributes, while making judgments alone will not. This is because it is reasonable that the processing goal of discrimination will be stronger in the choice scenario than in the judgment scenario. In comparisons of similar items, when there is a lack of "absolutely" different attributes, people tend to seek information about "relatively" different attributes that would be otherwise considered similar in dissimilar scenarios. Thus, these "relatively" different attributes are accentuated in similar-item comparisons.

Method

Participants

A total of 66 participants were recruited from the pool of undergraduate students in the Indiana University SONA Psychology Research Sign-Up System. Subjects participated in the study to earn required course credit. The study was approved by the Institutional Review Board at Indiana University and was pre-registered in AsPredicted (https://aspredicted.org/DGN_F69). All participants reviewed the study information sheet before participating.

Based on the exclusion criteria, the following participants were excluded: (1) participants who gave healthiness judgment scores that have a correlation of less than 0.3 with the population

mean, (2) participants who clicked "I don't know this food" for more than 30% of the food pairs, and (3) participants who reported as having special diet restrictions since many of the food items contained meat.

As per the preregistration criterion, four participants were excluded who gave healthiness ratings that had a low correlation to the population mean. We raised the exclusion criterion for the "I don't know this food" rate from 30% to 60% since the criterion turned out to be too stringent, removing 50% of the participants.[1] Eight participants who responded "I don't know this food" for more than 60% of the trials and were excluded. Nine vegan, vegetarian or pescatarian participants were also excluded from analysis.

With some participants in more than one exclusion group, the final study cohort had 49 participants. Among them, 61.2% were female and 38.8% were male. Also, they were 70.8% White, 20.8% Asian, 2.1% Black, and 6.3% multiracial. The age of our participants ranged from 18 to 26 years old (M = 19.19).

Materials

The experiment was designed using PsychoPy. In the main part of the experiment, participants gave ratings and made choices between pairs of food items in multiple trials. The food names were based on a list of 80 food items extracted from Allrecipes (https://www.allrecipes.com/).

Participants were presented with a set of three questions to obtain judgments of overall value, healthiness and pleasure respectively: (1) How much would you like to have this food as a part of your meal on a typical day? (2) How pleasurable do you find this food? (3) How healthy

[1] With the original 30% "I don't know" rate exclusion criteria, 33 participants would be excluded from analysis, which is 50% of the total participants recruited for this study. Additionally, the accentuation effect of deciding on food overall judgment, along with the effect within three food judgment questions, remained null with data from the remaining 33 participants.

do you find this food? Participants responded on a scale of -100, indicating a strongly negative response, to 100, indicating a strongly positive response. If participants were unfamiliar with any of the food items, they could select "I don't know this food."

Table 1

Examples of Similar Food Pairs

Food Name 1	Food Name 2	Similarity
Indian Tomato Chicken	Thai Chicken Curry	0.776
Salisbury Steak	Philly Steak Sandwich	0.684
Thai Spicy Basil Chicken Fried Rice	Classic Chicken Pad Thai	0.683
Strawberry Mojito	Margarita Cocktail	0.683
Greek Orzo Salad	Buffalo Chicken Pasta Salad	0.682

Note. Food similarity was computed by calculating the value 1 - *d*, where *d* denotes the Euclidean distance between the pair of food vectors obtained from the RoBERTa model. The similarity ranges from 0 to 0.991 in the study sample of 2,000 food names, with lower values indicating lower similarity and higher values indicating higher similarity. Forty pairs were manually selected to avoid pairs that would be semantically similar but identical in meaning (e.g., chicken satay and Thai chicken satay).

Since we wanted to study the accentuation in the perception of attributes, we assumed that this would be easier to observe with highly similar food pairings. To obtain the similarity data, we employed a natural language processing algorithm, RoBERTa, that was trained on corpus data including open web text, news, stories, and Wikipedia (Yinhan Liu et al., 2019). The model employed for the experiment was "all-roberta-large-v1", which contains 1024 dimensions and has proved its effectiveness in extracting the key aspects underlying people's semantic expressions (Gandhi et al., 2022; Yinhan Liu et al., 2019). We created 40 pairs of food items that

were similar to each other based on the Euclidean/cosine distances between the embeddings. Examples of the pairings can be seen in Table 1.

Participants were tasked with solving a simple math algebra problem between each trial. For example, they were asked to calculate the value of x for the equation $x + 8 = 12$.

Design

Our experiment had a counterbalanced within-subject design. The factor was whether participants would make a choice before the judgment tasks. To test the effect of this factor, all participants were provided with two blocks in a randomized order; either the judgment block or choice block could appear first.

The dependent variable was the difference between participants' overall value, pleasure, and healthiness ratings in each food pairings on the -100 to 100 scale between two blocks. The slider was placed at 0 (neither positive nor negative) by default. This scale was chosen because it is fine-grained and balanced (symmetric around 0; Gandhi et al., 2022).

Procedures

To conduct this study, we uploaded the PsychoPy experiment into Pavlovia and distributed the link in the SONA system at Indiana University, Bloomington. Participants accessed the survey through their own desktop. The age, gender, race, ethnicity, and dietary restrictions of the participants were collected at the beginning of the experiment.

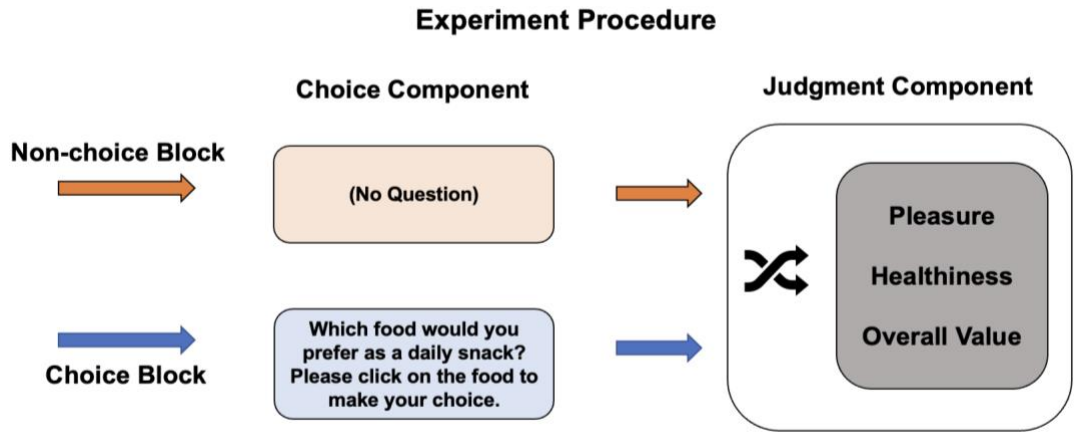
There were two blocks in the experiment, Non-Choice and Choice. In the Non-Choice Block, in each trial, participants were shown a pair of food names and were asked to provide judgments of overall value, healthiness and pleasure as described in the materials section (Figure 1A and 1B). Each question was presented one at a time in a random order. Before answering the first question, participants could click a button to indicate that they did not know a food item. If

they didn't know either food, as indicated by clicking the button, the judgment component associated with this pairing would be skipped.

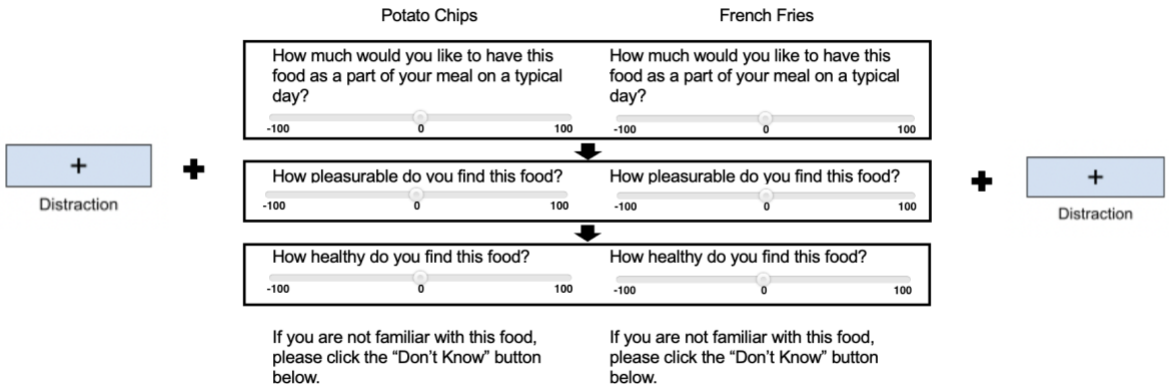
Figure 1

This figure shows the experimental design. Panel A shows the structure of the two blocks. In the Non-Choice Block, there was no choice component, and participants were only asked to provide their judgment on the food pair. In the Choice Block, there was a choice component, in which participants had to make a choice between the two food items and were then asked to judge the food pair along three dimensions. Panel B shows what participants saw during the judgment component for both blocks. For each trial, they had to provide judgments on overall value, pleasure, and healthiness. These components were presented in a random order.

A)



B)



Note. Food items varied across trials. Each question appeared one at a time in a random sequence. The order presented in the figure is one example of the random order in which each question appeared.

The Choice Block was similar to the Non-Choice Block. The only difference was that participants were asked to indicate their preference by clicking on a button that read "I prefer [food name]." After they made a choice, they were asked to provide judgment scores, with steps identical to the Non-Choice Block. The pairs in the Choice Block were identical to the ones in the Non-Choice Block.

All participants provided ratings for 80 food items twice, once in each of the two blocks. After participants completed all trials in their assigned group, they were required to enter the first two letters of their first name and first two letters of their last name for us to assign credits to matched names in the SONA system. After that, they saw an ending page thanking them for their participation. The duration of the experiment was approximately 30 minutes.

Results

After excluding participants who did not meet all requirements, we used data from the remaining 49 participants in the analysis. We had hoped all participants in the study would use the judgment rating scale similarly. For example, two participants might perceive the same food at the same level of pleasure, but one of them might give a judgment score of 50, while the other could give a score of 25. To account for this problem, we standardized the judgment scores of the first food and the second food in each trial by calculating the *z* scores for each type of food judgment. Within-subject variations were controlled by conducting this procedure at the individual level.

Pearson Correlations

Pearson correlations of standardized judgment scores for different types of judgments were computed. Among three pairwise correlations, overall value judgment was strongly positively correlated with pleasure judgment ($r = .71$, $p < .001$). While overall judgment was

significantly correlated with healthiness judgment, it is a weak positive correlation ($r = .19$, $p < .001$). No correlation was found between pleasure judgment and healthiness judgment ($r = .01$, $p = .42$). This indicates that higher overall value judgment was associated with higher pleasure judgment but was less associated with healthiness judgment.

We also computed the population mean pleasure, healthiness, and value judgment scores for each food and correlated each participant's mean pleasure, healthiness, and value judgment scores to each food's population mean. Among all three types of judgments, healthiness had the highest mean correlation, at $r = .69$ across all participants. Pleasure judgment and value judgment had the mean correlations of $r = .05$ and $r = -.1$, respectively. This indicates that the healthiness judgments were strongly correlated with each other. However, the pleasure and value judgments varied by participants.

Main Analysis on the Effect of Deciding

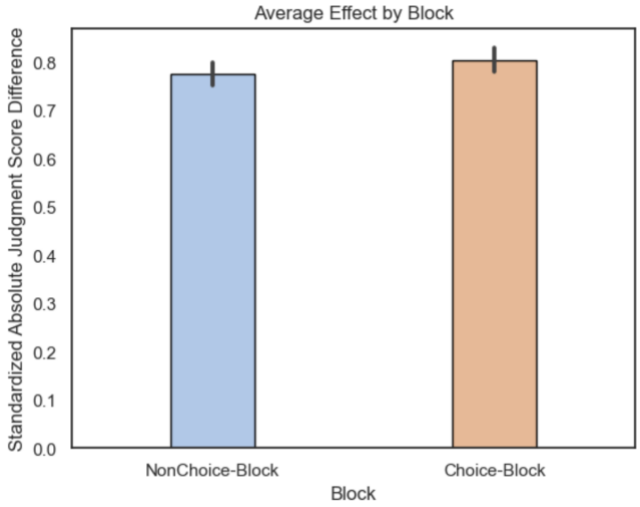
Since we were interested in how deciding impacts the judgment of attributes, the dependent measure was computed by taking the absolute value of the difference of the standardized *z*-score judgments for the two foods on each trial. A two-way repeated ANOVA was performed to test the effect of deciding and question type on the absolute difference of standardized food judgments for the food pairs. The main effect of the block is shown in Figure 2A. There was a statistically significant main effect in block, $F(1, 48) = 4.33$, $p = .043$, and of judgment type, $F(2, 96) = 81.93$, $p < .001$. The interaction effect of block and judgment type was also significant, $F(2, 96) = 5.91$, $p = .004$. There was a significantly higher absolute difference in standardized food judgment scores in the Choice Block than in the Non-Choice Block, and the three types of judgments do not have the same absolute difference of standardized judgment

score. The strong interaction effect also implies that the effect of deciding depends on what type of judgment people are considering when evaluating options.

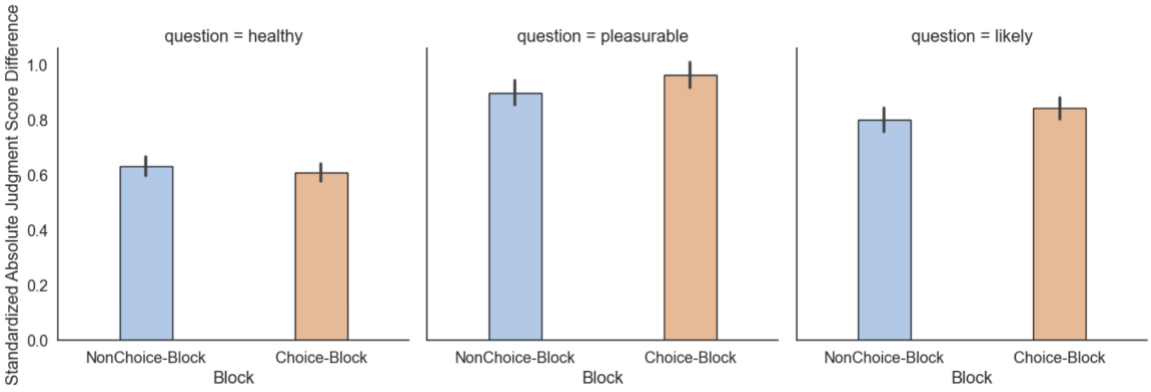
Figure 2

Panel A shows the average effect of deciding on food judgment (question-pooled). Panel B shows the average effect of deciding on food judgment for the three types of questions separately. Error bars represent 95% confidence intervals.

A)



B)



To probe the interaction effect of block and judgment type, we examined the effect of deciding on three types of judgment by conducting a related-sample *t* test for each of them (Figure 2B). For the pleasure judgment, the Choice Block (M = 0.98, SD = 0.22) had

significantly higher absolute difference judgment scores than the Non-Choice Block (M = 0.89, SD = 0.19), $t(48) = 2.97$, $p = .005$. For the overall value judgment, the same pattern was found (Choice Block: M = 0.85, SD = 0.21; Non-Choice Block: M = 0.79, SD = 0.19) but was marginally significant, $t(48) = 1.95$, $p = .056$. For the healthiness judgment, the absolute difference judgment scores in the Choice Block (M = 0.61, SD = 0.16) did not significantly differ from that in the Non-Choice Block (M = 0.62, SD = 0.20), $t(48) = -0.478$, $p = .635$. This shows that the healthiness judgments remained similar across the blocks, but the pleasure and likelihood judgments were impacted by the block.

Effect of Specific Choice on the Evaluation on Chosen Food

We also investigated how deciding influences the judgment scores for the chosen food and the unchosen food in a food pair. Since we were interested in both the direction and magnitude of judgment scores given to specific foods, we did not use the absolute value of judgment score differences. Instead, the main dependent measure was the standardized food judgment z-score of each food in the food pairs.

Considering that no choice was made prior to giving the food judgment in the Non-Choice Block, in the analysis, we linked the choices participants made in the Choice Block to the corresponding food pairs in the Non-Choice Block in our analysis. Thus, we were able to group food pairs in the Non-Choice Block according to the choices participants made in the Choice Block. Treating the Non-Choice Block judgments as the controlled level, we were able to examine the effect of deciding on food judgments.

Moreover, we also assigned the standardized food judgment scores in each food pair to a chosen judgment score group and an unchosen judgment score group according to the choices participants made. For example, if a participant chose the left food in the current food pair, the

judgment score given to the left food would be assigned to chosen food judgment score group, and the judgment score given to the right food would be assigned to unchosen food judgment score group.

With these coded variables, we were able to investigate how deciding influenced people's food judgment for chosen and unchosen food (Figure 2A and 2B). Related-sample *t* tests were conducted for each type of judgment.

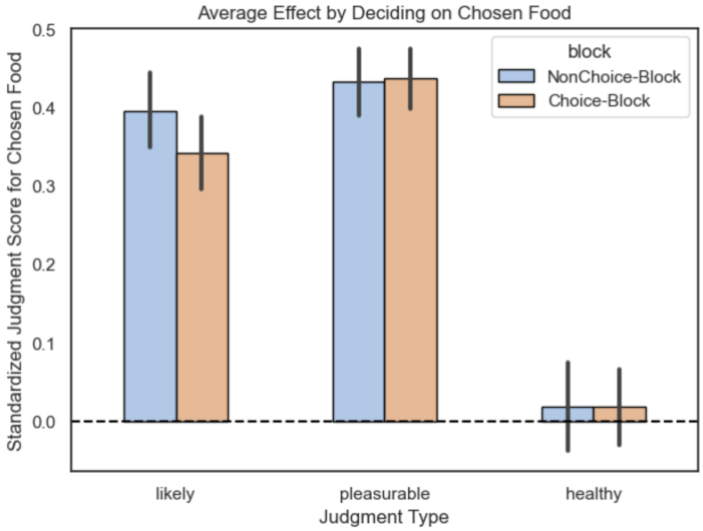
In the overall value judgment, no effect of deciding was found on judgment scores for chosen food (Choice Block: $M = 0.36$, $SD = 0.24$; Non-Choice Block: $M = 0.4$, $SD = 0.21$; $t(48) = -0.91$, $p = .37$). However, making the decision induced participants to report significantly lower judgment scores for the unchosen food (Choice Block: $M = -0.41$, $SD = 0.18$; Non-Choice Block: $M = -0.26$, $SD = 0.26$; $t(48) = -2.98$, $p = .004$). This indicates that when people are making choices, the unchosen option is viewed as less appealing than when making judgments alone.

For judgments regarding pleasure, no significant effect of deciding was found on the standardized judgment scores given for the chosen food (Choice Block: $M = 0.45$, $SD = 0.16$; Non-Choice Block: $M = 0.45$, $SD = 0.2$; $t(48) = -0.17$, $p = .862$). However, similar to the pattern in overall value judgment, making a choice significantly decreases the judgment scores for the unchosen food (Choice Block: $M = -0.47$, $SD = 0.19$; Non-Choice Block: $M = -0.35$, $SD = 0.16$; $t(48) = -3.19$, $p = .003$). This indicates that making choices leads people to perceive the unchosen option as less pleasurable than when making judgments alone.

Figure 3

Panel A shows the average effect of deciding on the standardized judgment score for the chosen food, grouped by types of judgment. Panel B shows the average effect of deciding on the standardized food judgment for the unchosen food, grouped by types of judgment. Error bars represent 95% confidence intervals.

A)



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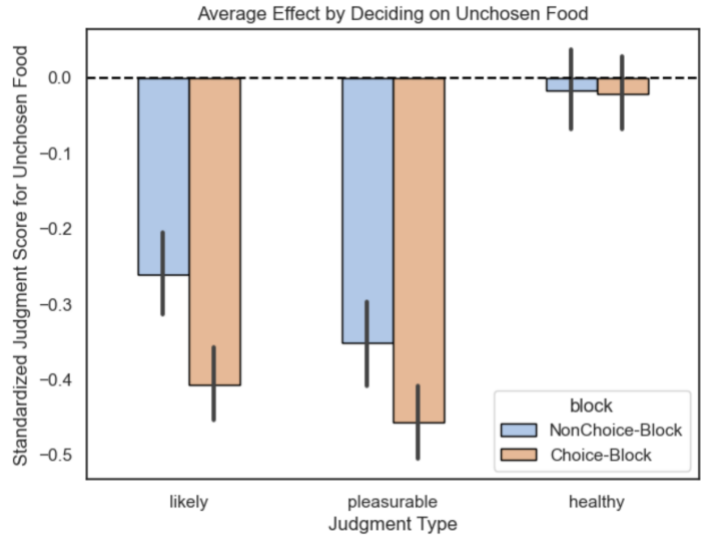

Note. No actual choices were made by participants in the Non-Choice Block. We linked the choice they made in the Choice Block to the judgments in the Non-Choice Block. Judgment scores of the food under "hypothetical choices" in Non-Choice Block were treated as the control level for testing the effect of specific choices in the analyses.

For healthiness judgments, deciding neither impacted the standardized judgment score for the chosen food (Choice Block: $M = 0.02$, $SD = 0.19$; Non-Choice Block: $M = 0.02$, $SD = 0.2$; $t(48) = -0.13$, $p = .9$) nor the standardized judgment score for the unchosen food (Choice Block: $M = -0.03$, $SD = 0.18$; Non-Choice Block: $M = -0.03$, $SD = 0.19$; $t(48) = 0.17$, $p = .87$). This indicates that deciding does not affect the evaluation of food healthiness.

The patterns detailed here show how deciding affects the evaluation of chosen and unchosen food. Our results show that the impact of deciding may accentuate the perception of the difference between options, and this accentuation effect is mainly driven by the decrease in judgment scores given to the unchosen food. At the level of judgment type, it appears that the healthiness judgment is the judgment most insensitive to the effect of deciding, and the overall value preference is likely to be made based on the food pleasure judgment rather than the healthiness judgment.

Discussion

This study investigated how making a choice in a similar two-item choice set will impact the perception of the difference between options. Our findings support our hypothesis that the underlying processes of making a choice and making judgment are interrelated. When people make a choice, the differences between options will be accentuated compared to when they are making judgments. Furthermore, we found that this accentuation process is driven by people's tendency to assign significantly lower judgment scores to the food which they did not choose rather than a higher judgment score to the chosen food. Interestingly, the effect of the accentuation was found in pleasure judgment and overall value judgment, but it did not impact the healthiness judgment.

General Effect of Deciding and Choice

The significantly higher absolute mean difference in standardized food judgments by Choice Block indicates that people judge food items to be more different from each other when choosing between them. This is consistent with our hypothesis and lends support to the notion that there is discrimination processing goal present when people are making choices.

In examining the effect of choices, it is interesting to note that making a choice does not affect the food judgment scores for the chosen food but significantly decreases people's judgment scores for the unchosen food. Along with the accentuation process we proposed, a possible explanation for this pattern is that when participants are considering choosing from a set composed of similar options, the judgments made on the unchosen food are anchored to the judgments for the superior option in the comparison. Hence, the accentuated difference makes the preferred option stand out by decreasing the score assigned to the food not chosen.

The finding that the accentuation effect influences perceptions of the unchosen food to be less appealing than might be expected also provides an explanation for people's "sticky choice" behavior. "Sticky choice" refers to a type of bias that occurs when people consistently prefer their initial choice even if new information against their initial choice is provided later (Brough et al., 2008). Previous research has explained this bias by examining people's strong incentive to remain consistent in their behaviors, but our findings may provide an additional explanation for this phenomenon. Because the initial choice scenario has already significantly made the unchosen food significantly less appealing, when no information against the chosen food is provided, people stick to the same choice. When information against the chosen food is provided, the chosen food does not necessarily overcome the lower evaluation of the unchosen

item. Hence, we would likely observe that people tend to keep insisting on their initial choice in subsequent decisions.

Healthiness, Pleasure, and Overall Value Ratings

The effect of deciding has different effects across the three types of judgment. The absolute differences in overall value and pleasure judgments were significantly accentuated by deciding, but a null effect was found in the absolute difference in healthiness judgment. The impact of choosing on decreasing the unchosen food judgment ratings was significant for both overall value and pleasure judgments but was not significant for the healthiness judgment.

The discrepancy in the pattern across the three types of judgment may imply how people approach these judgments differently. Compared with the judgment on pleasure and overall value, healthiness may be an attribute more objective than pleasure or value. For example, people may disagree on what type of food will make them feel happier, but they are less likely to disagree on whether a salad is healthier than a fried chicken sandwich. This objectivity was also implied by the high correlations to the population mean healthiness judgment across participants, especially when compared with low mean correlations to the population mean of pleasure and overall value judgment. This objective nature might make participants less susceptible to the impact of specific choice (in terms of giving higher scores to chosen food) and to the impact of deciding (in terms of giving deviating scores to the same food across blocks).

Another notable pattern is the highly correlated trends in the score for overall value judgment and pleasure judgment, as indicated by the significantly strong positive correlation between overall value judgment and pleasure judgment. Though this is only a correlational finding, and we cannot draw a causal conclusion, people may rely heavily on pleasure judgment to evaluate the overall value of food rather than rely on healthiness. Most importantly, even

though studies using attribute-by-options matrices mentioned healthiness as an important attribute which people typically consider by predefining it, our study design did not explicitly ask them to consider healthiness when they were making choices or making overall value judgment. This draws our attention to whether people underweight food healthiness when they are making food choices in real-life situations.

Moreover, since we chose food pairs that are semantically similar as the stimuli in the study, it is possible that the healthiness attribute did not differ across the two food items. Hence, it might have been relatively unhelpful in making a choice. A stronger focus would be placed on attribute judgments of overall value and pleasure. This stronger emphasis might have increased the impact of choice context. This explanation may serve as an indicator in support of our proposed accentuation process, in which the useful attribute comparison is inhibited, and the previously less-weighted attribute comparison becomes salient.

Recent behavioral neuroscience studies focusing on how the ventromedial prefrontal cortex (vmPFC) processes different attribute information provide support for the above two explanations. Essentially, the activity in the vmPFC has been found to encode eye fixation-dependent values and is responsible for the relative value comparison process in making decisions (Lim et al., 2011). When a self-control motive is salient, the vmPFC corporates both taste and healthiness information, while when a self-control motive is absent, the vmPFC employs only taste information in making food decisions (Hare et al., 2009).

It may be possible that in our real-world context, when a self-control motive is absent, people neurologically process healthiness and taste (pleasure) information differently. This is because healthiness information is inherently different from other attributes and is not involved in value comparisons at all. In the present study, the consistent finding is that healthiness

judgment was not correlated with overall value judgment at all. Since there was no need to self-control, only the pleasure judgment went into the comparison process and contributed to the overall value judgment.

Alternate Explanations

One explanation for our findings is through the post-justification and cognitive dissonance theories. According to these theories, after people make their choice, they tend to justify themselves that the option they have chosen is more desirable than the option they did not choose (Brehm, 1956; Rosenfeld et al., 1986). Our findings are not completely consistent with this theory since they suggest that the choice impact is bi-directional, which accentuates the difference both by increasing the desirability for the chosen food and decreasing the desirability for the unchosen food. However, in our study, no significant enhanced effect was found on judgments for chosen food. It is possible that the construct of "desirability" is composed of a different set of attributes in consideration and may be different from attribute-level judgment. Indeed, in terms of the effect in decreasing the evaluation on the unchosen food, we got consistent results with Brehm's conclusion (1956).

Strengths and Limitations

Our study design has several strengths. First, our within-subject design allowed us to capture the real impact of specific choices and reduce the effect of random noise. This design also enabled us to investigate individual differences in decision-making processes. Second, we utilized the RoBERTa model and web-scraped food recipe names from a real recipe website, which enhances the external validity of our study. By selecting stimuli that are as objective and representative of real-world scenarios as possible, we can increase the generalizability of our findings. Finally, our use of a continuous scale from -100 to 100 provides a more fine-grained

measurement of judgment ratings compared to traditional 7-point Likert scales, enabling us to better capture small differences in judgments.

However, our study also has some limitations. The first limitation in our study is the small number of participants included in our data analysis. Our target sample size was 60 people (after exclusion), but due to the timeline of the program, we wrote this thesis at the time when 66 participants completed the experiment (before exclusion). We plan to continue recruiting more participants in our study, hoping to find a more robust effect, since we got several marginally significant results with the current sample.

Another factor that led to a relatively small number of participants in the analysis was the relatively high "I don't know this food" rate for food pairs. This might be due to a relatively large portion of food recipe names being eastern food. This might have been an inadvertent consequence of the researcher choosing the food pairs being from Asia. As a result, if we use the pre-registration exclusion criteria of removing participants who have a "I don't know this food" rate higher than 30%, about half of the participants would be removed from the analysis. Therefore, we resorted to increase the rate criteria to 60% to retain a decent amount of data for analysis. A more varied or otherwise more suitable recipe list could be devised for the target participant group, which would likely result in a larger data set for testing accentuation effect.

Additionally, it is possible that the participants remembered the judgments made on the first block. Due to time restrictions, we designed our distraction trials to be relatively simple and short. Hence, participants might have carried forward their decisions and judgments in the subsequent block.

Implications and Future Directions

Our study has the potential to provide insights into the effect of deciding on people's judgment process. Specifically, the findings indicate that deciding will accentuates the perception of differences between options in a similar two-item choice set. Furthermore, accentuation impacts food judgments by driving down the evaluation of the non-chosen food. This is important to decision making researchers as they should carefully think about which way they prefer to ask their participants. For example, if they want to measure the judgment made by participants and confirm their preference by asking for a choice, it is more advisable to put the choice question after the judgment question. This is because asking for choice would potentially impact the subsequent judgment.

This study also finds that the susceptibility to the accentuation effect varies across attribute dimensions. The attribute of healthiness may be more objective compared to pleasure and overall value judgment and may be considered less important when people are making preferential judgment for food in a naturalistic context.

Together, the two major findings together may possibly extend the understanding of "sticky choice" bias and help explain persistently poor diets. The less important healthiness is when making a preferential choice, the poorer a choice tends to be initially in terms of diet and health. The accentuation of deciding further drives down the pleasure and overall value judgment for the unchosen food. Through a largely unconscious process, this can motivate people to stay with suboptimal food choice, potentially placing them in an endless loop of poor diet decisions ("sticky choice" bias). Merely forcing an initial healthy food choice would therefore not be an efficient interruption to end this loop, as that food will also be judged to be more pleasurable and be valued leading it to be chosen again.

This mechanism may shed light on how to devise strategies in future diet intervention programs. Those strategies may need to target cultivating a lasting self-control motive or pay special attention offering repeated reminders of healthiness when making food decisions but merely build an environment where individuals are encouraged to make good decisions.

Multiple directions are available for future research. First, it is important to further study why healthiness is relatively less susceptible to the effect of deciding. It would be valuable to investigate how researchers should categorize food attributes so that they can understand which attributes characteristics induce people to give more weight to them when they make choices and overall value judgments.

Furthermore, the current study only examined the effect of accentuation effect for similar food pairs. Future studies may look at whether the same effect is significant for food pairs that are not similar. Additionally, changing the stimuli from food names to food images or expanding the effect of deciding to involve more than a two-item comparison are both potentially promising directions.

Finally, semantic representations have successfully quantified the mental representations of words and phrases that describe decision options and do not require attributes to be predefined. Studies on how people actively infer the healthiness attributes of food through words have tried to use semantic representations to capture the abstract attributes reflected in language and find evidence relevant to predictions of people's judgments of food healthiness (Bhatia, 2017; Gandhi et al., 2022). The RoBERTa model used in this study to determine the similarity between food names is similar to the one used in judgment modeling (Word2Vec), but RoBERTa has more dimensions. It is claimed to be more advanced than the Word2Vec model and can interpret multiple strings. It is possible in the future to use the RoBERTa model to test

its ability to predict people's healthiness judgments and see how people process this specific attribute when making judgments.

Conclusions

This study explored the impact of making a choice on the perception of differences between options, revealing that deciding has an accentuation effect that is driven by a tendency to give lower judgment scores to the unchosen option. Notably, this effect is more apparent in overall value and pleasure judgments than in healthiness judgments, with pleasure being a crucial factor in evaluating the overall value of food. This may be due to the similarity in comparison process or the inherent nature of healthiness being different from pleasure judgements. Our findings are consistent with previous findings in behavioral neuroscience and may explain why people may have persistently poor diets with "sticky choice" bias.

As mentioned above, these insights may help devise diet intervention programs in the future. Multiple directions research avenues should be considered based on this study, including expanding the choice context to food pairs that are not similar, investigating the effect of choice on judgment patterns with choice sets having more than two items, and modeling and predicting human judgements. Once more research is completed on how people implicitly process food information, different intervention programs can be devised and tested to help people make better food decisions.

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