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If I Indulge First, I Will Eat Less Overall: The Unexpected Interaction Effect of Indulgence and Presentation Order on Consumption

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Across 4 experiments, this research is the first to uncover the interaction effect of food type (indulgent vs. healthy) and food presentation order (first vs. last) on individuals' sequential food choices and their overall caloric intake. This work showed that, when selecting foods in a sequence (e.g., at a buffet or on a food ordering website), individuals are influenced by the first item they see and tend to make their subsequent food choices on the basis of this first item. This notion can be utilized to nudge individuals into consuming less food overall. In contrast to what one might intuitively assume, Experiment 1—a field study in a real-life cafeteria—showed that when an indulgent (healthy) dish is the first item, lower-calorie (higher-calorie) dishes are subsequently chosen and overall caloric consumption is lower (higher). Experiments 2 and 3 replicated these effects in the context of ordering food on a website. Experiment 4 further revealed that high (vs. low) cognitive load alters the identified interaction effect, such that when an indulgent dish is the first item, higher-calorie dishes are subsequently chosen.

Public Significance Statement

Can we nudge people into consuming fewer calories by changing the order in which they choose an indulgent dish from a buffet or order it from a website? This multiexperiment research advances the idea that indulgence and order of food presentation work together to influence food consumption, showing that choosing an indulgent dish first may lower people's overall caloric intake.

Keywords: cognitive load, field experiment, food consumption, indulgence, order effects

People are often faced with the situation of sequentially constructing a meal from an array of food options, including a variety of entrees, side dishes, soups, salads, and desserts. This situation is often found at "all-you-can-eat" buffet restaurants, in school cafeterias, and at employee canteens. Today, many people also make sequential choices when ordering food on websites such as Uber Eats and GrubHub. In all of these settings, people most often consider and select one option at a time. Traditionally, desserts are located at the end of the sequence. In some situations, however, people can see and choose the dessert first, as can be the case at "all-you-can-eat" buffets, where individuals can enter the sequence from multiple directions. In light of this observation, this research is the first to ask the question: Can a simple change in the type of food (indulgent vs. healthy) and the order of food presentation (first vs. last) substantially alter downstream food choices and overall caloric intake? In other words, would we observe different food choices and different magnitudes of caloric intake if an indulgent option was placed at the beginning, instead of at the end, of a food sequence? In light of the fact that obesity remains a mounting issue with worrisome health and financial consequences (World Health Organization, 2017), this unanswered question is an important one.

There is growing recognition that both environmental nudges and cognitive factors can significantly affect what and how much people choose to eat. These factors include portion and package size (Scott, Nowlis, Mandel, & Morales, 2008), social influence (McFerran, Dahl, Fitzsimons, & Morales, 2010), food visibility

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(Privitera & Creary, 2013), traffic light color labels (Trudel, Murray, Kim, & Chen, 2015), nonfood incentives (Reimann, Bechara, & MacInnis, 2015; Reimann & Lane, 2017; Reimann, MacInnis, & Bechara, 2016), physical proximity (Baskin et al., 2016; Privitera & Zuraikat, 2014), attentional retraining (Kemps, Tiggemann, Orr, & Grear, 2014), food-related mental imagery (Christian, Miles, Kenyeri, Mattschey, & Macrae, 2016), and even the continuity people feel between their present and future selves (Rutchick, Slepian, Reyes, Pleskus, & Hershfield, 2018). Our research adds to this important line of work by showing that simple changes in the way food is presented can nudge individuals to make overall healthier choices and consume fewer calories. Specifically, the present research provides converging behavioral evidence, from four experiments, that food type and food presentation order *together* influence food choices and caloric intake. Our study is relevant from both a theoretical perspective and the standpoint of practical applicability.

Theoretically, it is thus far unknown when and how indulgence and sequential presentation order interact to influence food choice and caloric intake. However, there is a growing body of literature showing that the order of items in a choice set may influence consumer evaluations and choice. For example, Haugtvedt and Wegener (1994) noted that when several persuasive messages are conveyed, the first message has the greatest influence on downstream attitudes. Relatedly, Carlson, Meloy, and Russo (2006) indicated that the first piece of information that individuals perceive about a product brand leads them to prefer that brand. Along similar lines, Pandelaere, Millet, and Van den Bergh (2010) provided initial evidence that people prefer songs and pictures to which they are exposed first in a sequence over those to which they are exposed later. This line of research has shown that when items are presented sequentially, the order in which they are presented has a critical effect on downstream judgments and decisions. In particular, it seems that the first item in a sequence may play an especially prominent role.

Practically, buffet restaurants, cafeterias, and canteens may be able to simply switch *both* the type of foods offered and their presentation order to nudge individuals toward healthier food choices and overall less caloric consumption. Thus far, however, the potential application of this idea has been largely overlooked.

A second, related question is this: If food type (indulgent vs. healthy) and presentation order (first vs. last) indeed interact to influence food choices and overall caloric intake, then why does this interaction effect take place? To provide some answer for this question, we draw from the literature on licensing, primacy, and cognitive load, as detailed next.

Conceptual Framework and Hypotheses

Food Type: How Licensing Alters Consumption

Prior research has argued and shown that either a prior virtuous choice or the intention to carry out a virtuous act may "license" individuals to subsequently choose more indulgent options (Khan & Dhar, 2006). For example, individuals who intended to act virtuously by volunteering or making a donation were more likely to select luxury items (e.g., designer jeans) than necessity items (e.g., vacuum cleaner; Khan & Dhar, 2006). This work implies that the choice of a healthy dish (which oftentimes represents a virtuous choice) would "license" the choice of an indulgent option subsequently. Indeed, in simultaneous choices, the mere presence of an item associated with a long-term health goal can signal progress toward that goal and, thereby, might license individuals to select a more indulgent option (Wilcox, Vallen, Block, & Fitzsimons, 2009). These literatures, thus, imply that *food type* (indulgent vs. healthy) may exert a profound effect on downstream food choices. However, prior literature is unclear on what happens in sequential choices in which either an indulgent or a healthy option is presented first. Indeed, there are mixed insights stemming from previous research on licensing: Work in this area has argued that making healthy choices can lead to goal balancing, where people subsequently choose to indulge (Dhar & Simonson, 1999). An initial indulgent option could possibly lead to a "what-the-hell" effect (Cochran & Tesser, 1996) such that people feel that their diet has been disrupted and, thus, subsequently indulge (Herman & Mack, 1975; Herman & Polivy, 1983). Yet, work in this domain has also argued that making healthy choices can also lead to goal highlighting, leading to subsequent healthy choice (Dhar & Simonson, 1999). In this paper, we aim to bring clarity to these mixed insights by asking and systematically investigating: Being offered an indulgent option first, would individuals further indulge in subsequent choices or would they restrain themselves from doing so? We propose that individuals who choose an indulgent (healthy) dish first are less (more) likely to licensed themselves to indulge and subsequently choose healthy (indulgent) dishes. We expect this effect to occur because healthy items (such as a bowl of fruit for dessert) can signal progress toward a goal and, therefore, make individuals more likely to license themselves to choose subsequent less healthy items. On the other hand, indulgent items (such as a cheesecake for dessert) do not signal progress toward a goal and, therefore, make individuals less likely to license themselves to choose subsequent indulgent items (Khan & Dhar, 2006).

Food Presentation Order: How Primacy Alters Consumption

Order effects are said to occur when, because of its position in a set, an item has greater influence on evaluation or choice relative to the other items in that set (Büyükkurt, 1986; Hogarth & Einhorn, 1992; Pandelaere et al., 2010). We argue that a primacy effect occurs in sequential choice sets, in which the first item is more effective in altering food choice and consumption than the last item because, at the end of the sequence, individuals have already made a series of consumption decisions, and the last food item is very unlikely to make individuals change their previous decisions (i.e., go back in line and return or change their food items). Furthermore, a primacy effect tends to occur when items are presented visually, when live (vs. memory-based) processing is required, and when presentation and evaluation are close in time (Gürhan-Canli, 2003; Hastie & Park, 1986; Krosnick & Alwin, 1987). The first item in a sequence may also be subjected to more cognitive elaboration, as more cognitive resources are available at the beginning of a series of choice tasks (Conway, Cowan, & Bunting, 2001; Cowan et al., 2005). In summary, a primacy effect should be expected in sequential choices, where consumers integrate information serially, items are presented visually, and evaluation and choice are temporally close. These conditions characterize sequential food choices such as building a meal from items in a cafeteria bar; thus, we expect that the first food item is more likely than subsequent items to exert a significant effect on sequential food choices. Taking together both the notions of licensing and primacy, we hypothesize:

Hypothesis 1: In sequential choices, choosing an indulgent (healthy) option first leads individuals to consume healthy (indulgent) options subsequently.

The Role of Cognitive Resources

Prior research has found that individuals under high cognitive load (i.e., time pressure) select different food items than do individuals are under low cognitive load (Veling et al., 2017). Furthermore, previous research has implied that, when confronted with an indulgent choice and so long as individuals have cognitive resources available, a self-control conflict arises, leading subsequent choices to be more aligned with long-term health goals. Conversely, when cognitive resources are limited, such a self-control conflict is less likely to arise (Fishbach & Converse, 2011). We argue that under conditions of high (vs. low) cognitive load, it is less (more) likely that a primacy effect occurs because individuals' cognitive resources are taxed (available). Under high cognitive load, the first item in a sequence may lose the advantage it has under low cognitive load, as cognitive capacity and memory are more crowded upon encountering the first item, which gives individuals lesser opportunity to encode and rehearse the first piece of information (Page & Norris, 1998). Indeed, in evaluation tasks, primacy effects are reduced when individuals are distracted, because distraction crowds their short-term memory (STM; Biswas, Biswas, & Chatterjee, 2009). We further argue that under high (vs. low) cognitive load, it might be more (less) likely that a licensing effect occurs when an indulgent (healthy) dish is presented first. Taxed cognitive resources may provide individuals with a "right to indulge" because they are "working hard" (Kivetz & Simonson, 2002) and, thus, give them a license to further indulge. We hypothesize:

Hypothesis 2: Under high (vs. low) cognitive load, choosing an indulgent option first leads individuals to consume indulgent (healthy) options subsequently.

Overview of Experiments

This paper reports the findings from four experiments. Experiment 1 showed, in the field setting of a real-life cafeteria, that participants base subsequent choices and caloric intake on the first food item presented sequentially: participants actually choose higher-calorie items and eat more if the first item is healthy, whereas they choose lower-calorie items and eat less if the first item is indulgent. Experiment 2 replicated these findings in the context of ordering food on a website. Experiment 3 showed that these effects are also valid if the presentation order of the main dish is altered, ruling out the competing explanation that these results are due to the unusual presentation order of the dishes or the "novelty" of seeing and choosing a dessert first. Experiment 4 revealed that under high (vs. low) cognitive load, participants chose higher-calorie items and ate more if the first item is indulgent. Figure 1 provides a summary of the experiments conducted in this research.

Field Experiment 1: Establishing the Dessert Type and Presentation Order Effect in a Cafeteria

Method

The objective of Experiment 1, a field experiment, was to test Hypothesis 1: Would participants, when the first item in a food sequence is indulgent (healthy), choose healthy (indulgent) foods in subsequent choices, thus consuming fewer (more) total calories? To test this prediction, we manipulated the food type and presentation order of a dessert relative to the other food items in a cafeteria buffet and subsequently observed the amount and type of food actually consumed by cafeteria patrons.

Participants and design. One hundred thirty-four cafeteria patrons (40% female, $M_{\text{age}} = 31.3$, $M_{\text{BMI}} = 25.8$) participated. We conducted Experiment 1 in one of the cafeterias of a large private university, which offers a daily fixed-price menu including a soup, main dish, side dish, bread, and dessert. Cafeteria patrons were primarily faculty, staff, and graduate students. Seven cases were excluded from further analyses due to incomplete responses. Experiment 1 employed a 2 (dessert presentation order: first, last) × 2 (dessert type: healthy, indulgent) between-subjects experimental design, with dessert presentation order and dessert type as between-subjects independent variables and actual calories consumed, type of the main dish chosen, and type of side dish chosen as dependent variables. On four different days, we varied the dessert presentation order by placing dessert at either the beginning or the end of the cafeteria buffet, and we also varied the dessert type by offering either a healthy or an indulgent dessert. It is important to note that patrons were only able to enter the buffet line from one specific point. Thus, on each day, only one or the other dessert was offered (and not both) and shown either first or last. As such, each of the four days represented one of the four experimental conditions: healthy dessert first; indulgent dessert first; healthy dessert last; and indulgent dessert last. In the healthy dessert conditions, the dessert offered was assorted fresh fruit (officially valued at 70 calories by the cafeteria services department). In the indulgent dessert conditions, the dessert offered was a slice of rich lemon cheesecake (officially valued at 189 calories by the cafeteria services department). These two desserts are similar to those used in previous consumer research (Shiv & Fedorikhin, 1999). Additionally, a pretest ($n = 64$) confirmed that individuals perceived fresh fruit, compared with lemon cheesecake, to be significantly healthier ($M = 6.22$, $SE = .25$ vs. $M = 2.44$, $SE = .27$), $t(62) = 10.39$, $p < .001$, $d = 2.60$, and also significantly less indulgent ($M = 3.69$, $SE = .27$ vs. $M = 6.19$, $SE = .17$), $t(62) = 7.88$, $p < .001$, $d = 1.96$. Similar to past research, perceptions of health and indulgence were measured by asking participants how healthy or how indulgent they perceived these two items to be on 7-point scales (Finkelstein & Fishbach, 2010).

Procedures. One of the authors and a research assistant worked on-site. Everyone in the cafeteria passed through the line; however, data were only collected from those who were recruited and filled out a survey. The research assistant approached every fourth person coming out of the serving line and asked them if they would answer a brief survey after finishing their meal. All the people who were approached agreed to participate. Meanwhile, one of the authors discreetly observed and recorded the foods that

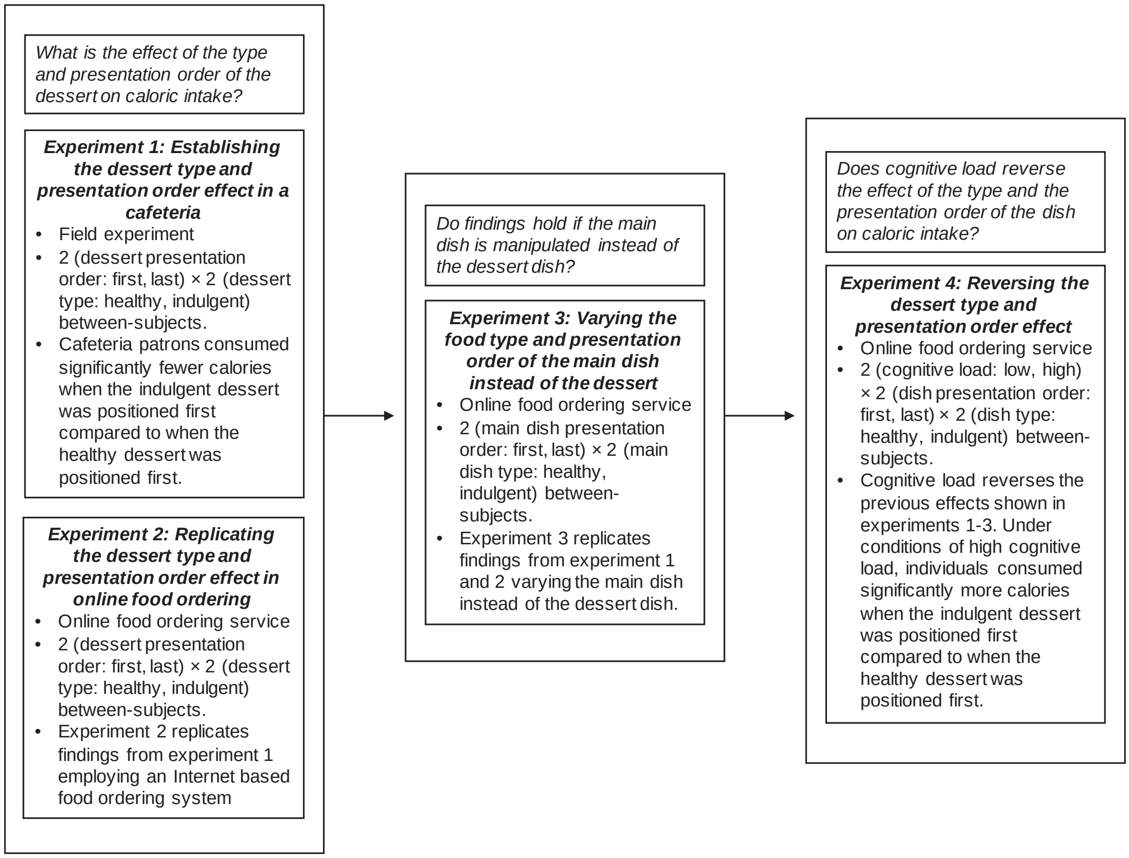

Figure 1. Overview of research questions and experiments.

the patrons had selected and placed on their trays. All patrons were only able to enter the cafeteria line from one specific point, guaranteeing that all patrons were subjected to the same sequence. Food items were visible behind clear glass shields; the available dishes included a soup, a main dish (choice of two options), a side dish (choice of two options), bread, and dessert. Both the two main dish options and the two side dish options always included a "lighter" choice (main dish: grilled chicken fajitas, 247 calories; side dish: small green salad, 60 calories) and a "heavier" choice (main dish: fried fish with tartar sauce, 530 calories; side dish: French fries, 265 calories). The soup contained 135 calories and the bread contained 80 calories, as reported by the cafeteria services department. Portion sizes were kept equal across all patrons, and patrons chose the dishes sequentially. The position of the nondessert food items was kept constant in the order listed above. It is important to note that all 134 participants took rather than left the dessert because it was part of the fixed-price menu. After finishing their meals, the selected patrons were approached and asked whether they would respond to a brief survey, as we had announced earlier. After the survey, the experimenters took a digital photograph of each patron's leftovers. As Experiment 1 was conducted on four different days, we ensured that cafeteria patrons did not participate more than once. On Days 2, 3, and 4, the research assistant asked participants whether they had completed the survey on a previous day; if they had, they were excluded from further participation. Figure 2 illustrates the four conditions employed in Experiment 1.

Dependent variables. A visual estimation method was used to assess actual calories consumed (Adams, Pelletier, Zive, & Sallis, 2005). Two graduate student raters, blind to the study hypotheses and previously trained in visual estimation methods, compared the image of the leftovers from each patron with the image of the original menu items, with the latter serving as the reference point. Visual estimates of the leftovers were recorded as a percentage of the reference portion (i.e., one serving) for each food item. Interrater reliability was good, $r = .82$, $p < .05$, and disagreements were resolved through discussion between the two raters. Each patron's percent-wise estimate was then converted into actual calories consumed, using the caloric information provided by the cafeteria services department for each food.

The types of dishes chosen (i.e., main dish and side dish) were also recorded to determine whether patrons had chosen the "lighter" or "heavier" option for each.

Control variables. Following previous studies on food choice and consumption (Irmak, Vallen, & Robinson, 2011; Shiv & Fedorikhin, 1999), age, gender, body mass index (BMI), perception of the importance of healthy eating, dieting, smoking, and exercise status were used as covariates in the analyses. To assess the perception of importance of healthy eating, we used three items measured on 7-point Likert scales (1 = *strongly disagree*; 7 = *strongly agree*): "Eating healthily is important to me," "I watch what I eat," and "I pay attention to nutrition information" (adapted from Chandon & Wansink, 2007). We averaged the responses to the three items to form an index of the importance of healthy

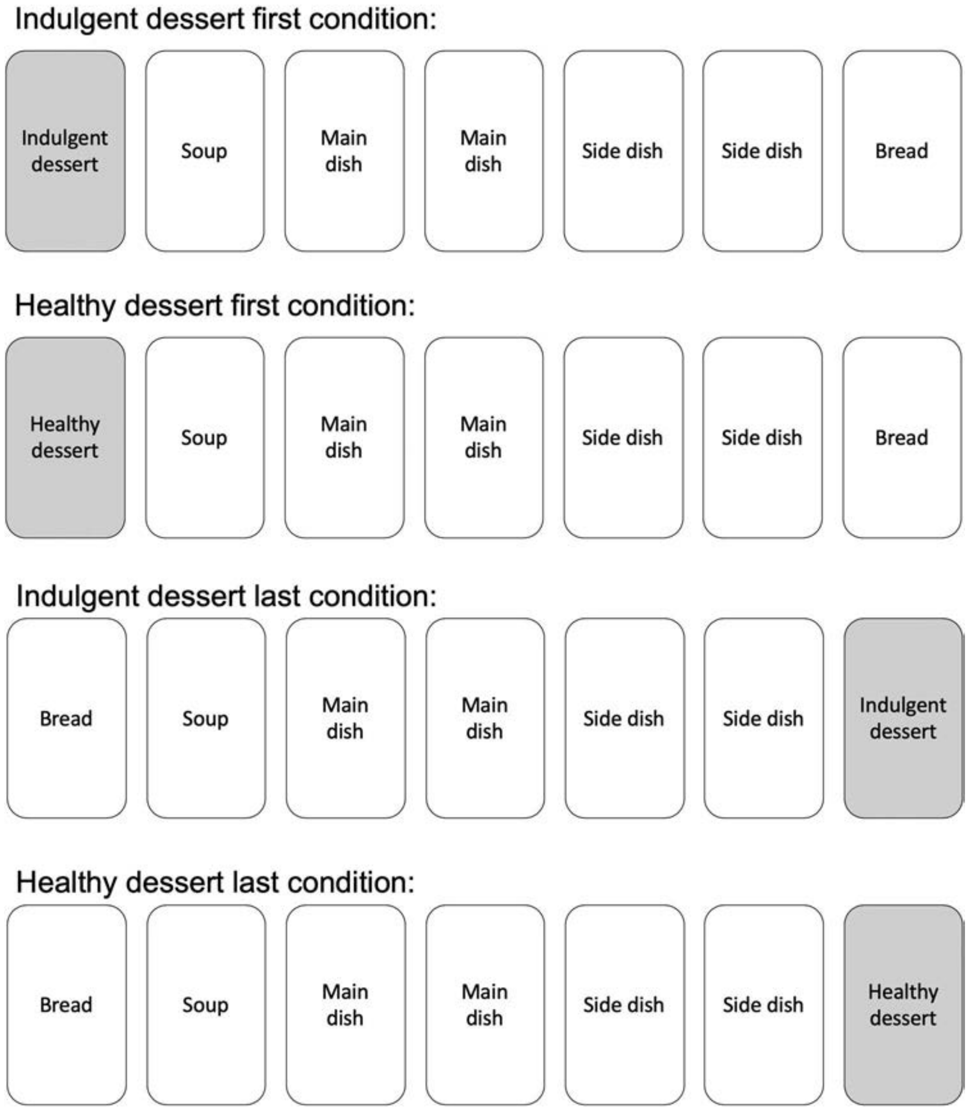

Figure 2. Four conditions used in Experiment 1.

eating ($\alpha = .75$). We also asked participants to rate whether they were on a diet, whether they smoked, and whether they exercised on 7-point Likert scales (1 = *strongly disagree*; 7 = *strongly agree*). Finally, participants reported their age, gender, height, and weight.

Results

Effects on actual calories consumed. A univariate analysis of variance with dessert presentation order and dessert type as between-subjects independent variables and actual calories consumed as dependent variable found a significant main effect of dessert type, $F(1, 123) = 9.93$, $p < .01$, $\eta_p^2 = .08$. The main effect of dessert presentation order was not significant, $F(1, 123) = .05$, *ns*. More importantly, the predicted interaction effect of dessert presentation order and dessert type on actual calories consumed was found, $F(1, 123) = 26.63$, $p < .001$, $\eta_p^2 = .18$. Post hoc tests revealed that patrons consumed significantly fewer calories when the indulgent dessert was positioned first ($M = 582$, $SE = 18.28$) than when the healthy dessert was positioned first ($M = 830$, $SE = 33.60$), $t(63) = 6.64$, $p < .001$, $d = 1.63$. In contrast, there was no significant difference in the number of calories patrons had consumed when the indulgent dessert was positioned last ($M = 743$, $SE = 39.28$) versus when the healthy dessert was positioned last ($M = 683$, $SE = 27.24$), $t(60) = 1.28$, $p > .10$. These results support Hypothesis 1. Results also showed that patrons consumed significantly fewer calories when the indulgent dessert was positioned first ($M = 582$, $SE = 18.28$) than when it was positioned last ($M = 743$, $SE = 39.28$), $t(61) = 3.89$, $p < .001$, $d = .96$. Conversely, when the healthy dessert was positioned first, patrons consumed significantly more calories ($M = 830$, $SE = 33.60$) than when it was positioned last ($M = 683$, $SE = 27.24$), $t(62) = 3.42$, $p < .01$, $d = .85$. Panel A in Figure 3 illustrates the results. Table 1 presents the average calories either including or excluding the calories of the manipulated item.

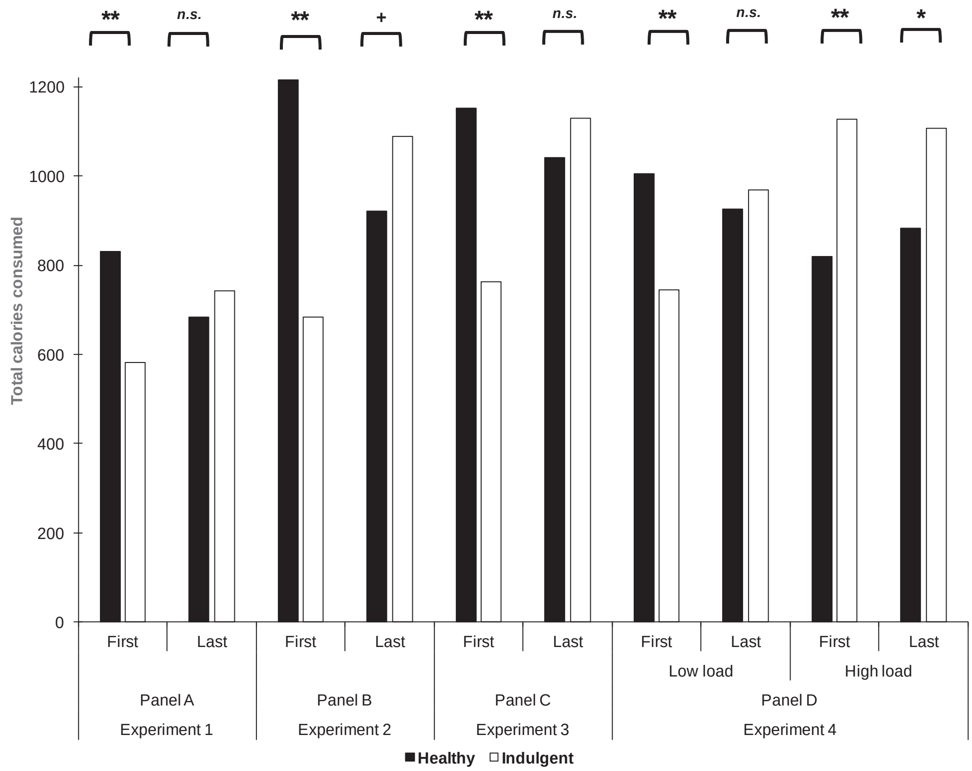

Figure 3. Results from Experiments 1–4. $^{+}$ $p < .10$. * $p < .05$. ** $p < .01$. ^{ns} $p > .10$.

Effects on the type of the main dish chosen. A binary logistic regression with dessert presentation order and dessert type as independent variables and main dish choice (“lighter” or “heavier”) as the dependent variable revealed a significant interaction effect between dessert presentation order and dessert type, Wald $\chi^2(1) = 4.18$, $p < .05$. In particular, whereas 67.6% of participants chose the lighter main dish in the indulgent dessert first condition, only 32.4% of participants chose the lighter main

Table 1
Experiments 1–4: Average Calories per Condition Including and Excluding the Manipulated Food Item

Condition	Experiment	Cognitive load	Including the manipulated item	Excluding the manipulated item
Indulgent dish first	1		582	393
	2		684	494
	3		762	332
	4	Low	744	554
		High	1,128	938
Healthy dish first	1		830	760
	2		1,216	1,146
	3		1,152	962
	4	Low	1,004	934
		High	820	750
Indulgent dish last	1		743	554
	2		1,089	899
	3		1,129	699
	4	Low	969	779
		High	1,107	917
Healthy dish last	1		683	613
	2		922	852
	3		1,041	851
	4	Low	926	856
		High	884	814

dish in the healthy dessert first condition, Pearson's $\chi^2(1) = 6.72$, $p < .05$. There were no significant differences between the indulgent dessert last (44.4%) and healthy dessert last (55.6%) conditions in terms of lighter main dish choice, Pearson's $\chi^2(1) = .10$, *ns*. Further, patrons chose the lighter main dish significantly more often when the indulgent dessert was positioned first (65.7%) than when it was positioned last (34.3%), Pearson's $\chi^2(1) = 4.37$, $p < .05$, but the same was not true when the healthy dessert was positioned first (42.3%) versus when it was positioned last (57.7%), Pearson's $\chi^2(1) = .66$, *ns*.

Effects on the type of side dish chosen. A binary logistic regression with dessert presentation order and dessert type as independent variables and side dish choice ("lighter" or "heavier") as the dependent variable revealed a significant interaction between dessert presentation order and dessert type, Wald $\chi^2(1) = 4.23$, $p < .05$. In particular, whereas 66.7% of participants chose the lighter side dish in the indulgent dessert first condition, only 33.3% of participants chose the lighter side dish in the healthy dessert first condition, Pearson's $\chi^2(1) = 6.67$, $p < .05$. There were no significant differences between the indulgent dessert last (44%) and healthy dessert last (56%) conditions in terms of lighter side dish choice, Pearson's $\chi^2(1) = .13$, *ns*. Further, patrons chose the lighter side dish significantly more often when the indulgent dessert was positioned first (68.6%) than when it was positioned last (31.4%), Pearson's $\chi^2(1) = 6.76$, $p < .01$, but the same was not true when the healthy dessert was positioned first (46.2%) versus when it was positioned last (53.8%), Pearson's $\chi^2(1) = .09$, *ns*.

Effect of control variables. We also controlled for several different variables. An analysis of covariance with dessert presentation order and dessert type as between-subjects independent variables; age, gender, BMI, perception of the importance of healthy eating, dieting, smoking, and exercise status as covariates; and actual calories consumed as the dependent variable revealed that none of the control variables, except age ($p < .05$), had a significant effect. It is important to note that the main model, as reported in the previous paragraphs, is neither dependent on nor substantially altered by the inclusion of the control variables.

Discussion

Experiment 1 provides initial evidence that when individuals choose foods sequentially, they make their subsequent food choices based on the first item they put on their trays. As expected, the two independent variables—dessert presentation order and dessert type—together influenced actual calories consumed through their interaction. As our results showed, when the healthy dessert was the first food item that individuals placed on their trays, they subsequently chose more indulgent food items and consumed more calories. On the other hand, when the indulgent dessert was the first food item that individuals placed on their trays, they subsequently chose more healthy items and consumed fewer calories. Importantly, these results suggest that the first item presented can have considerable influence over subsequent choices in long sequences of different items. Further, these results also showed that participants base all of their subsequent choices on the initial choice rather than only the next one. For example, in Experiment 1, the item following the dessert in the indulgent-first conditions was a relatively light vegetable soup. Had participants based their subsequent choice only on the prior choice, choosing the healthier soup would have licensed them to meet a health goal, thereby freeing them to indulge in subsequent items (Chernev & Gal, 2010; Dhar & Simonson, 1999). Instead, we found evidence that individuals based all subsequent choices on this initial choice.

Posttests

Method

The results of the field study raised some questions regarding possible confounds: (a) Do people actually know that chicken fajitas have approximately half the calories of fried fish with tartar sauce? (b) How healthy or unhealthy do people perceive the dishes used in the study to be? and (c) Do some of these pairings "go together" better than others? That is, do people perceive either fajitas or fried fish to pair better with either lemon cheesecake or fresh fruit? In this section, we follow up on these confounds.

Participants and design. One hundred twenty individuals (60% female, $M_{age} = 36.7$) were recruited from Amazon Mechanical Turk and successfully completed the entire study in exchange for monetary compensation.

Procedures. Participants were first shown pictures of food dishes and then asked to estimate how many calories each dish contained and to rate how healthy they considered each dish to be (1 = *very unhealthy* to 7 = *very healthy*). Finally, participants were asked to choose which entree (chicken fajitas or fried fish) would taste better with each dessert (fresh fruit and cheesecake).

Results

It was found that participants indeed knew that the chicken fajita dish had significantly fewer calories ($M = 471.60$, $SE = 22.18$) than the fried fish dish ($M = 717.67$, $SE = 40.80$), $t(238) = 5.30$, $p < .001$, $d = .69$. Furthermore, participants rated the chicken fajita dish as healthier ($M = 5.07$, $SE = .11$) than the fried fish dish ($M = 2.44$, $SE = .12$), $t(238) = 16.03$, $p < .001$, $d = 2.08$. Moreover, participants rated the bowl of fruit dessert healthier ($M = 6.57$, $SE = .07$) than the cheesecake dessert ($M = 1.63$, $SE = .08$), $t(238) = 45.04$, $p < .001$, $d = 5.82$. Additionally, the soup was perceived as relatively healthy (tested against the value of 5 in the scale, $M = 5.36$, $SE = .11$), $t(119) = 3.23$, $p < .01$. On the other hand, the participants did not indicate that either the fruit or the cheesecake would pair better with a particular dish ("Which dish would taste better with a bowl of fresh fruit for dessert?" vs. "Which dish would taste better with a slice of cheesecake for dessert?," Pearson's $\chi^2(1) = .82$, *ns*. Indicating that there is no difference in preference for a particular dish with a particular dessert.

Experiment 2: Replicating the Dessert Type and Presentation Order Effect in Online Food Ordering

Method

The objective of Experiment 2 was to replicate the results from Experiment 1 in a different context—food choice over the Internet. We deliberately chose this context because individuals increasingly make food choices online, such as ordering food for delivery or having a delivery service pick up orders from local restaurants (e.g., Uber Eats and GrubHub). To achieve this objective, we designed a mock-up online food delivery service, and we again manipulated the food type and presentation order of the dessert relative to the other food items. We then assessed the caloric value and the types of foods ordered by participants.

Participants and design. One hundred sixty individuals (53% female, $M_{\text{age}} = 37.6$, $M_{\text{BMI}} = 26.8$) were recruited from Amazon Mechanical Turk, logged onto a website created for this study, and successfully completed the entire study in exchange for monetary compensation. Experiment 2 employed a 2 (dessert presentation order: first, last) × 2 (dessert type: healthy, indulgent) between-subjects experimental design with dessert presentation order and dessert type as between-subjects independent variables and estimated calories consumed, type of main dish chosen, and type of side dish chosen as dependent variables.

Procedures. Participants received a link to access the study's website. After agreeing to participate in the study, participants were asked to imagine that they were about to have dinner and order from the website. Participants were then shown different food options in sequential order and asked to make their choices, mirroring the procedures of Experiment 1. The stimuli included both verbal descriptions and a pictorial representation of each food item. Every food item included the choice between a healthier and a more indulgent option of the dish. The sequence was similar to Experiment 1: dessert (fruit salad, 70 calories; chocolate cake, 190 calories), soup (vegetable soup, 90 calories; baked potato soup, 325 calories), main dish (grilled lemon chicken, 190 calories; crispy chicken cordon bleu, 430 calories), side dish (grilled vegetables, 90 calories; macaroni and cheese, 330 calories), and bread (whole wheat rolls, 170 calories; buttery brioche rolls, 300 calories). Figure 4 shows the visual stimuli used in Experiment 2. Next, participants indicated what percentage of each food item they would eat, and, finally, they responded to the rest of the study measures.

Measures. All control variables assessed in Experiment 2 were identical to those assessed in Experiment 1, with the addition of a hunger measure. Hunger was assessed by asking participants how many hours it had been since their last meal and also to rate how hungry they felt on a 7-point scale from 1 = *not hungry at all* to 7 = *very hungry*.

Because Studies 2–4 were conducted over the Internet, instead of employing a measure of the actual calories consumed, we relied on an estimation of the calories the subject would consume. Participants were asked to estimate the amount of food they would eat of every dish they chose following these instructions: "How much of your X dish will you eat? Slide the pointer to the point on the scale that best represents the percentage of this dish that you would eat if you were having this meal for dinner, where 0 means you would eat NOTHING and 100 means you would eat EVERYTHING." We then converted these percentages to calories to obtain an estimate of the calories consumed. Subjective calorie estimates are commonly used in food psychology studies (Chandon & Wansink, 2007; Chernev & Gal, 2010; Parker & Lehmann, 2014).

Results

Effects on estimated calories consumed. A univariate analysis of variance with dessert presentation order and dessert type as between-subjects independent variables and estimated calories consumed as dependent variable found a significant main effect of dessert type, $F(1, 156) = 8.73$, $p < .01$, $\eta_p^2 = .05$. The main effect of dessert presentation order was not significant, $F(1, 156) = .79$, *ns.* More important, the predicted interaction effect of dessert presentation order and dessert type on estimated calories consumed was found, $F(1, 156) = 32.06$, $p < .001$, $\eta_p^2 = .17$. Participants estimated significantly fewer calories consumed when the indulgent dessert was positioned first ($M = 684$, $SE = 52.97$) than when the healthy dessert was positioned first ($M = 1{,}216$, $SE = 63.49$), $t(79) = 6.02$, $p < .001$, $d = 1.41$. In contrast, there was only a marginally significant difference in the estimated calories consumed when the indulgent dessert was positioned last ($M = 1{,}089$, $SE = 67.97$) versus when the healthy dessert was positioned last ($M = 922$, $SE = 54.09$), $t(77) = 1.94$, $p < .10$, $d = .43$ (these differences are due mainly to the difference in calories between the healthy and the indulgent dessert). These results provide additional support for Hypothesis 1. Results also showed that participants estimated significantly fewer calories consumed when the indulgent dessert was positioned first ($M = 684$, $SE = 52.97$) versus when it was positioned last ($M = 1{,}089$, $SE = 67.97$), $t(69) = -4.59$, $p < .001$, $d = 1.11$. Conversely, when the healthy dessert was positioned first, participants estimated significantly more calories consumed ($M = 1{,}216$, $SE = 63.49$) versus when it was positioned last ($M = 921$, $SE = 54.09$), $t(87) = 3.47$, $p < .01$, $d = .74$. Panel B in Figure 3 illustrates the results.

Effects on the type of the main dish chosen. A binary logistic regression with dessert presentation order and dessert type as independent variables and main dish choice ("lighter" or "heavier") as the dependent variable revealed a significant interaction between dessert presentation order and dessert type, Wald $\chi^2(1) = 4.03$, $p < .05$. In particular, whereas 55.8% of participants chose the lighter main dish in the indulgent dessert first condition, only 44.2% of participants chose the lighter main dish in the healthy dessert first condition, Pearson's $\chi^2(1) = 8.63$, $p < .01$. There were no significant differences between the indulgent dessert last (48.8%) and healthy dessert last (51.2%) conditions in terms of lighter main dish choice, Pearson's $\chi^2(1) = .02$, *ns.* Further, there was no difference in lighter main dish choice when the indulgent dessert was positioned first (53.3%) versus when it

Figure 4. Food stimuli used in Experiments 2–4. See the online article for the color version of this figure.

was positioned last (46.7%), Pearson's $\chi^2(1) = 2.32$, *ns*. There was also no difference when the healthy dessert was positioned first (46.3%) versus when it was positioned last (53.7%), Pearson's $\chi^2(1) = 1.76$, *ns*.

Effects on the type of side dish chosen. A binary logistic regression with dessert presentation order and dessert type as independent variables and side dish choice ("lighter" or "heavier") as the dependent variable revealed a significant interaction between dessert presentation order and dessert type, Wald $\chi^2(1) = 4.39$, $p < .05$. In particular, whereas 55% of participants chose the lighter side dish in the indulgent dessert first condition, only 45% of participants chose the lighter side dish in the healthy dessert first condition, Pearson's $\chi^2(1) = 6.66$, $p < .05$. There were no significant differences between the indulgent dessert last (45.7%) and healthy dessert last (54.3%) conditions in terms of lighter side dish choice, Pearson's $\chi^2(1) = .14$, *ns*. Further, participants chose the lighter side dish significantly more often when the indulgent dessert was positioned first (57.9%) versus when it was positioned last (42.1%), Pearson's $\chi^2(1) = 4.28$, $p < .05$, but the same was not true when the healthy dessert was positioned first (48.6%) versus when it was positioned last (51.4%), Pearson's $\chi^2(1) = .712$, *ns*.

Effect of control variables. We controlled for several different variables. An analysis of covariance with dessert presentation order and dessert type as between-subjects independent variables; age, gender, BMI, perception of the importance of healthy eating, hunger rating, number of hours since last meal, dieting, smoking, and exercise status as covariates; and estimated calories consumed as dependent variable revealed that BMI ($p < .05$), age ($p < .05$), hunger rating ($p < .05$), and perception of the importance of healthy eating ($p < .05$) were significant control variables. It is important to note that the main model, as reported in the previous paragraphs, is neither dependent on the inclusion of the control variables nor substantially altered by them.

Discussion

The results of Experiment 2 replicate those of Experiment 1 in terms of the effects of dessert presentation order and dessert type on calories consumed. Importantly, we replicated the proposed effects while employing an Internet-based ordering system. Because online food delivery services represent a growing industry (expected to grow by 25% annually and to reach 65% penetration rate worldwide by 2020; Hirschberg, Rajko, Schumacher, & Wrulich, 2016), it is imperative to investigate how the design of food delivery apps (in terms of food type and presentation order of the food items presented) can encourage individuals to choose healthier food options over the Internet.

Experiment 3: Varying the Food Type and Presentation Order of the Main Dish Instead of the Dessert

Method

In Experiment 3, we again aimed to replicate the results from Experiments 1 and 2, but here we introduced an important change to our experimental design: instead of varying the presentation order of the dessert, we varied the presentation order of the main dish and offered either an indulgent or a healthy main dish. Because it might be perceived as unusual for desserts to be presented first, effects in our previous experiments may have been driven by this unusual presentation order. To rule out this possibility, we manipulated the position of the main dish relative to the other food items in our virtual food delivery service and observed the amount and types of food ordered by participants.

Participants and design. One hundred eighty individuals (41% female, $M_{age} = 36.4$, $M_{BMI} = 26.5$) were recruited from Amazon Mechanical Turk, logged onto our food delivery service website, and successfully completed the entire study in exchange for monetary compensation. Experiment 3 employed a 2 (main dish presentation order: first, last) $\times$ 2 (main dish type: healthy, indulgent) between-subjects experimental design, with main dish presentation order and main dish type as between-subjects independent variables and estimated calories consumed, type of side dish chosen, and type of dessert chosen as dependent variables.

Procedures. Procedures and stimuli were identical to Experiment 2, except that the presentation order of the main dish was varied and the presentation order of the dessert was kept constant (i.e., the dessert was always the second to last food item in the sequence).

Measures. All control variables assessed in Experiment 3 were identical to those assessed in Experiment 2.

Results

Effects on estimated calories consumed. A univariate analysis of variance with main dish presentation order and main dish type as between-subjects independent variables and estimated calories consumed as dependent variable found a significant main effect of main dish type, $F(1, 176) = 11.08$, $p < .01$, $\eta_p^2 = .06$. The main effect of main dish presentation order was significant, $F(1, 176) = 7.96$, $p < .01$, $\eta_p^2 = .04$. More importantly, the predicted interaction effect of main dish presentation order and main dish type on estimated calories consumed was found, $F(1, 176) = 27.60$, $p < .001$, $\eta_p^2 = .14$. Participants estimated significantly fewer calories consumed when the indulgent main dish was positioned first ($M = 762$, $SE = 41.41$) than when the healthy main dish was positioned first ($M = 1{,}152$, $SE = 52.71$), $t(88) = 5.82$, $p < .001$, $d = 1.23$. In contrast, there was no significant difference in the estimated calories consumed when the indulgent main dish was positioned last ($M = 1{,}129$, $SE = 44.91$) versus when the healthy main dish was positioned last ($M = 1{,}041$, $SE = 41.95$), $t(88) = 1.42$, *ns*. These results provide additional support for Hypothesis 1. Results also showed that participants estimated significantly fewer calories consumed when the indulgent main dish was positioned first ($M = 762$, $SE = 41.41$) than when it was positioned last ($M = 1{,}129$, $SE = 44.91$), $t(88) = 6.01$, $p < .001$, $d = 1.27$. Conversely, there was no significant difference in the estimated calories consumed when the healthy main dish was positioned first ($M = 1{,}152$, $SE = 52.71$) versus when it was positioned last ($M = 1{,}041$, $SE = 41.95$), $t(88) = 1.64$, $p > .10$. Panel C in Figure 3 illustrates the results.

Effects on the type of side dish chosen. A binary logistic regression with main dish presentation order and main dish type as independent variables and side dish choice ("lighter" or "heavier") as the dependent variable revealed a significant interaction between main dish presentation order and main dish type, Wald

$\chi^2(1) = 4.99$, $p < .05$. In particular, whereas 62.2% of participants chose the lighter side dish in the indulgent main dish first condition, only 37.8% of participants chose the lighter side dish in the healthy main dish first condition, Pearson's $\chi^2(1) = 5.38$, $p < .05$. There were no significant differences between the indulgent main dish last (44.4%) and healthy main dish last (55.6%) conditions in terms of lighter side dish choice, Pearson's $\chi^2(1) = .74$, *ns.* Further, participants chose the lighter side dish significantly more often when the indulgent main dish was positioned first (63.6%) than when it was positioned last (36.4%), Pearson's $\chi^2(1) = 6.40$, $p < .05$, but the same was not true when the healthy main dish was positioned first (45.9%) versus when it was positioned last (54.1%), Pearson's $\chi^2(1) = .41$, *ns.*

Effects on the type of dessert chosen. A binary logistic regression with main dish presentation order and main dish type as independent variables and dessert choice ("lighter" or "heavier") as the dependent variable revealed a significant interaction between main dish presentation order and main dish type, Wald $\chi^2(1) = 3.91$, $p < .05$. In particular, whereas 59.3% of participants chose the lighter dessert in the indulgent main dish first condition, only 40.7% of participants chose the lighter side dish in the healthy main dish first condition, Pearson's $\chi^2(1) = 4.63$, $p < .05$. There were no significant differences between the indulgent main dish last (46.3%) and healthy main dish last (53.7%) conditions in terms of lighter dessert choice, Pearson's $\chi^2(1) = .40$, *ns.* Further, participants chose the lighter dessert significantly more often when the indulgent main dish was positioned first (62.7%) than when it was positioned last (37.3%), Pearson's $\chi^2(1) = 7.65$, $p < .01$, but the same was not true when the healthy main dish was positioned first (50%) versus when it was positioned last (50%), Pearson's $\chi^2(1) = .00$, *ns.*

Effect of control variables. Only the perception of the importance of healthy eating ($p < .05$) had a significant effect. Nevertheless, results were not altered by this variable.

Discussion

Experiment 3 replicates the effect of food presentation order observed in the previous two studies with one crucial difference: we varied the presentation order of the main dish but not that of the dessert. In Experiment 3, we manipulated the position of the main dish in a food sequence. As in Experiments 1 and 2, we found that when an indulgent (healthy) dish is the first item, lower-calorie (higher-calorie) dishes are subsequently chosen and overall caloric consumption is lower (higher). More importantly, Experiment 3 ruled out the alternative explanation that these effects are driven by the unusual presentation order of the food in the first two experiments. These results provide evidence that the proposed effects are not driven by the "novelty" of seeing/choosing the dessert first.

Experiment 4: The Role of Cognitive Resources in the Effect of Food Type and Presentation Order

Method

The objective of Experiment 4 was to test Hypothesis 2: Would participants under high (vs. low) cognitive load be more (less) likely choose indulgent (healthy) options subsequently when an indulgent option is presented first?

Participants and design. Two hundred ninety-six individuals (50% female, $M_{\text{age}} = 33.6$, $M_{\text{BMI}} = 26.6$) were recruited from Amazon Mechanical Turk, logged onto our food delivery service website, and successfully completed the entire study in exchange for monetary compensation. Experiment 4 employed a 2 (cognitive load: low, high) × 2 (dessert presentation order: first, last) × 2 (dessert type: healthy, indulgent) between-subjects experimental design with cognitive load, dessert presentation order, and dessert type as between-subjects independent variables and estimated calories consumed, type of main dish chosen, and type of side dish chosen as dependent variables.

Procedures. Procedures and stimuli were identical to Experiments 2 and 3, except for the cognitive load manipulation. Following previous studies (Patrick, MacInnis, & Park, 2007; Shiv & Fedorikhin, 1999), we manipulated cognitive load by asking participants to memorize a seven-digit number in the high cognitive load condition and a two-digit number in the low cognitive load condition.

Measures. All control variables assessed in Experiment 4 were identical to those assessed in Experiments 2 and 3. In line with previous work on cognitive load, we added cognitive load measures for the purpose of a manipulation check. We asked participants to rate, on 7-point Likert scales, how hard it was to concentrate, how stressful the task was, and how much effort was required to complete the task (adapted from Patrick et al., 2007). These three items were averaged to form a cognitive load index ($\alpha = .87$).

Results

Manipulation check. An independent samples *t* test revealed that the cognitive load manipulation was successful. Participants in the high load condition revealed a higher cognitive load index ($M = 3.79$, $SE = .13$) compared with participants in the low load condition ($M = 1.96$, $SE = .10$), $t(294) = 11.01$, $p < .001$, $d = 2.63$.

Effects on estimated calories consumed. An analysis of variance with cognitive load, dessert presentation order, and dessert type as between-subjects independent variables and estimated calories consumed as dependent variable found a three-way interaction effect of cognitive load, dessert presentation order, and dessert type, $F(1, 288) = 5.35$, $p < .05$, $\eta_p^2 = .02$. This interaction effect indicates that the effect of dessert presentation order and dessert type on estimated calories consumed was different under high versus low cognitive load. These results provide support for Hypothesis 2. There was also a significant interaction effect between dessert type and cognitive load on estimated calories consumed, $F(1, 288) = 20.25$, $p < .001$, $\eta_p^2 = .07$. Neither the main effects nor the other two-way interactions were significant (all ps $> .05$). As expected, participants in the low-cognitive-load condition revealed choice patterns similar to those identified in Experiments 1–3. Specifically, in the low-cognitive-load condition, there was a significant interaction effect between dessert presentation order and dessert type on estimated calories consumed, $F(1, 144) = 7.57$, $p < .01$, replicating the findings from Experiments 1–3. Participants estimated significantly fewer calories consumed when the indulgent dessert was positioned first ($M = 744$, $SE = 43.54$) than when the healthy dessert was positioned first ($M = 1{,}004$, $SE = 60.30$), $t(72) = 3.49$, $p < .01$, $d = .81$. In contrast, there was no significant difference in the estimated calories consumed when the indulgent dessert was positioned last (M = 969, SE = 55.39) versus when the healthy dessert was positioned last (M = 929, SE = 57.26), $t(72) = .51$, *ns.* These results provide additional support for Hypothesis 1. Results also showed that participants estimated significantly fewer calories consumed when the indulgent dessert was positioned first (M = 744, SE = 43.54) than when it was positioned last (M = 969, SE = 55.39), $t(72) = 3.19$, $p < .01$, $d = .74$. Conversely, when the healthy dessert was positioned first, participants estimated more calories consumed (M = 1,004, SE = 60.3) than when it was positioned last (M = 929, SE = 57.26), $t(72) = .90$, albeit not significant.

However, participants in the high-cognitive-load condition revealed significantly different choice patterns from participants in the low-cognitive-load condition. Specifically, the former group of participants estimated more calories consumed when the indulgent dessert was positioned first (M = 1,128, SE = 75.31) than when the healthy dessert was positioned first (M = 820, SE = 47.74), $t(72) = 3.45$, $p < .01$, $d = .80$. There was a significant difference in the estimated calories consumed when the indulgent dessert was positioned last (M = 1,107, SE = 70.14) than when the healthy dessert was positioned last (M = 885, SE = 54.85), $t(72) = 2.50$, $p < .05$, $d = .58$. The other two contrasts revealed nonsignificant differences when the indulgent dessert was positioned first (M = 1128, SE = 75.31) versus when it was positioned last (M = 1107, SE = 70.14), $t(72) = .20$, *ns*, and when the healthy dessert was positioned first (M = 820, SE = 47.74) versus when it was positioned last (M = 885, SE = 54.85), $t(72) = .89$, *ns.* Panel D in Figure 3 illustrates the results.

Effects on the type of the main dish chosen and type of side dish chosen. A logistic regression with cognitive load, dessert presentation order, and dessert type as independent variables and main dish choice ("lighter" or "heavier") as dependent variable showed a significant three-way interaction effect of cognitive load, dessert presentation order, and dessert type on main dish chosen, Wald $\chi^2(1) = 5.17$, $p < .05$. There was also a significant two-way interaction effect between cognitive load and dessert presentation order on the main dish chosen, Wald $\chi^2(1) = 5.54$, $p < .05$. All other interaction effects were nonsignificant.

In the low-cognitive-load condition, there was a significant interaction effect between dessert presentation order and dessert type, Wald $\chi^2(1) = 6.32$, $p < .05$. This finding replicates the results from Experiments 1–3. Specifically, participants selected the lighter main dish significantly more often when the indulgent dessert was presented first compared with when the healthy dessert was presented first (76% vs. 38%), Pearson's $\chi^2(1) = 10.79$, $p < .01$. There was no significant difference in lighter main dish selection between the indulgent dessert last and healthy dessert conditions (46% vs. 49%), Pearson's $\chi^2(1) = .05$, *ns.* Further, participants chose the lighter main dish significantly more often when the indulgent dessert was positioned first (60%) than when it was positioned last (40%), Pearson's $\chi^2(1) = 4.19$, $p < .05$, but the same was not true when the healthy dessert was positioned first (42%) versus when it was positioned last (58%), Pearson's $\chi^2(1) = .72$, *ns.*

In the high–cognitive load condition, the interaction effect between dessert type and presentation order and main dish choice was not significant, Wald $\chi^2(1) = .45$, *ns.* This finding provides an interesting departure from the effect identified in our previous experiments. Specifically, participants *did not* select the lighter main dish *more* often when the indulgent dessert was presented first compared with when the healthy dessert was presented first, but actually *less* often—that is, the effect identified in our previous studies and in the "low cognitive load" condition was reversed (35% vs. 60%), Pearson's $\chi^2(1) = 4.39$, $p < .05$. There was also a nonsignificant difference in lighter main dish selection between the indulgent dessert last and healthy dessert last conditions (43% vs. 57%), Pearson's $\chi^2(1) = 1.35$, *ns.* The within-domain comparisons were nonsignificant: participants neither chose the lighter dish more often when the indulgent dessert was positioned first (35%) versus when it was positioned last (55%), Pearson's $\chi^2(1) = 2.34$, *ns*, nor chose the lighter dish more often when the healthy dessert was positioned first (59%) versus when it was positioned last (52%), Pearson's $\chi^2(1) = .36$, *ns.* The main effect of dessert type was significant, Wald $\chi^2(1) = 3.44$, $p < .1$, providing evidence of highlighting when a sequential choice is made under high cognitive load, but the main effect of dessert presentation order was not significant, Wald $\chi^2(1) = 2.30$, *ns.*

Whereas low-cognitive-load participants chose the lighter main dish 76% of the time in the indulgent-first condition (vs. 37% in healthy-first), high-cognitive-load participants chose the lighter main dish only 35% of the time in the indulgent-first condition (vs. 59% in healthy-first), $\chi^2_{\text{low versus high load, indulgent-first}}(1) = 4.19$, $p < .05$. Table 2 summarizes these results.

Effects on the type of side dish chosen. A logistic regression with cognitive load, dessert presentation order, and dessert type as independent variables and side dish choice (lighter or heavier) as dependent variable showed a significant three-way interaction effect of cognitive load, dessert presentation order, and dessert type on side dish chosen, Wald $\chi^2(1) = 3.40$, $p < .10$. Therefore, the results of the side dish choice mirrored those of the main dish choice, described in the previous paragraph. Table 3 summarizes the results.

Effect of control variables. We again controlled for several different variables. An analysis of covariance with dessert presentation order, dessert type, and cognitive load as between-subjects independent variables; age, gender, BMI, perception of the importance of healthy eating, hunger rating, number of hours since last meal, dieting, smoking, exercise status, and cognitive load index as covariates; and estimated calories consumed as dependent variable revealed that gender ($p < .05$), and perception of the importance of healthy eating ($p < .001$) were significant control variables. It is important to note that the main model, as reported in the previous paragraphs, is neither dependent on the inclusion of the control variables nor substantially altered by them.

Discussion

Experiment 4 replicates the interaction effect of food type and food presentation order on estimated calories consumed, which we had identified in the previous experiments. Notably, however, this effect is only specific to the low-cognitive-load condition, whereas the effect reverses under high cognitive load. When an indulgent dish was presented first, high-cognitive-load participants estimated consuming *more* total calories and tended to select *heavier* main and side dishes.

Table 2
Experiment 4: Lighter Main Dish Choice Under Low and High Cognitive Load

Presentation	Condition	Low cognitive load	High cognitive load	Difference
Presented first	Indulgent dish first	76%	35%	$p < .01$
	Healthy dish first	37%	59%	$p < .10$
	Difference	$p < .01$	$p < .05$	
Presented last	Indulgent dish last	52%	55%	*n.s.*
	Healthy dish last	48%	52%	*n.s.*
	Difference	*n.s.*	*n.s.*	
Within indulgent choices	Indulgent dish first	76%	35%	$p < .01$
	Indulgent dish last	52%	55%	*n.s.*
	Difference	$p < .05$	$p < .05$.	
Within healthy choices	Healthy dish first	37%	59%	$p < .10$
	Healthy dish last	48%	52%	*n.s.*
	Difference	*n.s.*	*n.s.*	

Note. *n.s.* = nonsignificant *p* value, $p > .10$.

General Discussion

The title of this paper is "If I indulge first, I will eat less overall," which we consider to be a very short summary of our research. According to our results, when individuals choose food items in sequence, the first dish they put on their tray has an important effect on the subsequent food items they choose and, consequently, in the total amount of calories they consume. In aggregate, the results of four experiments consistently showed that when the first item in a sequence is indulgent, individuals subsequently choose healthier foods and consume fewer calories. We also found that cognitive load plays a critical role in this effect, shedding new light on the roles of licensing and primacy as possible underlying mechanisms.

Theoretical Contributions

This research makes important contributions to several streams of literature. First, it contributes to the literature on environmental cues that influence food choice and consumption, which has explored how factors such as the influence food choice and consumption. Whereas earlier research has suggested that the presentation order of food items can influence choices (Wansink & Hanks, 2013), we have extended this line of inquiry by examining the interaction effect of food type and food order presentation.

Second, we expand the notion of licensing in choice. Our results suggest that whereas individuals who have made a healthy consumption decision first subsequently license themselves to make more indulgent food choices (in line with Khan & Dhar, 2006), individuals who have made an indulgent consumption decision first are less likely to license themselves to indulge and instead make healthier subsequent food options.

Third, we build on previous research on the role of cognitive resources in the context of food choices (Fishbach & Converse, 2011; Kemps, Tiggemann, & Grigg, 2008; Veling et al., 2017) by further substantiating that limited cognitive resources can alter food choice. Specifically, we have provided initial evidence that under high cognitive load, individuals who chose an indulgent food dish first tended to choose more indulgent subsequent food dishes and consume more total calories. This finding implies that the positive benefits of the primacy effect of the indulgent item, which we have uncovered in this work, have likely been muted.

Limitations and Implications for Future Research

This research has some limitations that may provide avenues for future research. First, in this research, we used two foods that represent strong manipulations of healthfulness. However, "healthy" and "indulgent" represent only the two extremes of the healthfulness continuum of foods. It is possible that medium levels of

Table 3
Experiment 4: Lighter Side Dish Choice Under Low and High Cognitive Load

Presentation	Condition	Low cognitive load	High cognitive load	Difference
Presented first	Indulgent dish first	67%	42%	$p < .05$
	Healthy dish first	37%	56%	$p < .10$
	Difference	$p < .01$	*n.s.*	
Presented last	Indulgent dish last	55%	55%	*n.s.*
	Healthy dish last	55%	52%	*n.s.*
	Difference	*n.s.*	*n.s.*	
Within indulgent choices	Indulgent dish first	67%	42%	$p < .05$
	Indulgent dish last	55%	55%	*n.s.*
	Difference	$p < .05$	*n.s.*	
Within healthy choices	Healthy dish first	37%	56%	$p < .10$
	Healthy dish last	55%	52%	*n.s.*
	Difference	*n.s.*	*n.s.*	

Note. *n.s.* = nonsignificant *p* value, $p > .10$.

healthiness or indulgence associated with the first item presented may lead to different responses. Further research should explore the moderating effect of the level of healthfulness of the first food item.

Second, in a similar manner, future studies could explore how individuals choose items that represent combinations of healthfulness and indulgence (e.g., fresh strawberries with whipped cream). Research has found that individuals tend to average the caloric content of combinations of "vices" and "virtues" in food items (Chernev & Gal, 2010), suggesting that combinations of indulgent and healthy components will be considered healthy, which may lead individuals to subsequently choose more indulgent items.

Third, we explored order effects in food sequences of six items. However, individuals often face sequential choice sets that include more items (e.g., casino buffets). It is possible that the effects seen in the present research may be lessened or disappear in longer sequences. Research on memory recall has indicated that primacy effects may disappear or may revert to recency effects in very long sequences of items (Hogarth & Einhorn, 1992). Thus, varying the length of the sequence is an interesting area for future research.

Fourth, in this research we only explored the immediate effect of type and presentation order of food on consumption. An interesting area for future research would be to test whether these effects remain over time in subsequent meals throughout the day (breakfast, brunch, lunch, dinner).

Fifth, overall, we found that an indulgent first dish will encourage individuals to eat less than a healthy first dish. Nevertheless, it would be interesting to test whether nonfood indulgences would have the same effect. For example, if an individual were to make food choices right after indulging an expensive massage session or buying a luxury item, would the individual tend to choose either healthier or heavier food options?

Sixth, we acknowledge that Experiments 2 through 4 were conducted in an online setting. As such, the generalizability of our findings might be limited. Nonetheless, our Experiment 1 was a field experiment with real cafeteria patrons, actual food choices, and genuine consumption. Taken together, these four experiments lend converging support to our hypotheses.

Seventh, future research may investigate the role of salience in the identified effect. Could this effect occur because indulgent items can oftentimes be significantly more salient than healthier items (Cooper & Knutson, 2008; Reimann et al., 2016; Wiggin, Reimann, & Jain, in press) and, therefore, might weigh heavier in subsequent choices than healthier items? As such, would the primacy effect of the first item may be more pronounced for indulgent than healthy items?

Applications for Improving Consumer Welfare

Overweight and obesity have become major public health problems for countries around the world. The World Health Organization (2017) estimates that worldwide obesity has tripled since 1975; more than 1.9 billion adults in the world are overweight, and more than 650 million are obese. The results of the present research suggest a possible environmental intervention that may be used to help individuals eat both better and less. Interventions based on manipulating the order in which food items are presented in a sequence, such as in a cafeteria buffet, are attractive because they are simple, cheap, and easily implementable.

Our findings can also be used in restaurant menu design and, more importantly, in the design of food delivery apps and webpages. Because people are increasingly adopting this type of app to order their food, our results can help to design the interface of such apps to make individuals order more healthy food options.

Although the caloric reduction of modifying the order of presentation of food items in a sequence observed in the present research is small, the cumulative effects of interventions based on order effects might be significant. For example, research has estimated that a reduction of just 100 calories per day could prevent weight gain in most of the population (Hill, Wyatt, Reed, & Peters, 2003). Further, because sequential food decisions are common in high volume settings, such as school or workplace cafeterias, they offer the potential of benefiting a large number of individuals.

Applications for Food Providers

Strategies based on the order of presentation of food items not only can help restaurants and food vendors to respond to public and regulatory pressures to encourage individuals to eat healthier but also could contribute to their bottom lines. As many healthier food items often carry a premium (e.g., a fancy salad bar), presentation-order strategies that encourage individuals to select more indulgent items first could drive up sales and profit. In that sense, food vendors who use a one-price strategy (e.g., all-you-eat buffet) could possibly reduce operating expenses by placing indulgent items (e.g., desserts that can be prepared in advance and stored) at the beginning of their buffets, so that individuals are more likely to choose less food further down the buffet line.

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