RESEARCH
Research Paper

Visual Cues and Optimal Defaults in Fast-Food Combo Meals Benefit Health-Concerned Consumers—A Randomized Scenario-Based Experiment

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ABSTRACT

Background The use of low-calorie menu items as optimal defaults and visual cues may nudge consumers to healthier choices at restaurants. However, little is known regarding their effects on emotions and behavioral intentions, particularly among people with different levels of health concern.

Objective Evaluate optimal defaults and visual cues' effect on anticipated pleasure and order intention depending upon consumers' health concern level.

Design Between-subjects randomized scenario-based experiment.

Participants/setting In all, 636 US adults recruited through an online crowdsourcing platform in July 2020.

Intervention Participants saw 1 of 6 menu boards in a fast-food drive-through simulation. Half the menu boards included meal photos with (1) menu items to be arranged as a combo by choice (ie, create-your-own combo); (2) traditional combos that included high-calorie default items; or (3) optimal combos that included low-calorie default items. The remaining 3 boards were identical without photos.

Main outcome measures Anticipated pleasure, order intention, and health concern were evaluated with 7-point Likert scales.

Analysis Statistical tests included multiple regression, Kruskal-Wallis, χ^2, and analysis of variance. Education and sex were tested as potential confounders.

Results Optimal combos negatively affected anticipated pleasure ($P = .003$) and order intention ($P < .001$) compared with choice combos. Order intention reduction was the same for traditional and optimal combos ($P = .128$). The presence of photos changed order intention for optimal combos but varied by consumer's health concern level. When health concern was lower, photos decreased the likelihood of ordering the optimal combos ($B = -3.06$, $P = .001$), but when health concern was higher, photos enhanced ordering intention compared with the choice group ($B = 0.60$, $P = .001$). The photos did not affect anticipated pleasure for any level of health concern.

Conclusions The adverse effect of optimal defaults and how visual cues may reduce their negative effect should be considered in menu design.
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INTERVENTIONS AT RESTAURANTS TO PROMOTE healthy eating are highly desirable.[1-3] In the United States, 1 in 5 daily calories consumed come from restaurants.[4] Even with in-restaurant restrictions during the COVID-19 pandemic, restaurants were a top food source.[5-7] For example, an April 2021 consumer survey reported that 3 in 10 consumers considered obtaining restaurant food a high priority in their purchasing decisions.[8] Furthermore, numerous fast-food chains posted record sales during the pandemic due to their existing drive-through infrastructure and focus on takeout.[8,9] Unfortunately, frequent food consumption away from home is associated with greater daily energy intake,[10] and statistics show that these current dietary practices are deleterious and represent a health risk.[11] Consequently, several strategies have been suggested to encourage better food choices in restaurants.

Experts in behavioral economics have suggested using "nudges" as a strategy to improve consumer decision-making.[12] A nudge is a factor that may modify the conditions under which people make decisions to "push" them toward a desirable behavior.[12] Initiatives that persuade people toward better food choices without their complete awareness can be characterized as nutritional nudges. Although nudge theory goes beyond food decisions, its adoption to shape food

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choices has been widely accepted.[13-15] Researchers suggest the concomitant use of more than 1 nudge in food environment interventions may be beneficial.[16,17] However, knowledge about how these initiatives work together and their effects in the restaurant context is still limited.[14,15,18] Optimal defaults and visual cues are 2 lesser investigated nutritional nudges. Therefore, this study analyzed their influence on consumers' food choice decisions in restaurants. This examination provides experimental evidence for food environment interventions that encourage healthier consumer food choices.

Defaults act as a nudge because of their unconscious influence on people's choices.[19] Fast-food restaurants traditionally offer combo meals with high-calorie defaults, such as french fries and sodas.[20] As a way to promote healthier food choices, other, more optimal defaults have been suggested.[21,22] Optimal defaults may include low-calorie or healthier menu items. Including vegetables, fruits, or nutrient-dense beverages as optimal defaults in kids' meals has been shown to decrease calories ordered and boost nutrient-dense choices.[23-25] In 2 studies with adults, similar results were found.[21,26] Therefore, optimal defaults work as a nutritional nudge.

Potentially, however, optimal defaults could have negative side effects on anticipated pleasure and order intention for combo meals, but no research has tested these potential outcomes. The first stage of food intake decisions is the expectation of pleasure.[27] At that point, people prioritize taste judgments to select food.[28,29] Unfortunately, some consumers presume healthy food does not taste good (referred to as the unhealthy = tasty intuition).[30-32] If optimal defaults are not considered tasty, anticipated pleasure may be affected and subsequently reduce order intentions. Feedback theory states anticipated emotions act as a regulator that influences behaviors.[33] For example, anticipated pleasure is a determinant of a customer's restaurant visit intention.[34] Adverse effects to anticipated pleasure would be problematic for the adoption of optimal defaults. In that sense, it would be necessary to explore if the simultaneous use of other nudges, such as visual cues, could moderate those side effects.

Visual cues have been suggested as a potential nutritional nudge. Menus pictures and pre-exposure to food images have been shown to influence consumers' attitudes and eating desires.[35-38] Therefore, visual exposure to healthy menu items could prompt a positive attitude and desire for healthier food choices.[39] At the same time, the inclusion of visual cues to highlight healthy food could reduce impulsive decisions to purchase nutrient-poor choices at restaurants.[17] However, experimental research supporting these claims regarding healthy menu items is lacking. Furthermore, a systematic review found no evidence of visual cues alone promoting healthy eating in a restaurant context.[18]

Studies with food items show that visual cues work differently in people with distinct characteristics. For example, consumers making a conscious effort to restrict food intake are more sensitive to images with low-calorie items.[36,40] Therefore, responses to visual cues on menus could be different for people who actively care about the nutritional quality of their food choices compared with those who are not interested. Foodservice management literature has labeled the consumer profile of those who seek healthy options when eating out as "health-concerned" or "health-conscious" individuals.[41,42] Highly health-concerned consumers could be more sensitive to visual cues with optimal defaults than those with a low health concern. Consequently, the moderation effect of visual cues on the optimal defaults' impact could change according to health concern level.

Therefore, this study evaluated the effect of optimal defaults with and without visual cues on anticipated pleasure and order intention among consumers with different health concern levels in the context of fast-food combo meals. First, the optimal defaults' effect on anticipated pleasure and order intention was determined through a comparison of their inclusion among 3 combo types: (1) combo meals arranged by customer choice (ie, participants could create their own combo meal), (2) traditional combos with traditional high-calorie defaults, and (3) optimal combos with low-calorie optimal defaults. Next, change in the defaults' effect on anticipated pleasure and order intention when in the presence of visual cues was investigated. Finally, the moderating effect of visual cues was analyzed based upon different levels of health concern.

RESEARCH SNAPSHOT

Research Questions: How do optimal defaults in combo meals affect adults' anticipated pleasure and order intention? Does the inclusion of visual cues moderate the effects depending on health concern level?

Key Findings: In a scenario-based experiment, the use of low-calorie menu items as optimal defaults in combo meals adversely affected anticipated pleasure and order intention compared with choice combos. However, visual cues' presence influenced order intention depending on the consumer's level of health concern. For anticipated pleasure, visual cues did not moderate the adverse effect for any level of health concern.

MATERIALS AND METHODS

Research Design

This study used a scenario-based experiment aligning with prior studies about consumers' perceptions and food choices using hypothetical scenarios with reliable results.[32,43-45] In the present study, participants were asked to imagine going to a new fast-food restaurant's drive-through to redeem a gift card that could only be used for combo meals. In an online survey programmed in Qualtrics, participants were shown pictures of a fast-food drive-through menu board. Purchase procedures emulated a visitor's experience in a typical fast-food drive-through. A university institutional review board approved the study protocol.

A between-subjects experimental design with a $3_{(\text{combo type})} \times 2_{(\text{visual cues})}$ approach was used to present the conditions. The combo types were displayed on 3 menu boards that included meal photos with (1) menu items that participants could select from to build their own combo; (2) traditional combos with high-calorie sides and beverages by default; or (3) optimal combos with low-calorie optimal sides and beverages by default. Similarly, the combos were presented in 3 other boards without photos. Therefore, the study

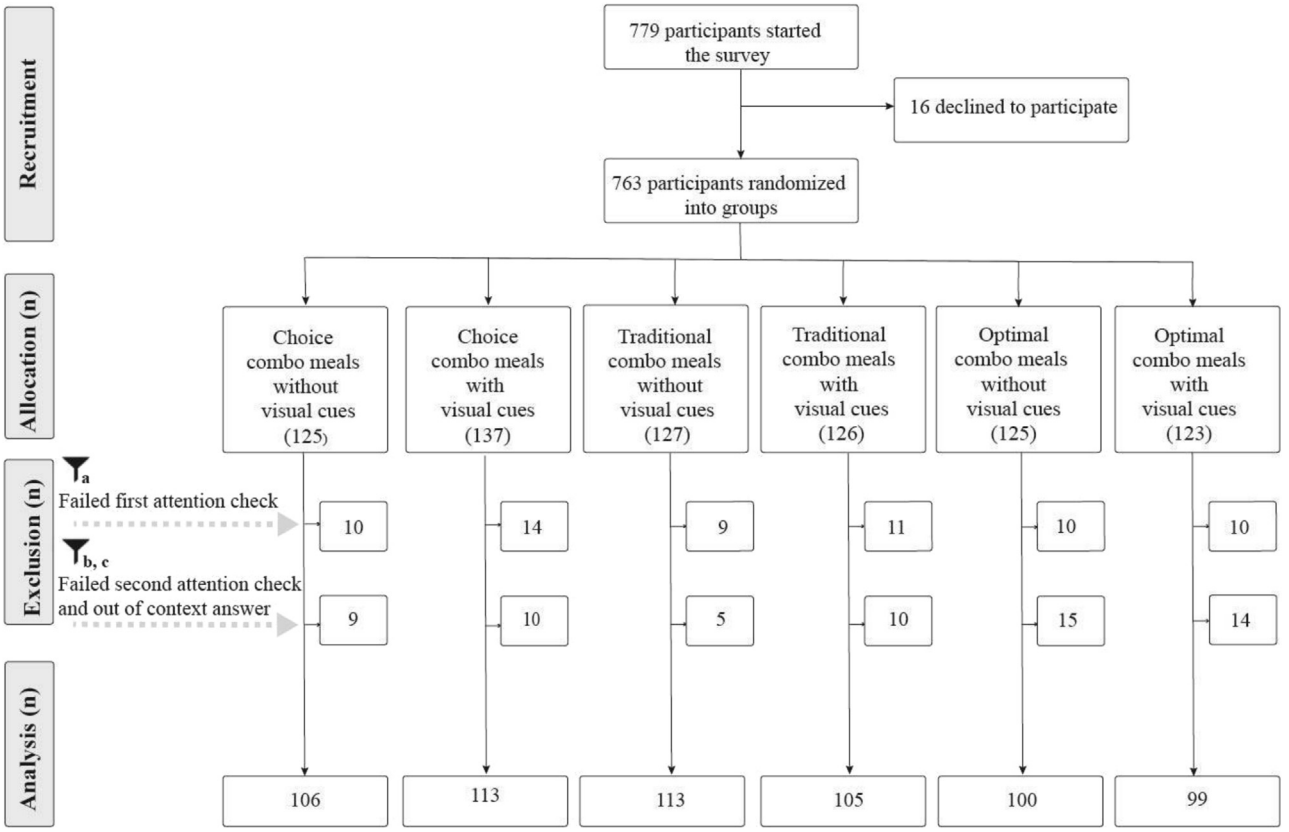


Figure 1. Randomization process for an online scenario-based experiment evaluating the effect of optimal defaults and visual cues in a fast-food drive-through. [a]The first attention check was an item that asked for a specific answer on a 7-point Likert response format. [b]The second attention check was an item asking about the presence of a product not included on the board displayed. [c]Out-of-context answers refer to responses to an open question that appear to be automatically generated, such as may be created with bot software.

included 6 parallel groups assessed through a scenario-based online survey.

Participant Recruitment

The criteria for participation were being a US resident and being older than 18 years of age. Amazon Mechanical Turk (MTurk), an online crowdsourcing platform,[46] was used for participant recruitment during 4 consecutive days in July 2020. Those who met the inclusion criteria saw an advertisement to respond to a survey about perceptions of menu design. Respondents were recruited until sampling goals were met. As compensation, participants received $1 for completing the survey, and the online platform fee was 40% of the responders' pay rate.

After consenting to take part in the study, participants were automatically and randomly allocated to 1 of the 6 menu groups (allocation ratio: 1:1:1:1:1:1) via the online survey software (Qualtrics) to create similarly sized groups. Only researchers were aware of the group assignment. With a power level of 0.80 ($\alpha = .05$), a minimum of 100 participants per group was established *a priori* as reasonable for capturing group differences. That number was increased by 20% to compensate for potential exclusion during data cleaning. Figure 1 describes the final analytic sample and filters used.

Procedure and Materials

Once participants were randomized into an experimental condition, the scenario of a typical fast-food drive-through without brand association was displayed. Instructions stated that they had received a gift card to purchase a combo meal. The use of a gift card was to limit the price effect. During the survey, participants saw a menu, ordered their food, and responded to a questionnaire.

First, participants saw 1 of the 6 menu boards with the available menu items. Next, the person placed their order. For those with traditional and optimal combo meals, the screen indicated if the combo included regular or diet soda. At that point, participants could choose a specific drink from the type of beverages already included in the combo. In addition, water was included as a response option on the screen, as is typical in the United States. After making their selections, a summary of the food order was displayed. At that moment, respondents were asked an open-ended question if there was anything else that the operator could help with to provide an opportunity for order customization. Finally, respondents went through a series of screens with a self-administered questionnaire examining psychographic and demographic variables.



Figure 2. Menu boards presented in an online scenario-based experiment that evaluated the effect of optimal defaults and visual cues in the context of a fast-food drive-through.

Menu boards were designed with typical US fast-food offerings based on market studies.[47-51] Figure 2 displays the 3 menu boards with visual cues to illustrate the experimental conditions. As shown, the same menu items were presented to all groups, with combo meals varying according to the included defaults. All menu boards also had a section with high-calorie and low-calorie sides and drinks to allow customization if participants wished to personalize their order. For the choice combo meals, menu items were listed per individual component. Traditional combos had, per default, french fries and regular sodas. Optimal combos contained a green salad and diet soda as low-calorie choices. Menu items, nutritional information, and prices mirrored the offerings of leading fast-food chains in the United States.

For the visual cue menu boards, the researchers prepared the food images to guarantee uniformity. For pictures of side items, an equal portion size was used for the green salad and french fries. The portion sizes were based on the reference amounts established by the Food and Drug Administration for fresh vegetables and french fries (85 g in both cases).[52] The primary photos included the entrée and side but were modified to include the beverage. Drinks were included as a component, using the same type of image commonly found in fast-food restaurants. The photos were edited to be homogeneous for background color, viewing distance, and menu item arrangement. In a pretest, 5 restaurant industry experts and 10 consumers evaluated the realism of the images and their location on the menu boards. All group members approved the final version of the menu boards with pictures.

Measurements

The psychographic variables of interest were adapted from standardized assessments used in previous studies. For anticipated pleasure, a scale from Hur and Jang[34] was used to ask participants to rate how they would feel eating the ordered meal. The scale included 3 items with a 7-point Likert response format anchored with terms such as "disappointed" and "delighted." An average score was calculated for the final variable analyzed. Order intention was measured with a single item used by Byrd[53] and Sun[54] in similar experiments. Specifically, participants used a 7-point Likert scale anchored with "extremely unlikely (1)" and "extremely likely (7)" to rate the ordering intention for their selected combo meal. Health concern was determined through 4 statements from Jin et al.[42] The wording in the items was modified slightly to better fit with the scenario. These statements included items such as "Self-consciousness about my health encourages me to choose healthy food" and "Concern about my personal health makes me want to purchase healthy food in restaurants." Participants reported their agreement with the sentences using 7-point Likert scales anchored with "strongly disagree (1)" and "strongly disagree (7)." The average score of the respondents' 4 answers was used as an aggregate health

Table 1. Descriptive information, reliability, and correlation of constructs included in an online scenario-based experiment that evaluated the effect of optimal defaults and visual cues in a fast-food drive-through

Measurement items per construct	Cronbach' α	Mean (SD[a])	Correlation of Study Constructs[b] 1	2	3
1. **Anticipated pleasure**[c]	.81	5.91 (0.32)	1		
Select the number that best represents how you would feel if you ate the food that you just ordered as your combo meal.					
• Unpleasant (1) …..…….. Pleasant (7)					
• Sad (1) ……..…..…. Happy (7)					
• Disappointed (1) …… Delighted (7)					
2. **Order intention**[d]	Not applicable	5.81 (1.29)	0.59**	1	
What is the likelihood that you would order the combo meal that you selected in the scenario? Response format: Extremely unlikely (1) ……. Extremely likely (7)					
3. **Health concern**[e]	.88	5.04 (0.11)	0.27**	0.21**	1
Indicate how much you agree or disagree with each statement about your current health concern when selecting food.					
• The risk of diet-related diseases makes me choose healthy food.					
• Self-consciousness about my health encourages me to choose healthy food.					
• Concern about my personal health makes me want to purchase healthy food in restaurants.					
• My physical appearance or concern about my weight makes me want to purchase healthy food in restaurants.					
Response format: Strongly disagree (1) ……. Strongly agree (7)					

[a]SD = standard deviation.
[b]Pearson correlation coefficient.
[c]Items were from Hur and Jang.[34] Response choices based on a Likert scale range from 1 to 7. Only the anchor numbers (ie, 1 and 7) included a descriptive word. The responses to the 3 items were aggregated to calculate a mean anticipated pleasure score.
[d]Items were from Byrd et al.[53] and Sun et al.[54] Response choices based on a Likert scale of 1 = extremely likely, 2 = moderately unlikely, 3 = slightly unlikely, 4 = neither likely nor unlikely, 5 = slightly likely, 6 = moderately likely, 7 = extremely likely.
[e]Items were from Jin et al.[42] Response choices based on a Likert scale of 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree. The responses to the 4 items were aggregated to calculate a mean health concern score.
**$P < .01$.

concern score. Two pilot studies were conducted to check scenario comprehension and instrument clarity, with subsequent updates completed as needed. Table 1 shows a complete list of the final items for each scale, along with measures of internal consistency and means (available as supplementary material).

The questionnaire included additional items used as control variables and used to evaluate comparability among groups before conducting the statistical analyses (Table 2). For example, participants rated their hunger level based on 1 item anchored at "1 = not hungry at all" and "7 = very hungry" as used by Byrd[55] et al and Ferriday et al[56] before being exposed to the scenario. Additionally, at the end of the questionnaire, participants were asked about demographic characteristics and other behaviors that may have influenced the variables of interest.

Data Analysis

Manipulation checks confirmed the interventions were interpreted as planned. The questionnaire included (1) an item verifying respondents saw the combo meals' photos; (2) a question about the presence of low-calorie choices in the combo meals; and (3) a question asking whether preset combo meals were included in the menu boards.

Kruskal-Wallis tests compared responses about anticipated pleasure and order intention among the 3 combo types. The responses showed negative skewness and different variability per group that did not allow the use of parametric

Table 2. Demographic and dietary characteristics of participants in a randomized online scenario-based experiment that evaluated the effect of optimal defaults and visual cues in the context of a fast-food drive-through (n = 636)[a]

		Combo Type					
		Choice Combos		Traditional Combos		Optimal Combos	
Variable/response set	All	No visual	Visual	No visual	Visual	No visual	Visual
	n (%)						
All (n)	636	106	113	113	105	100	99
Sex							
Male	382 (60.6)	67 (63.2)	67 (60.4)	77 (68.1)	60 (58.3)	54 (54.5)	57 (57.6)
Female	246 (39.0)	39 (36.8)	44 (39.6)	35 (31.0)	43 (41.7)	43 (43.4)	42 (42.4)
Intersex[b]	2						
Missing	6						
Age category, y							
19-29	140 (22.3)	19 (17.9)	28 (25.2)	28 (25.0)	24 (23.5)	21 (21.2)	20 (20.2)
30-39	269 (42.8)	52 (49.1)	50 (45.0)	50 (44.6)	38 (37.3)	41 (41.4)	38 (38.4)
40-49	110 (17.5)	21 (19.8)	22 (19.8)	16 (14.3)	18 (17.6)	17 (17.2)	16 (16.2)
50-59	73 (11.6)	9 (8.5)	8 (7.2)	14 (12.5)	14 (13.7)	15 (15.2)	13 (13.1)
60+	37 (5.9)	5	3	4	8 (7.8)	5	12 (12.1)
Missing	7						
Education							
High school grad or less	61 (9.6)	11 (10.5)	9 (8.0)	8 (7.1)	14 (13.5)	10 (10.0)	9 (9.1)
Some school or technical school	78 (12.3)	11 (10.5)	15 (13.4)	12 (10.6)	14 (13.5)	14 (14.0)	12 (12.1)
College degree or above	494 (78)	83 (79.0)	88 (78.6)	93 (82.3)	76 (73.1)	76 (76.0)	78 (78.8)
Missing	3						
BMI[c]							
Normal or underweight (BMI <25)	297 (58.5)	47 (57.3)	49 (52.1)	58 (63.0)	42 (51.9)	52 (70.3)	49 (57.6)
Overweight (BMI 25 to <30)	143 (28.1)	22 (26.8)	32 (34.0)	21 (22.8)	27 (33.3)	14 (18.9)	27 (31.8)
Obesity (BMI 25 to <40)	52 (12.2)	12 (14.6)	13 (13.8)	12 (13.0)	11 (13.6)	7 (9.5)	7 (8.2)
Extreme obesity (BMI > 40)	6	1	0	1	1	1	2
Missing	128 (20.1)						
Intake modification[d]							
Yes	270 (42.6)	41 (38.7)	46 (41.1)	53 (46.9)	50 (48.1)	42 (42.0)	38 (38.4)
No	364 (57.4)	65 (61.3)	66 (58.9)	60 (53.1)	54 (51.9)	58 (58.0)	61 (61.6)
Missing	2						
	mean (standard deviation)						
Frequency of consumption from fast-food restaurants per week[e]	2.96 (1.88)	2.98 (1.78)	3.17 (1.84)	2.97 (1.96)	2.74 (1.92)	2.89 (2.08)	3.01 (1.69)
Hunger prior to survey[f]	4.52 (1.73)	4.52 (1.83)	4.8 (1.63)	4.50 (1.69)	4.55 (1.78)	4.30 (1.80)	4.44 (1.59)

[a] χ^2 Analysis was used to test for differences in the percentages for each demographic aspect and intake modification. Analysis of variance was used to test for significant differences in the means for hunger prior to the survey. No significant difference ($P < .05$) was found for any case.

[b] This term describes people who have reproductive anatomy or chromosomal pattern that cannot be classified as male or female.

[c] BMI = body mass index. BMI categories are according to the Centers for Disease Control definitions for adults. Participants self-reported their current weight in pounds and their current height in feet and inches. After transforming variables to kilograms and meters, respectively, BMI was calculated with the equation [Weight/(height2)]*703. Implausible data entered by participants resulted in 128 entries being treated as missing values.

[d] Intake modification was measured with an item asking: "Are you currently modifying your food intake for health or weight reasons?"

[e] Respondents were asked, "How often do you get food from fast-food restaurants in a typical week (before COVID-19 pandemic)?" For this response, the 1.5 Interquartile Range Rule was applied to remove extreme values. According to the sample distribution, any value higher than 9.5 was replaced with the sample mean (2.96) (38 responses). The cutoff is congruent with a recent report that says that maximum frequencies of around 30 times per month may be seen.[51]

[f] Before presenting the scenario, participants were asked to rate their degree of hunger on a scale anchored at 1 = not hungry at all and 7 = very hungry. This procedure was used by Byrd et al[55] and Ferriday et al[56] in similar studies.

procedures. After the Wallis test, a post hoc examination using Dunn test with Bonferroni correction was used to evaluate contrast among groups.

Multiple regression models tested the 3-way interaction between combo type, visual cues, and health concern. Since previous research found that sex and education explained some food choices,[57-59] they were included in the models as covariates. All categorical predictors were included in the models as dummy coded using 0 and 1. The multiple moderation effect was evaluated using the approach recommended by Hayes.[60] After establishing moderation, the Johnson-Neyman technique was applied to examine regions in the range of health concern scores where the interaction was significant. Statistical significance was set at $\alpha < .05$, 2-tailed, for all the analyses.

RESULTS

In total, 763 responses were collected. After filtering for incomplete surveys or those who failed attention check questions, 636 responses remained (Figure 1). Table 2 presents the main demographic characteristics of the respondents included in the analysis. The analytic sample involved participants from 48 states in the United States. Most participants identified themselves as Caucasians (56.5%) or African Americans (26.2%). More than 60% of the participants were younger than 40 years old, with a college degree or above. Forty percent of the respondents reported modifying their intake for health or weight reasons. There were no significant differences among combo meals groups for any demographic or dietary aspect.

Defaults' Main Effects on Order Intention and Anticipated Pleasure

Defaults in combo meals affected order intention and anticipated pleasure (Figure 3). Specifically, the results showed that the likelihood of participants ordering the meal selected from the menu board differed significantly between combo types. Pairwise comparisons adjusted by Bonferroni correction showed that traditional and optimal combo meals' order intentions were lesser than those reported for the choice combos. However, the comparisons did not show differences between the optimal and the traditional combos. For anticipated pleasure, the analysis indicated that the optimal combo meals obtained the lowest values compared with the choice and the traditional combos.

Moderated Moderation of Visual Cues

Multiple regression models revealed that visual cues did not moderate the defaults' effect on anticipated pleasure and order intention; however, further testing was conducted to determine the moderating role of health concern on visual cues' effect. More specifically, a test was done to determine if the moderation of the defaults' effect by visual cues was itself moderated by health concern level (moderated moderation[60]).

Linear regression was performed with anticipated pleasure as the dependent variable. Results did not show that visual cues' moderation of the decrease in anticipated pleasure with the optimal combos varied with health concern level. Three-way interactions between health concern, visual cues, and combo types were tested. The regression coefficients for the 3-way interactions were not significant. In fact, the model did not show that the presence of visual cues alone could modify the effect of the defaults on anticipated pleasure.

Different results, however, were found with order intention. The model presented in Table 3 (available at www.jandonline.org) supports the moderating effect of visual cues on the optimal combo meals based on health concern level. When health concern values were lower, visual cues decreased the likelihood of ordering optimal combos, but when health concern was higher, visual cues enhanced order intention compared with the choice combo group. No effect was found in the traditional combos.

Figures 4 and 5 display visual depictions of the model in Table 3 (available at www.jandonline.org). Given that education was included as a significant covariate, the lines were estimated for participants with high school or less as the reference group. However, similar patterns were observed at all education levels. It is known that individuals with less education are likely to make poorer food choices and have greater exposure to fast-food restaurants.[58]

Figure 4 illustrates the traditional and the optimal default effect compared with the choice combos with/without pictures at different levels of health concern. The top panel shows that without visual cues, the order intention for the optimal combo meals remained lower than the choice combos. In contrast, the bottom panel illustrates that the optimal combo's order intention varied with health concern level when visual cues were added. Conversely, as shown in Table 3 (available at www.jandonline.org), visual cues' effect on order intention did not change depending on health concern for participants with traditional combos. Both panels show this consistent trend for the traditional combo meal.

The effect of visual cues on the group ordering optimal combos was then examined among different levels of health concern. The Johnson-Neyman technique revealed a significant effect when participants exhibited average health concern scores lower than 4.09 or higher than 6.03. A higher score represented the responses of participants who actively contemplate the nutritional quality of their food choices due to health considerations. In the present study, the median aggregated score was 5.25 (interquartile range = 4.5-6.0). For respondents with low health concern (average score less than 4.09; 20.29% of respondents), the presence of pictures diminished their order intention for optimal combo meals. By contrast, participants with high health concern (greater than 6.03; 20.60% of respondents) increased their intention to order the optimal combo when pictures were present.

Since no significant moderating effect was found in the traditional option, Figure 5 focuses on the results within the groups with choice and optimal combo meals. For participants who arranged the combo meal by themselves (bottom panel), the presence of pictures also changed their order intention at different levels of health concern. In the group with optimal combos, the top panel displays the interaction between visual cues and health concern. The intersection point corresponds to values of 4.5 of the aggregate health concern score (25th percentile of the distribution). The graph shows that the inclusion of visual cues altered the order intention for optimal combos in opposite ways depending on the levels of health concern. The top panel also displays that in the optimal combos, the presence of pictures did not negatively impact anyone with scores above 4 (20th percentile).

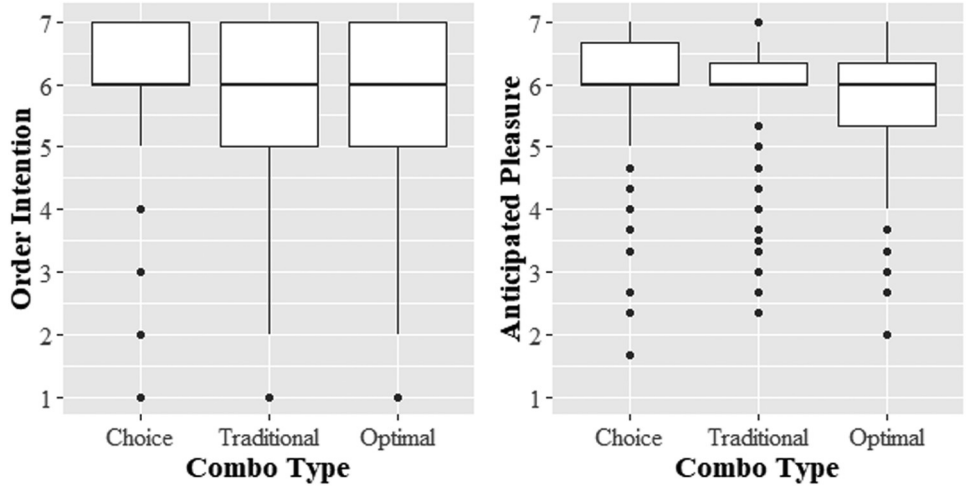


Figure 3. Order intention and anticipated pleasured of participants exposed to 3 different combo types in a randomized online scenario-based experiment that evaluated the effect of optimal defaults in the context of a fast-food drive-through (n = 636). Order intention was based on an item asking the likelihood of participants ordering the combo meal they selected in the scenario. The response scale ranged from "extremely unlikely (1)" to "extremely likely (7)."[53,54] A Kruskal-Wallis test evaluated differences in order intention among the combo types: H(2) = 16.61, $P < .001$, $\varepsilon 2 = 0.026$. The post hoc examination showed the following results about pairwise comparisons: choice vs traditional combos: Dunn test = 42.58, $P = .032$; choice vs optimal combos: Dunn test = 62.58, $P < .001$; traditional vs optimal combos: Dunn test = 42.58, $P = .128$. Anticipated pleasure was based on a mean score of 3 items that evaluated pleasure-related emotions. The response scale was anchored with emotions such as "Unpleasant (1)" to "Pleasant (7)."[34] A Kruskal-Wallis test was conducted to evaluate differences in anticipated pleasure among the combo types: H(2) = 10.96, $P = .004$, $\varepsilon 2 = 0.017$. The post hoc examination showed the following results about pairwise comparisons: choice vs traditional combos: Dunn test = 22.16, $P = .196$; choice vs optimal combos: Dunn test = 57.56, $P = .003$; traditional vs optimal combos: Dunn test = 35.40, $P = .044$. Combo type: (1) choice: combo meals created by respondents; (2) traditional: combo meals included per default french fries and regular soda; (3) optimal: combo meals included per default green salad and diet soda. Responses included participants with and without visual cues in the respective combo type.

DISCUSSION

This scenario-based experiment demonstrated the adverse effects of optimal defaults on adults' anticipated pleasure and order intention of a selected combo meal in a fast-food drive-through. The influence on anticipated pleasure was not changed by including a second nutritional nudge—visual cues of photos of the combo meal. Nevertheless, the study showed that the optimal defaults' impact on order intention was moderated by including visual cues. The inclusion of photos on menu boards with optimal combos changed the optimal defaults' effect on order intention depending on consumers' health concern level. For participants who reported little interest in healthy food choices, the optimal defaults' photos further reduced the likelihood of ordering them. Conversely, for those with high health concern scores, the presence of visual cues increased their order intention for the optimal combo meal. In fact, for most participants reporting a neutral health concern, the optimal combos' pictures did not negatively impact their order intention.

The reduction in anticipated pleasure and order intention is congruent with the unhealthy = tasty intuition and feedback theory.[30-33] Pleasure seeking is a crucial driver of food choices, but it has been scarcely considered in the promotion of healthy eating.[61,62] Initiatives to promote healthy eating must consider pleasure. Enjoyment predicts future selection and consumption of food.[63,64] The diminished pleasure associated with the optimal combos could suggest that people may not even initiate the food order and would not benefit from low-calorie offerings on restaurant menus. More research is needed to evaluate optimal defaults' longitudinal effects on nutritional and behavioral-related outcomes in adults.

These adverse effects may also be problematic for the foodservice industry. Most of the time, effects of interest for restauranteurs are not considered, even though they are crucial to guaranteeing the sustainability of the measures promoted.[65] Restauranteurs are more willing to adopt health-related initiatives perceived as advantageous for their establishment.[66] Negative effects on customer perceptions may discourage retailers from implementing and sustaining health-related initiatives.[65] Common barriers to healthy eating promotion in restaurants include restauranteurs' assumption that people will reject healthy items or have a poor attitude to these offerings.[67-69] In that sense, the negative effect on anticipated pleasure and order intention without further analysis supports those common complaints and does not offer any commercial benefit. However, the broader analysis provided in the present study showed other important insights. For example, the reduction in order intention produced by the defaults was the same for the traditional and optimal combos (Figure 3). Additionally, results showed adverse effects, at least in order intention, may be moderated by visual cues presented to a specific market segment: highly health-concerned consumers.

Using visual cues to highlight low-calorie items could be valuable to restaurant marketers. As shown by this study's results, the concomitant use of optimal defaults and visual

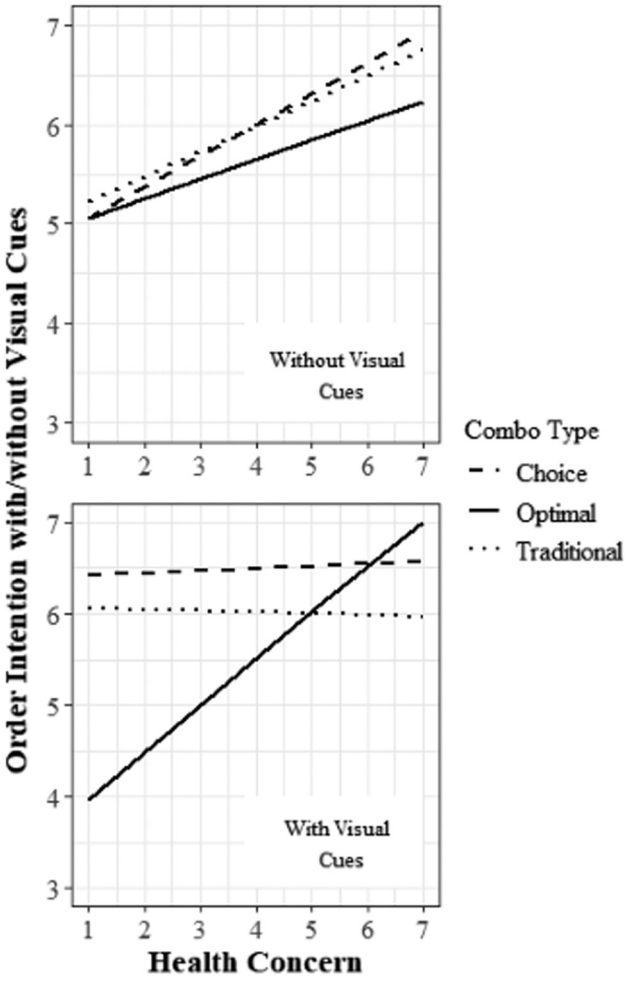


Figure 4. Defaults' effect on order intention according to health concern level and the presence or not of visual cues on the menu board in a fast-food scenario-based experiment. Combo type: (1) choice: combo meals created by respondents; (2) traditional: combo meals included, per default, regular soda, and french fries; (3) optimal: combo meals included, per default, diet soda, and green salad. Visual cues: (1) without visual cues: menu boards just with text; (2) with visual cues: menu boards with combo meals photos. Order intention was measured with an item that asked the likelihood of participants ordering the combo meal they selected in the scenario. The response scale ranged from "extremely unlikely (1)" to "extremely likely (7)."[53,54] Health concern was based on a mean score of 4 items that asked participants agreement with sentences like "Self-consciousness about my health encourages me to choose healthy food." The response scale ranged from "Strongly disagree (1)" to "Strongly agree (7)."[42] Regression lines were predicted based on the model in Table 2, considering minimum, median, and maximum values for health concern (1, 5.2, and 7, respectively). The lines were estimated for people with high school or less. Johnson-Neyman technique's results: (1) for participants with low health concern score (less than 4.09), the presence of pictures diminished their order intention for optimal combo meals (HC = 4.0, effect = −0.64, $t = -1.96$, $P = .038$); (2) for participants with high health concern (score greater than 6.03), the presence of pictures increased their intention to order the optimal combo (HC = 6.1, effect = 0.63, t = 2.05, $P = .041$).

cues improved the order intention in those who cared most about the nutritional quality of their food choices. In fact, for most of the respondents, the visual cues did not hurt their determination to purchase the combo meal (Figure 5, top panel). Those results are aligned with previous literature highlighting that visual stimuli on menus can be a powerful tool in restaurants.[70,71] Therefore, fast-food restaurants adopting optimal defaults photos on menu boards could leverage the sale of the optimal combo meals. Having the optimal combo without visual promotion might decrease demand even by those more sensitive to that offering (Figure 4, top). For individuals not interested in healthy options, other menu items will be selected. This latter outcome does not affect the restaurant, but it represents a challenge for healthy eating promotion.

The study displayed an unexpected effect of visual cues on low health-concerned individuals exposed to optimal defaults. For them, the photos discouraged the optimal combo meals' order intention. Visual cues have been suggested as a nutritional nudge to push healthier choices at restaurants,[17,39] but that did not occur for individuals who likely need healthier choices the most. The optimal combos' images did not persuade those who paid little attention to purchasing low-calorie items. For them, rejection of the healthier options actually became stronger with the subtle nudge. Although the effect contradicts the nutritional nudges' spirit, it supports the theoretical construct of attention bias; people may have selective attention toward specific stimuli.[36] Additionally, these findings document another research problem: how to push healthy choices to those who do not care about them. Future research should consider testing other nutritional nudges oriented exclusively to people with low health concern.

The finding also raises doubt about visual cues' role in favorably modifying eating practices at fast-food restaurants for the adult population. A literature review that suggested visual cues as a nudge in restaurants did not address experimental studies.[17] Other reviews also did not find evidence of restaurant strategies that included visual cues as a nutritional nudge.[18] In addition, a recent study reported that increasing menu items' visibility as a nutritional nudge did not change food choices.[72] In the present experiment, the visual cues' effect on optimal combos' order intention was not the same for all the respondents. Finally, there was no evidence suggesting visual cues changed anticipated pleasure toward the combo meals among people with different levels of health concern. This lack of definitive evidence about this nutritional nudge may question its effectiveness. Perhaps visual cues may help normalize healthy offerings as part of nutritional environments at restaurants or work better with another nutritional nudge, but more research to support it is necessary. Policy makers should consider these inconclusive findings in future interventions targeting restaurants.

Results of this study should be interpreted cautiously, considering the study's limitations. The scenario-based experiment included one of the most classic menu offerings in US fast-food restaurants: a burger, fries, and soda. That decision was made to increase external validity but may have also influenced the findings. The association between those menu items may have been so ingrained that it may have affected responses. Additionally, the combination in the optimal combo meals may not have evoked a completely

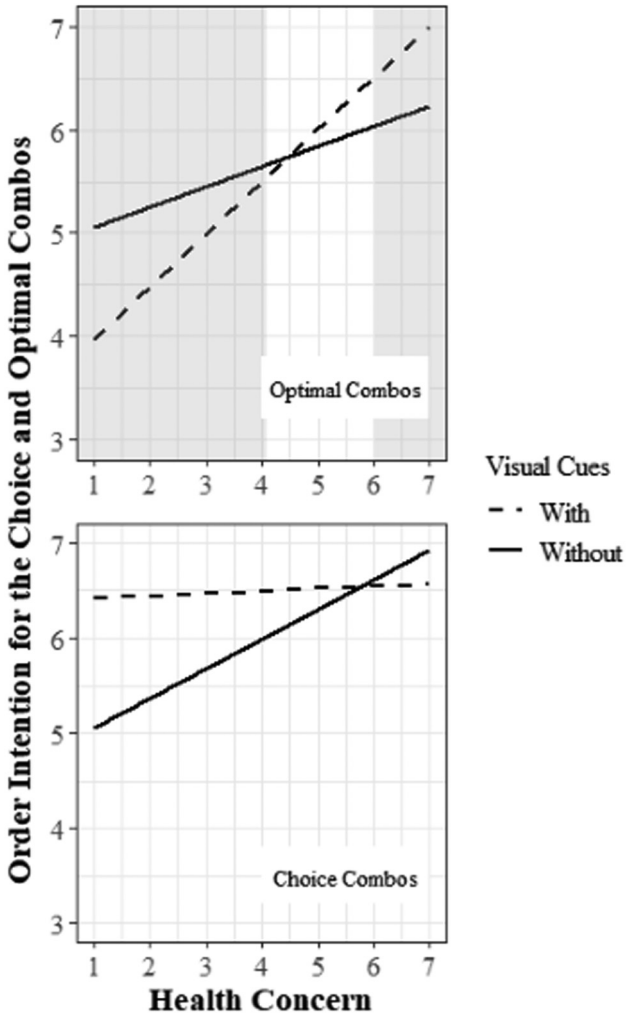


Figure 5. Conditional effect of visual cues on order intention in the choice and optimal combo meals as a function of health concern, according to the responses collected in a fast-food scenario-based experiment. Combo type: (1) choice: respondents created their combo meals; (2) optimal: combo meals included per default diet soda and green salad. Visual cues: (1) without: menu boards just with text; (2) with: menu boards with combo meal photos. Order intention was measured with an item that asked the likelihood of participants ordering the combo meal they selected in the scenario. Response scale ranged from "extremely unlikely (1)" to "extremely likely (7)."[53,54] Health concern was based on a mean score of 4 items that asked participants agreement with sentences like "Self-consciousness about my health encourages me to choose healthy food." Response scale ranged from "Strongly disagree (1)" to "Strongly agree (7)."[42] Regression lines were predicted based on the model in Table 2, considering minimum, median, and maximum values for health concern (1, 5.2, and 7, respectively). The lines were estimated for people with high school or less. On the top panel, the gray areas indicate the region of significance for the interaction between optimal combos, visual cues, and health concern.

healthy alternative for those with a high health concern. For example, the diet soda option is seen as a health risk by some consumers.[73,74] This study focused on drinks available in fast-food outlets, but healthy eating involves more than low-calorie alternatives. Consequently, more work should be done with other products considered to be low-calorie or healthy.

Another study limitation is the use of a scenario-based survey distributed via crowdsourcing. Although other research using crowdsourcing has demonstrated its validity and considers it a good source of consumer insights,[46,75,76] a real-world context would reduce limitations associated with self-reported behavioral intentions. Likewise, data collection during the COVID-19 pandemic may also have affected people's perceptions of their health concern or order intention for indulgent food.

In addition, value perception may have been another confounding variable; however, value perception of the combo meals was not included because of the significant body of prior research.[43] Instead, this experiment attempted to restrain the influence of price evaluation with a gift card prompt. The presence of menu prices may have influenced respondents; however, the budget constraint would have affected all the groups in the same way because the prices were similar.

The generalizability of the results is limited to the context addressed. For instance, the results of visual cues must be understood in the context of combo meals. Similarly, the experiment examined behavioral outcomes in adults who lived in the United States and used fast-food drive-through options. Different effects may be found elsewhere. Likewise, the scenario does not allow extrapolation to other kinds of restaurants or menus. The lack of results associated with visual cues might also be explained by the fact that people do not spend very much time considering the menu board in a drive-through. Although the use of the drive-through setting imposed such constraints, the use of a drive-through was considered a unique advantage to the study due to the lack of research on nutrition in this behavioral setting.

This study offers theoretical and practical contributions. The findings expand the literature on nudge theory and show some of nudges' downsides that still need to be addressed. Policy makers and restauranteurs interested in health-focused concepts could take the results into account for future initiatives that include nutritional nudges. This study also highlights the importance of diverse aspects of menu design. Beyond menu planning and nutrient analysis, procedures like grouping menu items and using visual cues have other crucial effects. Practitioners and consultants in the restaurant sector could use this experimental evidence for menu design decisions related to healthy eating promotion at restaurants and other foodservice outlets.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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AUTHOR CONTRIBUTIONS

M. Diaz-Beltran, B. Almanza, and C. Behnke conceptualized the idea. M. Diaz-Beltran, B. Almanza, C. Behnke, K. Byrd, and D. Nelson developed the protocol and instruments to data collection. M. Diaz-Beltran collected the data, conducted the statistical analysis, wrote the first draft of the manuscript, and was the lead writer of the final version. B. Almanza, C. Behnke, K. Byrd, and D. Nelson provided critical manuscript revisions. B. Almanza supervised all the aspects of the project. All authors approved the final manuscript prior to submission.

Table 3. Summary of regression analysis to explain moderation of optimal defaults' effect on order intention by visual cues and health concern based on responses collected in a fast-food scenario-based experiment (n = 636)[a]

	Unstandardized Coefficients				95% Confidence Interval	
Predictors[b]	B	SE[c]	t	*P* value[d]	Lower bound	Upper bound
Intercept	4.74	0.58	8.21	<.001	3.61	5.88
Trad[e]	0.19	0.72	0.26	.794	−1.23	1.60
Opt[f]	0.13	0.72	0.18	.858	−1.28	1.54
VC[g]	1.65	0.71	2.32	.021*	0.25	3.05
Trad * VC	−0.51	0.95	−0.54	.593	−2.37	1.35
Opt * VC	−3.06	0.96	−3.20	.001*	−4.94	−1.18
HC[h]	0.31	0.11	2.91	.004*	0.10	0.52
Trad * HC	−0.05	0.14	−0.40	.690	−0.32	0.21
Opt * HC	−0.12	0.14	−0.87	.387	−0.39	0.15
VC * HC	−0.29	0.13	−2.16	.031*	−0.55	−0.03
Trad * VC * HC	0.02	0.18	0.09	.932	−0.34	0.37
Opt * VC * HC	0.60	0.18	3.30	.001*	0.25	0.96
Covariates						
Education: some school or technical school	−0.57	0.21	−2.69	.007*	−0.98	−0.15
Education: college degree or above	−0.37	0.17	−2.19	.029*	−0.70	−0.04

[a]Model tested: $R^2 = 0.12$, F(13,617) = 6.472, $P < .001$. The addition of only visual cues and their interactions with combo type did not improve the prediction of order intention ($\Delta R^2 = 0.005$, $\Delta F = 1.010$, $P = .388$). The inclusion of health concern and its interaction with combo type and visual cues did improve the estimation ($\Delta R^2 = 0.076$, $\Delta F = 8.853$, $P < .001$). The 3-way interactions represented 2.1% of the R^2 change ($\Delta F = 7.525$, $P = .001$). In this model, sex was not a significant predictor to control. In contrast, education was included due to its significance, even with the presence of other variables.

[b]The categorical variables were dummy coded. Combo type 1: choice = 0, traditional = 1; combo type 2: choice = 0, optimal = 1; visual cues: absence = 0, presence = 1; education 1: people with high school or less = 0, some school or technical school = 1; education 2: people with high school or less = 0, college degree or above = 1.

[c]SE = standard error.

[d]Statistically significant predictors of order intention ($P < .05$).

[e]Trad = traditional combos; combo meals included per default french fries and regular soda.

[f]Opt = optimal combos; combo meals included per default green salad and diet soda.

[g]VC = visual cues.

[h]HC = health concern; based on a mean score of 4 items that asked participants agreement with sentences like "Self-consciousness about my health encourages me to choose healthy food." Response format anchored "Strongly disagree (1)" and "Strongly agree (7)."[42]