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Encouraging consumers to select meals in advance rather than at mealtime has been proposed as a strategy to promote healthier eating decisions, taking advantage of the improved self-control that is thought to accompany decisions about the future. In two field studies at an employee cafeteria and a third in a university setting, we examine how time delays between placing a lunch order and picking it up affect the healthfulness of that lunch. The first study, a secondary data analysis, finds that longer delays between placing an order and picking up the meal are associated with reductions in calorie content. The second study tests the causality of this relationship by exogenously restricting some lunch orders to be substantially delayed, leading to a marginally significant (approximately 5%) reduction in calories among delayed orders. The third study compares orders for truly immediate consumption versus orders placed in advance and demonstrates a significant (100 calorie, or approximately 10%) reduction in lunch calories. We discuss evidence regarding possible theoretical mechanisms underlying this effect, as well as practical implications of our findings.

Keywords: time delay, field experiment, eating

Online Supplement: http://dx.doi.org/10.1509/jmr.14.0234

Advance Ordering for Healthier Eating? Field Experiments on the Relationship Between the Meal Order–Consumption Time Delay and Meal Content

Certain moments seem particularly propitious for making optimal decisions. Every January 1 brings along a host of New Year's resolutions reflecting the course of action people would like to take (and, perhaps optimistically, think they will take) during the coming year. Similarly, people can maintain relatively atypical eating habits in the presence of temporal landmarks such as Lent and Passover. Emotionally charged events, like a heart attack or a cancer diagnosis, provide "teachable moments" in which people tend to initiate beneficial health changes, such as quitting smoking or starting a weight loss program (e.g., Demark-Wahnefried et al. 2005; McBride, Emmons, and Lipkus 2003). Dai, Milkman, and Riis (2014) document the "fresh start effect," showing that people are more likely to begin dieting and exercising at the start of a temporal cycle, such as the beginnings of weeks, months, and years, as well as after birthdays and holidays.

Cleverly timed decisions can help individuals exercise the self-control required to stick to intentions. Schelling (1978, p. 290) reports on a particular timing strategy for workplace calorie reduction:

> I have heard of a corporate dining room in which lunch orders are placed by telephone at 9:30 or 10:00 in the

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ISSN: 0022-2437 (print)
1547-7193 (electronic)

> morning: no food or liquor is then served to anyone except what was ordered at that time, not long after breakfast, when food was least tempting and resolve was at its highest.

In this article, we test the actual impact of such an intervention. Building on diverse theoretical work suggesting that advance decision making should result in more self-advantageous choices, we propose that consumers will select healthier meals when required to order lunch further in advance. This behavioral response to advance selection could benefit a wide population, especially given the emergence of new online and mobile technologies at firms such as Starbucks that provide consumers the option to place and even pay for orders in advance and from remote locations (Wong 2014). If advance ordering promotes better nutritional content of meals, this could become a new arrow in the quiver of societal attempts to lower calories in, and more generally improve the healthfulness of, consumers' diets.

We present findings from three field studies that examine the relationship between the timing of lunch orders and the calorie content of the meals ordered. We first demonstrate the relationship between naturally occurring variation in order timing and lunch calorie content in a workplace setting (Study 1). Then, in the same workplace environment, we test the effect of exogenously restricting lunch order timing—that is, experimentally manipulating whether employees could order lunch only in the morning or during typical lunch hours (Study 2). Requiring employees to order lunch in advance affected meal choice and had a marginally significant impact on the total calories in lunch orders. Finally, in a third study, we manipulate whether lunch orders are placed before or after a morning class, to better operationalize immediate consumption and avoid selection effects. We show a substantial difference in calories ordered between advance and lunchtime decisions, an effect that is partially mediated by reported hunger.

THEORETICAL BACKGROUND

When people consider future options, preference for options that are best in the long run tends to shift in favor of more immediately satisfying options as the delay between choice and consumption shrinks. We elaborate in the following sections.

Present Bias

This phenomenon reflects the fact people discount the future hyperbolically; they are more impatient for decisions involving early costs and benefits than for later ones (Ainslie 1975; Kirby and Herrnstein 1995; Pronin, Olivola, and Kennedy 2008; Rachlin and Green 1972; Read and Van Leeuwen 1998; Strotz 1956; Thaler 1981). When some consequences of a decision are immediate, hyperbolic time discounting predicts a pronounced preference for consumption in which benefits are front-loaded—in this case, high-calorie foods. In contrast, when all consequences are delayed, hyperbolic time discounting implies that early and later costs and benefits will be weighed in a more evenhanded fashion, which should shift preference toward more healthful but less immediately satisfying items.

The interplay of impulsivity and deliberation reflects the conflict between what has been called the "want" self and the "should" self (Bazerman, Tenbrunsel, and Wade-Benzoni 1998; O'Connor et al. 2002). For immediate outcomes (as compared to future outcomes), a body of research has shown that people make more impulsive choices, selecting "vice," or "want," options at the expense of "virtue," or "should," options (for two such reviews, see Khan, Dhar, and Wertenbroch 2005; Milkman, Rogers, and Bazerman 2008). As decisions are projected farther into the future, they are more likely to reflect the desires of the "should" self, compared with decisions in the near future (Rogers and Bazerman 2008), suggesting that time delays can distinguish not only between "now" and "later" but also (to an extent) between "soon" and "later."

Hot–Cold Empathy Gaps

Schelling's (1978) description of a corporation's lunch-ordering scheme—that employees were ordering lunch "not long after breakfast, when food was least tempting"—evokes a mechanism that might be at play: hot–cold empathy gaps. Empathy gaps capture the idea that people have little ability to imagine how they would feel or behave in a visceral state different from the one they are in (Loewenstein 1996, 2005). Applied to food, empathy gaps predict that an individual who is not hungry, due to having recently eaten breakfast, will underappreciate his or her own preference for unhealthy, satisfying food at lunchtime.

A large body of research supports an empathy gap motivation to explain different decisions for the future as a function of one's immediate visceral drive state (e.g., Badger et al. 2007; Read and Van Leeuwen 1998; Sayette et al. 2008). In the domain of eating, several studies have supported the notion that hungry shoppers buy more unplanned and higher-calorie items (e.g., Gilbert, Gill, and Wilson 2002; Nisbett and Kanouse 1968; Tal and Wansink 2013). In a study by Gilbert, Gill, and Wilson (2002), for example, when shoppers who entered a grocery store without a shopping list were given a muffin before shopping, they spent a smaller proportion of their total bill on unplanned items than those who received no muffin and were therefore hungrier while they shopped.

Construal Level

Food decisions made further in advance also might be healthier than those made closer to the moment of consumption because there are differences in the types of costs and benefits taken into consideration for decisions made for the near future versus the distant future. Temporal construal theory (e.g., Trope and Liberman, 2000, 2003) predicts that more distant future events are more likely to be represented in abstract, high-level terms. Therefore, when placing a food order further in advance, people are more likely to mentally represent the items according to relatively general categories, such as healthy and unhealthy, and the types of considerations are more likely to be higher-order, such as the goal of losing weight. In contrast, when making decisions for the present, people are more concerned with subjective experience (Pronin, Olivola, and Kennedy 2008), focusing their attention on lower-level considerations, such as the taste of the food, perhaps downplaying health-related concerns and ordering a more indulgent meal (Read, Frederick, and Airoldi 2012).

Integrating the predictions of construal-level theory with a multiple-selves model can generate predictions about the influence of temporal distance on the healthfulness of a future meal. Kivetz and Tyler (2007) propose a distinction between an idealistic self, who prefers identity-promoting benefits, and a pragmatic self, who prefers instrumental benefits, and they show that making decisions for the more distant future activates the idealistic self. In the context of advance lunch ordering, this suggests that the further in advance people place their orders, the more likely they will be to seek opportunities to identify themselves as healthy (pursuing an idealistic goal and preferring identity benefits) and the less likely they will be to be concerned with the details relevant to the consumption experience itself (e.g., the satisfaction derived from eating). That is, the pragmatic/idealistic distinction suggests that people ordering in advance will be more likely to pursue healthy options than those ordering closer to the time of consumption.

PRIOR EMPIRICAL RESEARCH

When studied experimentally, the relationship between advance ordering and healthy food choice appears robust. Studies have shown that people who make choices for immediate consumption order unhealthier snacks than those who make choices for future consumption. Read and Van Leeuwen (1998) asked adult participants to select a snack to be received one week later and then, one week later, asked the same participants to make a selection for immediate consumption, giving participants the chance to change their advance choices. The proportion of unhealthy snacks chosen was higher for immediate than for advance choices. Bucher-Koenen and Schmidt (2011), likewise, had children choose between an apple and candy either one day in advance or for immediate consumption; the children were more likely to choose candy for immediate than for delayed consumption. Similarly, Hanks, Just, and Wansink (2013) conducted a study in which elementary school students chose their lunch entrée either in the morning while in their classroom or at lunchtime while in the cafeteria. Those who ordered in advance were more likely to order a healthy entrée, as well as to select and consume more fruits and vegetables. Finally, a field study of more than one million online grocery orders finds that healthy "should" items, such as vegetables, compose a larger percentage of one's order as the time delay between order and delivery increases over a period of multiple days (Milkman, Rogers, and Bazerman 2010).

In combination, these studies provide support for the idea that advance ordering could be an effective tool for promoting healthier food choice, but all studies, not surprisingly, had limitations. The two snack studies were isolated decisions in which participants selected only a single snack from limited menus. The cafeteria study combined timing and location into a single manipulation, so it is unclear to what extent removing the decision from the cafeteria setting might have contributed to the effect. The online food ordering study was observational rather than experimental, so causality is difficult to assess. It could be, for example, that when people's pantries are relatively full and they have less of an immediate need for groceries, they allow for a greater delay between order placement and order delivery. Moreover, although statistically significant, this effect was relatively small in magnitude; each day of delay increased the choice share of "should" options by less than 1% (Milkman et al. 2010).

In summary, despite consistent findings that link advance ordering and healthier decisions, little has been done to test the direct causal relationship between the timing of meal order placement and the calorie content of those meals. We address this gap first by conducting two field studies with workplace online lunch orders, testing the impact of advance ordering with employees' own money over multiple weeks in a naturalistic setting, while holding environmental factors constant. Finally, in a third study conducted in a more controlled setting, we compare decisions made for immediate and delayed consumption and include measures of self-reported hunger, meal satisfaction, meal waste, and postmeal snacking intentions.

STUDY 1

In an initial test of the relationship between lunch order timing and calorie consumption, we reanalyzed data collected in a series of two field experiments (VanEpps, Downs, and Loewenstein 2015, 2016) on lunch ordering conducted in a corporate office setting. Although these studies were designed to examine the effect of menu calorie labeling on lunch order content, the data also enable us to examine the naturally occurring correlation between order timing and lunch order content. The absence of a correlation would undermine an expectation of a causal relationship.

In these studies, participants were randomly assigned to order from menus on which items were presented with no calorie labels, numeric calorie labels, traffic light calorie labels, or a combination of both label types. In some conditions, participants were shown their full lunch's calorie content or a corresponding traffic light label as they made choices. Pooling the data from these studies, we now examine calorie and nutrient content of meals as a function of the participant-determined timing of the lunch order. We present the results both controlling for and not controlling for the main effects of the experimental manipulations in the studies and interactions between the study manipulations and timing of meal orders.

Participants

Participants in the two previous studies were randomly selected employees of Humana, a large health-care company. Details of recruitment and the participant sample are presented elsewhere (VanEpps, Downs, and Loewenstein 2015, 2016). Our data set included 394 individuals who placed at least one order; over the study period, these individuals placed a total of 1,389 orders. The sample was 58% female, 84% white, and 32% dieting, with a median body mass index of 26 (range 16–55), a median age of 39 years (range 22–71), and a median household income in the category $75,000–$100,000.

Data Properties

Lunches consisted of one meal (ranging from 170 to 950 calories), plus optional additional snacks (ranging from 62 to 420 calories each) and drinks (ranging from 0 to 290 calories each). Participants could place their order any time after 7:00 A.M. When ordering, they selected the time they would like to pick the order up, between the hours of 11:00 A.M. and 2:00 P.M., with at least 30 minutes advance notice required. Participants could place up to three orders per week throughout the course of the study.

Total lunch calories ordered ranged from a minimum of 170 to a maximum of 1,470, with an average calorie content of 551 calories (SD = 253). The length of delay between order placement and order pickup ranged from 31 to 312 min (M = 105 min, SD = 62), and the median delay was 88 min. Orders were placed as early as 7:10 A.M. and as late as 1:28 P.M., and the median time of order placement was 10:27 A.M.

Statistical Analyses

Our primary goal is to measure the effect of timing on a given lunch order. To control for the potential correlation in errors that might arise from multiple orders from the same person on different days, we used mixed-model regressions with maximum likelihood estimation, using each order placed as the unit of analysis, nested within participants, to predict total lunch calories. We calculated the linear effect of time elapsed, in hours, between when the order was placed and when the order was scheduled to be picked up by the participant. We also included the effect of the time of day at which the order was placed, measured in hours after 7:00 A.M. We included both of these variables because they should logically pick up different effects. The first can be interpreted as the effect of time delay per se; the second, to the extent that it provides a crude measure of time since breakfast, provides a better indication of the impact of appetite rather than the direct effect of time delay.

As a separate analysis for robustness, we control for the experimental manipulations in this study by including dummy variables for each type of menu observed (i.e., numeric label, traffic light label, both labels, order-level numeric aggregation, and order-level traffic light aggregation) and the interaction of each with time delay. Finally, because participants for this study were recruited in two separate samples (but still observed the same experimental procedures), we include a dummy variable for the second sample.

As a final analysis for robustness, we also conduct each set of analyses using fixed effects for each individual customer, which enables us to identify the effect of time delay when controlling for the average lunch calorie content ordered by any given customer (see the Web Appendix).

Results

Table 1 presents the results of the regressions predicting total lunch calories from hours between ordering and order pickup (time delay), time of ordering, menu labeling conditions, and interactions between time delay and menu labeling conditions. Standard errors are clustered at the individual customer level. Consistent with past research on time delay, there is a strong, negative relationship between delay and calorie content ($p = .015$); for every hour of delay, there is a decrease of approximately 38 calories in the lunch ordered. The effect of the absolute time of day is, in contrast, not significant, and, indeed, the negative point estimate is inconsistent with what one would expect were appetite primarily responsible for differences in order calories.[1] We found similar effects for fat and saturated fat content, but we found no effects for carbohydrate, protein, fiber, or sodium content. Regressions reporting the impact of timing on these other variables are provided in the Web Appendix.

There were no interactions between time delay and any of the menu labeling conditions for calorie content (all ps > .10; details presented in the Web Appendix), suggesting that the relationship between delay and healthier orders was not differentially affected by calorie information. There was an interaction between delay and sex, whereby the calorie content of orders placed by females was more affected by delay than those placed by males ($p < .05$), but there were no interactions between delay or time of day and any other demographic variable (age, race, dieting status, BMI; see Web Appendix). Moreover, there was no effect of delay on the total price of lunches selected or on the total number of items ordered (both ps > .10), indicating that delay is not related to willingness to spend or the size of lunch ordered.

Table 1

STUDY 1: TOTAL CALORIES ORDERED AS A FUNCTION OF TIME DELAY BETWEEN ORDER PLACEMENT AND ORDER PICKUP, TIME OF ORDER, STUDY MAIN EFFECTS, AND INTERACTIONS

	Model 1	*Model 2*
Time delay (hours)	−30.97* (11.97)	−37.92** (15.67)
Time of order (hours after 7:00 A.M.)	−7.22 (10.42)	−6.51 (10.41)
Study main effects included in model?	No	Yes
Time delay × Study interactions included in model?	No	Yes
Intercept	627.01 (54.74)	688.20 (59.35)
Number of observations	1,389	1,389
Number of participants	394	394

*$p < .05$.
**$p < .01$.
Notes: Robust standard errors clustered at the participant level are in parentheses.

Discussion

These results demonstrate a consistent relationship between the calorie content of an order and the delay between order placement and planned consumption, consistent with theories of hot–cold empathy gaps and temporal discounting. Such a relationship is consistent with, but not direct evidence of, a causal relationship between time delay and healthy lunch selection. For example, these results could merely demonstrate a selection effect, particularly if some individual trait, such as trait-level impatience, drives both the willingness to order in advance and the desire to order lower-calorie meals. To rule out this possible explanation, we conducted a robustness check with customer fixed effects, using only those participants who placed multiple orders, and found that the relationship between time delay and meal calories remained significant ($p < .01$). Alternatively, the causality of our effect could even be the reverse if participants ordered in advance as a precommitment strategy; perhaps those placing orders further in advance did so with the direct intention of exercising self-control over their future selves.

To determine whether these results reflect a causal effect of time delay on ordering preferences, and to test the feasibility and impact of an automated advance-ordering

[1]As might be expected, time delay and time of order placement were highly correlated ($r = -.84$, $p < .001$). We ran the same analyses without time of order placement and observed the same pattern of results for time delay, with ($\beta = -31.49$ calories, SE = 11.81; $p = .008$) and without covariates ($\beta = -24.12$ calories, SE = 6.74; $p < .001$). We also ran the analyses without time delay and observed a significant effect of hours elapsed after 7:00 A.M. on calories, with covariates ($\beta = 15.71$ calories, SE = 5.85; $p = .007$) and without ($\beta = 15.06$ calories, SE = 5.88; $p = .01$).

system, we conducted an experimental study in this field setting, directly manipulating the time at which orders could be placed.

STUDY 2

We test the potential efficacy of constraining advance ordering with a field experiment in the same corporate office setting as Study 1, with associates placing online orders from an on-site dining facility. Specifically, we randomly assign participants to either place orders in advance (i.e., before 10:00 A.M.) or at lunchtime (i.e., after 11:00 A.M.) and observe the effects of this system-imposed time delay on orders. Those in the advance-ordering condition, therefore, had to pick up orders at least 60 min after placing them (delay ranged from 61 to 363 min), whereas those in the lunchtime-ordering condition could receive their orders sooner (delay ranged from 30 to 179 min).

We examine the relative healthfulness of choices, measured as participants' propensity to select low-calorie meal options, as well as the more clinically relevant outcome of the total calorie content of lunches ordered. The experiment proceeded in two stages, with a slight modification introduced in the second. In the first wave of data collection, in which no calorie information was provided on the menu, preliminary analyses revealed no significant effect of delay. In addition to concerns about sample size and statistical power, we were concerned that uncertainty about which meals were lower in calories could have prevented participants from choosing lower-calorie options if they wanted to do so. As a result, we recruited a second wave of participants, using exactly the same methodology, except that we labeled eight of the thirteen meals as having fewer than 500 calories. (The remaining items ranged from 560 to 960 calories.) We pooled the data from these two samples for greatest statistical power and included a term in all analyses to capture the effect of the simple calorie label introduced for the second sample.

Participants

We randomly selected 1,105 full-time associates of Humana to receive invitations to participate (500 in the first sample and 605 in the second). A total of 507 (46%) invited associates registered for the study, 296 (58%) of whom placed at least one order. Of the 211 registrants (42%) who never ordered through the website, most (192; 91%) never logged into the website. There was no overall difference between assigned ordering times in participants' likelihood of logging in to the website (63% vs. 62%, respectively; $\chi^2 = .03$, $p = .86$) or placing an order (59% vs. 58%, respectively; $\chi^2 = .01$, $p = .92$). Analyses were restricted to those who placed an order; this subsample was 58% female, 84% white, and 48% dieting, with a median age of 38 years (range 22–66), a median BMI of 26 (range 17–53), and a median household income in the category $75,000–$100,000.

Materials

The menu of available options was the same as in Study 1. The entrance survey elicited participant age, sex, race, estimated household income, current dieting status, weight, and height. In addition, participants answered three numeracy questions (items taken from Lipkus, Samsa, and Rimer [2001]), reported how frequently they ordered lunches online through existing websites, and answered questions about their exercise and snacking habits. Finally, participants rated the importance (on a six-point scale) of several factors when they ordered a meal (price, fat content, calories, health benefits, portion size, variety, taste, convenience, and familiarity).

The exit survey elicited participants' preference for ordering time and whether they believed they ordered healthier meals in advance or at lunchtime. A full list of all survey items is included in the Web Appendix.

Procedure

We recruited participants in waves, allowing them to start placing orders the week after registration to ensure that all participants would have the same amount of time in the study (four business weeks). Participants were paid $5 for completing a short entrance survey and $5 upon completion of an exit survey, and they were given a $3 discount on up to three lunch orders per week for the four weeks of the study (up to 12 total lunches). When placing each order, participants selected when they would pick it up, between the hours of 11:00 A.M. and 2:00 P.M.

Each Monday, participants were told that they would need to place their orders either before 10:00 A.M. (advance condition) or between the hours of 11:00 A.M. and 1:00 P.M. (lunchtime condition) for the week. All participants in both waves were randomly assigned to one condition for the first two weeks and then were switched to the other condition for the final two weeks of the study. The sequence of condition assignment and its interaction with the ordering condition were included in analyses.

Statistical Analyses

We used self-reported height and weight to calculate BMI scores. We then calculated recommended daily calorie intake for each participant using Mifflin–St. Jeor equations (Frankenfield, Roth-Yousey, and Compher 2005), according to height, weight, age, and weight-loss intentions (500 calories were subtracted from the daily recommendation for those who reported dieting to lose weight). To determine which demographic variables to include as covariates for our primary analyses, we conducted bivariate correlations between each demographic variable and the outcome of total calories, retaining variables significantly correlated with total calories ($p < .05$). All analyses were conducted with and without these covariates,[2] and roughly the same patterns of results and significance levels held across models.

As with Study 1, we used mixed-model regressions with maximum likelihood estimation to handle the hierarchical data, analyzing the total calorie content of each order. To test whether participants disproportionately chose from the list of low-calorie meals, we also conducted a mixed-effects binary logistic regression on the likelihood of ordering a meal with fewer than 500 calories, including both waves of data collection and the same covariates used in our primary analyses.

Finally, we analyzed the total cost (before the $3 discount was applied) and number of items in each order, as

[2]The covariates included in analyses were sex, age, income category dummy variables, a dummy variable for being white, dieting status, and the ratings of the importance of taste, price, fat content, calorie content, health benefits, and variety in meal orders.

well as the nutrient content of each order, running separate analyses for the effect of order timing on each of six nutrients: fat, saturated fat, carbohydrates, protein, sodium, and fiber. The results of these nutrient content analyses are reported in the Web Appendix.

Results

Summary statistics. Total lunch calories ranged from 170 to 1,590 calories, with average calorie content of 589 calories (SD = 269). As a manipulation check, we compared the delay between order placement and order pick-up between the lunchtime condition (M = 42 min, SD = 20) and the advance condition (M = 168 min, SD = 53; $t(1,132) = 55.29$, $p < .001$).

Meal content. As shown in Table 2, orders placed in advance had marginally fewer calories (M = 568, SE = 15) than those placed at lunchtime (M = 598 calories, SE = 14; $p = .086$). The calorie label that identified which meals had fewer than 500 calories also had an independent effect, reducing calories ordered by approximately 60 calories ($p = .01$), but did not interact with the timing restriction manipulation ($p = .95$). Taking advantage of the fact that many (145) participants placed orders under both early-ordering and late-ordering conditions, we estimated calorie intake including fixed effects for each of these participants. Again, the timing restriction led to a modest reduction in calories ordered (advance: M = 572 calories, SE = 12; lunchtime: M = 603 calories, SE = 10; $p = .065$).

There were no interactions between the timing restriction and any demographic variable (all ps > .10; see Web Appendix). There were no significant effects of the timing restriction or the order in which condition was assigned on meal calories or on snack and drink calories (all ps > .10; see Web Appendix).

Because the only calorie labels in this study were categorical, identifying some options as having lower calories, we also tested whether delayed timing promoted selection from the low-calorie list. Indeed, orders placed in advance were more likely to include a meal from the under-500 list than orders placed at lunchtime (60% vs. 53%; $p = .05$). Those exposed to the low-calorie label were more likely to select from that list than those not exposed (63% vs. 48%; $p < .01$), but there was no interaction between label presence and timing restriction ($p = .57$), nor was there a differential effect of which restriction participants were given first ($p = .11$). The full logistic regression results are reported in the Web Appendix.

Participant perceptions. When asked at which time point respondents thought they ordered healthier lunches, 27 respondents (out of 261; 10%) thought they ordered healthier lunches in advance,[3] and 7 respondents (3%) thought they ordered healthier at lunchtime. However, the vast majority (227 out of 261; 87%) indicated that they thought they ordered the same way regardless of when they placed their orders.

[3]Analysis of the orders made by these 27 respondents suggests that they did, indeed, order approximately 108 fewer calories when ordering in advance ($p = .07$), although the pattern of results and significance levels for calories ordered among the entire sample remains unchanged when we control for responses to this survey question.

Table 2

STUDY 2: TOTAL CALORIES ORDERED AS A FUNCTION OF ADVANCE ORDERING RESTRICTION, LABEL PRESENCE, AND SEQUENCE OF CONDITION ASSIGNMENT, PLUS DEMOGRAPHICS (SEX, AGE, AND RACE) AND ADDITIONAL COVARIATES

	Model 1	*Model 2*	*Model 3*
Advance ordering	$-28.46^{\dagger}$ (15.23)	−22.85 (16.42)	$-30.01^{\dagger}$ (17.46)
Label present	$-44.26^{\dagger}$ (22.71)	$-38.00^{\dagger}$ (22.76)	−59.04* (23.73)
Advance first	1.70 (23.09)	−7.40 (23.07)	−6.57 (23.45)
Demographics included in model?	No	Yes	Yes
Additional covariates included in model?	No	No	Yes
Intercept	614.08 (20.96)	602.93 (56.23)	463.86 (162.57)
Number of observations	1,134	971	842
Number of participants	296	257	225

$^{\dagger}p < .10$.
$*p < .05$.
Notes: Robust standard errors clustered at the participant level are in parentheses.

Discussion

This study provides preliminary causal evidence of the health benefits of ordering in advance, with participants more likely to select from the lower-calorie category when ordering in advance, but the overall 30-calorie reduction (approximately 5% of lunch calorie content for this sample) was only marginally statistically significant (p-values observed between .065 and .086). Although the "under 500 calories" label was not assigned to participants randomly, it appears to have led to greater selection of low-calorie meals. This is consistent with earlier research that has found a modest but reliable effect of calorie labeling on calories in food orders when the order decision is made without visceral food cues present (VanEpps, Downs, and Loewenstein 2016; Wisdom, Downs, and Loewenstein 2010). We find no evidence, however, for an interaction between calorie labeling and timing restrictions.

The high ecological validity of this study brought with it some important limitations. First, the cafeteria required 30 min to prepare even the "immediate" orders, limiting the comparison against advance ordering to "soon" instead of "now." In addition, participants were permitted to decide whether or not to place an order on any given day, which allowed for potential selection effects whereby participants might have chosen to place orders only when assigned to the lunchtime or advance condition, depending on their preferences. In a third study, although it is conducted in a less typical setting, we aim to address these limitations.

STUDY 3

In the final study, we compare advance orders with those made for immediate consumption, eliminating the brief delay that was built into Studies 1 and 2 to accommodate the food preparation time requirements of the cafeteria. In addition, Study 3 restricts ordering to a single event. Participants decided to participate in the study before they learned about any time delay for their orders, and they could not self-select out of participation depending on their assigned condition (as participants in the previous study could). Finally, in contrast to Studies 1 and 2, in which orders were placed over several weeks as part of an ongoing field experiment and survey items thus could not be paired with each lunch order, Study 3 includes measurement of hunger, meal satisfaction, and food waste, taken around the time of consumption.

Measurement of hunger as a potential mediator allows for a more direct test of the hot–cold empathy gap, in which time delay decreases calorie consumption by guiding individuals to place orders when they are less hungry. According to this account, the experienced feeling of hunger should lead one to ignore non-hunger-related goals and enhance the attractiveness of unhealthier orders, without any particular regard for when the decision is implemented (Loewenstein 1996; Read et al. 2012; Van Boven and Loewenstein 2003). That is, a hungry person will order more food than a satiated person, but the increase in food ordered should not differ depending on whether the meal is ready now or after a delay.

Participants

We recruited 212 students from undergraduate (24%) and graduate-level (76%) university classes that ended between 11:30 A.M. and 12:30 P.M. Students were informed in advance that the study consisted of taking three short surveys in exchange for a free catered lunch; approximately 80% of students invited to the study elected to participate. Of the initial 212 who agreed to participate, 14 either did not complete a lunch order or did not stay to receive the lunch order they initially placed and thus were not included in analyses; they were similarly distributed between advance (8%) and immediate (5%) experimental conditions.[4] In addition, three participants correctly identified the design of the study in a postlunch survey; these individuals were thus excluded from primary analyses, although including them does not change the pattern or significance level of the results. The final sample of 195 participants was 42% female and had a median age of 25 years (range 19–54). Racial/ethnic makeup of the sample was 62% Asian (East Asian, South Asian, or Asian American), 27% white, 4% African or African American, 3% Hispanic, 3% mixed race/ethnicity, and 1% not reported.

Procedure

Participants completed three short surveys in exchange for the free lunch: one right before class (time 1), one at the end of class, right before receiving their lunch (time 2, ranging from 80 to 170 min after time 1, depending on class schedule), and one after eating their lunch (time 3). All participants were asked to complete identical survey materials, but, to randomly assign individuals to order in advance or not, we randomized whether they completed the lunch-order survey at time 1 (right before class; n = 98) or time 2 (right before obtaining their lunch; n = 97). They completed a demographic survey at whichever time point they did not complete the lunch-order survey (time 1 or time 2). Participants received their lunch immediately after providing their survey at time 2, and they were allowed to leave with their lunch at that time.

Lunches were delivered by a local catering company no more than an hour before the end of class and were then assembled and distributed directly outside the classroom, along with a paper survey to be completed after finishing the lunch and returned by campus mail. Participants who did not return the survey right away were reminded by e-mail, with a link to complete it online, and were instructed to submit the survey as soon as possible, with surveys accepted up to one week after study participation. Of the 195 participants, 162 (83%) submitted the final survey, with slightly greater response rates from those who completed lunch order surveys at time 2 (88%) versus at time 1 (79%; $\chi^2(1) = 2.84$, $p = .09$).

Materials

All three surveys included mood-related questions (current mood; feeling toward the city of Pittsburgh, where their university was located; and current state of alertness) intended in part to mask the true purpose of the study from participants. One of the surveys randomly administered prelunch included the demographic items, and the other provided an order form to select a lunch, elicited a hunger rating on a seven-point scale, and asked at what time the participant had last eaten. The final survey, to be completed after lunch, asked about meal satisfaction, eating and exercise habits, dieting, food allergies, and snacking plans for the day, and then asked participants to indicate how much of each item (sandwich, side dish, cookie or fruit, and beverage), in quartiles, they had left uneaten at lunchtime. Meal satisfaction was measured by a four-item scale ($\alpha = .67$) that asked the extent to which participants enjoyed the meal, would be willing to pay $8 for the meal, would have selected the same meal had more options been available, and would be willing to write a positive review of the meal.

The lunch options were created to allow for a wide range of calorie options and to communicate relative indulgence versus moderation using descriptive words and phrases. Participants were asked to choose one of three half-sandwiches (with optional mayonnaise and mustard packets), one of three side dishes, a cookie or a piece of fruit, and one of three beverages; each category also included the option to decline. For each item category, the options included a relatively healthy option (e.g., "Garden veggie pasta salad, loaded with vegetables"), a relatively unhealthy option (e.g., "Creamy potato salad, made with real mayonnaise"), and an intermediate option (e.g., "Homemade coleslaw"), which pretesting confirmed were perceived as they were intended. All survey items are included in the Web Appendix.

Statistical Analyses

We estimated calorie information from recipes, with total meal calories ordered ranging from 314 to 1,505 calories (M = 944 calories, SD = 259). We used linear regression to predict total calories ordered—as well as calories in each

[4] As a robustness check of our primary analyses, we conducted the same test including those six participants who placed an order but did not stay to receive their order, and we observed the same pattern and significance level of results ($p < .01$).

meal component—from experimental condition, adding those demographic variables retained as covariates (using the same procedure as in Study 2 to determine covariates, with sex emerging as the only significantly correlated demographic variable) in a second model, and including the effect of hunger ratings (a proposed mediator) in a third model. We then directly tested mediation by hunger using the bootstrap method and the MEDIATE macro for SPSS recommended by Hayes and Preacher (2014). Additional models tested for interactions between condition and select demographic variables, such as sex and age (see Web Appendix). We also calculated the estimated value of uneaten lunch calories for participants who submitted the final survey, as a measure of food waste. We used linear regression to determine the effect of advance ordering on food waste, meal satisfaction, and hunger. We used logistic regression to examine snacking intentions as a measure of potential compensation among those who might have eaten smaller lunches than desired due to ordering in advance.

Results

Calories ordered. As shown in Table 3, participants who placed orders in advance ordered significantly fewer calories (M = 890) than those who placed orders at lunchtime (M = 999; $p < .01$). Figure 1 shows that ordering in advance had no effect on sandwich calories (advance: M = 455 calories; lunchtime: M = 459 calories; $p = .76$) or condiment calories (29 vs. 37 calories; $p = .24$) but did reduce drink calories (35 vs. 60 calories; $p < .01$) and marginally reduced side dish calories (160 vs. 176 calories; $p = .053$) and cookie or fruit calories (212 vs. 267 calories; $p = .056$; see Table 4).

Male participants ordered more calories than female participants (981 vs. 893 calories; $p < .05$); there were no effects of other demographics, nor did any demographic interact significantly with order timing (see Web Appendix). A simple linear regression demonstrated that greater self-reported hunger predicted more calories ordered ($p < .05$).

Mediation. Participants who ordered in advance rated themselves as significantly less hungry when placing their orders (3.46 vs. 4.89; $t(190) = 7.23$, $p < .001$), and, as reported in the previous section, greater hunger predicted more calories ordered, setting the stage for a mediation analysis. We estimated the direct and indirect effects of ordering condition on calories ordered, entering hunger rating as a possible mediator, and used a bootstrapping method with 5,000 replications to calculate the 95% confidence interval (CI) for the indirect effect mediated through hunger. This analysis did not reveal significant mediation through hunger ($\beta = -25$ calories; 95% CI: [−70, 14]). The remaining direct effect of ordering condition was marginally significant ($\beta = -77$ calories, SE = 42; $p = .07$).

Uneaten calories. The portion of the meal left uneaten did not differ between orders placed in advance (27%) and orders placed at lunchtime (26%; $p = .70$), nor did the average uneaten portion for any item category differ from the other categories (all ps > .20). Similarly, the caloric value of the uneaten food did not differ between advance orders (170 calories) and lunchtime orders (177 calories; $p = .82$). Additional simple linear regressions revealed no significant effects of hunger at the time of order purchase ($\beta = 17$ calories; $p = .13$) or of having eaten breakfast ($\beta = -8$ calories; $p = .82$) on uneaten calories.

Table 3

STUDY 3: TOTAL CALORIES ORDERED AS FUNCTION OF ORDER TIMING, PLUS COVARIATES (MODEL 2) AND POTENTIAL MEDIATORS (MODEL 3)

	Model 1	*Model 2*	*Model 3*
Advance ordering	−100.41** (36.52)	−108.92** (36.25)	−87.75* (41.55)
Male (dummy)		88.17** (36.78)	87.69* (37.25)
Hunger rating (1–7 scale)			15.91 (13.42)
Intercept	994.90 (25.89)	946.63 (32.30)	871.65 (72.49)
Number of observations	195	195	192

*$p < .05$.
**$p < .01$.
Notes: Standard errors are in parentheses.

Snacking intentions. Intended as a measure of compensatory eating by participants after lunch, plans to eat a snack between lunch and dinner did differ between ordering conditions, but not in the direction anticipated. Instead, only 44% of participants who ordered in advance planned to snack, compared with 65% of those who ordered at lunchtime ($p = .014$). Snacking intentions were not correlated with total calories ordered ($p = .78$) or uneaten calories ($p = .26$).

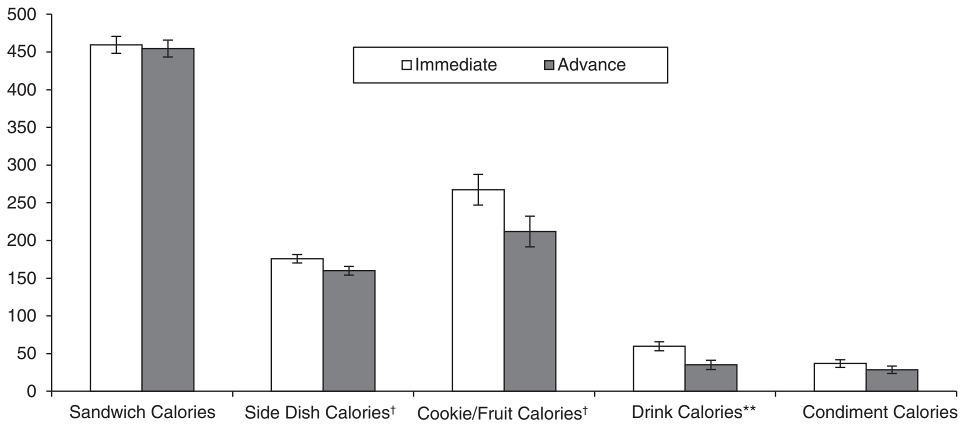
Additional analyses. Those who reported eating breakfast were significantly less hungry (M = 3.90) at the time of order placement than those who had not eaten breakfast (M = 4.69; $p < .01$), but having eaten breakfast did not have any direct effect on total calories ordered ($p = .92$). There was no difference in meal satisfaction between those who ordered in advance (M = 4.10) and those who ordered at lunchtime (M = 4.28; $p = .33$).

Discussion

The results of Study 3 indicate a causal impact of lunch order timing on meal healthfulness that is consistent with predictions. Although the results are not directly comparable to those of Study 2, given different methods and participants, it seems likely that the larger effect in Study 3 (a 100-calorie reduction in the advance condition, vs. the 30-calorie reduction in Study 2) is due to the immediate availability of lunchtime orders in Study 3. This absolute difference in calorie reductions between these two studies is likely at least partly due to the greater average number of items selected in Study 3 compared with Study 2 (3.8 vs. 1.4) and corresponding greater average number of calories (944 vs. 589). However, even when we evaluate the calorie reductions relative to total meal content, the effect of advance ordering in Study 3 (11% reduction) is more than double the effect observed in Study 2 (5% reduction), suggesting that the meal size alone cannot account for the larger effect in Study 3. Such an effect seems most consistent with quasi–hyperbolic time discounting models (e.g., Laibson 1997) or with models that assume immediate availability triggers visceral drives that generate shortsighted behavior (e.g., Loewenstein 1996; McClure et al. 2004). Self-reported hunger did not emerge as a significant mediator of this effect, which weakens support

Figure 1

CALORIES ORDERED FOR IMMEDIATE CONSUMPTION VERSUS IN ADVANCE, BY ITEM CATEGORY (STUDY 3)



†$p < .10$.
**$p < .01$.
Notes: Error bars indicate ±1 SE.

for a visceral account, although it also could reflect error in the measurement of hunger.

GENERAL DISCUSSION

Our results build on past work that has demonstrated a shift toward healthier choices when consumers order meals in advance. The first two studies demonstrate a modest change in ordering behavior over longer time delays, and the third shows an especially large impact of time delay on calorie content when compared with immediate consumption. The general lack of interactions with participant characteristics (excepting an interaction with sex in Study 1, which was not replicated in Study 2 or 3) suggests that these benefits are not limited to one subset of the population.

Of the different possible mechanisms that drive the effect of time delay on food choice, the three studies provide greatest support for an account based on hyperbolic time discounting (present bias). In the first study, calories in lunch orders were inversely related to time delay but unrelated to time of day, which is more consistent with a time discounting or temporal construal account than with one based on empathy gaps. In the second study, participants were more likely to select "low-calorie" meals when ordering in advance, yet advance ordering reduced total calorie content by only a modest amount, suggesting a categorical shift in preferences more aligned with time discounting or temporal construal accounts than with an effect of hunger. Finally, the third study points to a strong effect of immediacy, again suggestive of hyperbolic time discounting. Furthermore, although hunger rating in Study 3 was sensitive enough to differ substantially between conditions and to capture the failure to eat breakfast, it did not emerge as a significant mediator of the observed effect on lunch calories.

Note, however, that our manipulations, which solely involved time delay and minimized and held constant visceral cues, were especially well designed to demonstrate an independent effect of order timing. Without smells or sights of food, the impact of visceral factors might have been attenuated. Moreover, it is quite likely that hunger ratings provided an imperfect measure of the visceral urge to eat, which might have led to a further underestimation of the impact of visceral and empathy gap effects.

Directions for Further Research

Study 1 found a strong naturally occurring relationship between time delay in ordering and the calorie content of lunch orders. Although some of the self-generated delays could be due to the beliefs of participants who wanted to cut calories that ordering in advance would help them to do so, we found little evidence for this logic in Study 2's exit

Table 4

STUDY 3: CALORIES ORDERED, BY ITEM CATEGORY, AS A FUNCTION OF ORDER TIMING AND COVARIATE (SEX)

	Sandwich Calories	*Side Dish Calories*	*Cookie or Fruit Calories*	*Drink Calories*	*Condiment Calories*
Advance ordering	−4.80 (15.94)	−15.86† (8.14)	−55.31† (28.76)	−24.75** (8.53)	−8.21 (7.03)
Male (dummy)	43.95** (16.18)	−4.33 (8.26)	24.93 (29.18)	21.85* (8.65)	1.76 (7.13)
Intercept	433.80 (14.20)	178.33 (7.25)	252.65 (25.62)	47.05 (7.60)	35.80 (6.26)

†$p < .10$.
*$p < .05$.
**$p < .01$.
Notes: N = 195. Standard errors are in parentheses.

survey. It would be interesting to test an intervention in which employees were given an explicit choice of whether to precommit to placing lunch orders early, perhaps with some educational intervention to inform them of the benefits of doing so. Such an approach would be less heavy-handed than an external timing restriction, allowing those who wanted to place orders at lunchtime to do so, but would offer a self-control aid for those who desired one. This is a classic example of the types of policies advocated in the public-policy approach advanced by behavioral economists (Camerer et al. 2003; Thaler and Sunstein 2003). For example, Schwartz et al. (2014) find high consumer interest in a self-control commitment device that imposes risk of forfeiture of existing financial incentives for shoppers who fail to meet their own healthy grocery goals.

A small subset of participants in Study 2 believed that their meal choices would be healthier when they ordered in advance than when they ordered at lunchtime, a proportion that might grow over time as consumers observe their own behavior. This raises the potential concern that participants who order in advance for one meal might engage in compensatory energy balance strategies at other meals. Research has shown that after habituation to a given eating decision, like a low-calorie daily snack, subjects often compensate for the calorie difference at later meals (Louis-Sylvestre et al. 1989). Exit survey responses from Study 3 do not reveal plans for such compensatory consumption, although it is unknown how well these expectations were borne out. Longitudinal studies that measured eating decisions over a longer time frame would better capture the full impact of advance ordering on health outcomes.

The discounted (Studies 1 and 2) and free (Study 3) meals used in these studies were necessary to keep participants in a relatively closed system in which their choices could be observed and manipulations controlled. However, the relative inexpensiveness of food in these studies—and particularly in Study 3, when meals were free—might have encouraged overconsumption relative to typical dining. Past research has shown that financial windfalls increase financial spending (e.g., Arkes et al. 1994), suggesting that budgeting concerns are lessened when one receives such a gain, and perhaps that concerns about caloric budgeting diminish as well. Although we have no theoretical reason to suppose that the timing of meal selection would interact with meal cost, future studies could test for this pattern, by manipulating cost or using captive audiences who must pay for their meals, to replicate the findings.

Marketing Implications

A major challenge that firms face, particularly in light of legislation directed at reducing consumer calorie consumption, is managing the divergent goals of population health and company profits. These different goals can present industry with a conflict of motives between reducing calorie consumption versus selling more items at a higher profit margin (Ludwig and Nestle 2008; Rolls 2003). Restaurant operators will, of course, monitor the financial effects of any intervention that they try, and in so doing, they are likely to discover which strategies appear to promote health without cutting into profits. Moreover, offering or promoting low-calorie alternatives (Saelens et al. 2012) or voluntarily posting calorie labels (Hsu 2012) or other health information (Shah et al. 2014) can signal a restaurant's concern for its customer's health, potentially promoting customer satisfaction and loyalty.

Our results highlight an alternative strategy that could be cleverly framed to improve consumer perceptions of a meal's healthfulness, yet do so with minimal changes to the menu itself. Restaurants could encourage consumers to place their orders further in advance as a way to promote healthy eating, emphasizing the strategic benefits of doing so as a way to attract health-conscious consumers. Placing orders in advance might even give the restaurant more time and flexibility in preparing the orders, which has the potential of reducing costs to the restaurant and ensuring higher order quality. Furthermore, the results of Study 3 suggest that the greatest calorie reductions might be achieved primarily among secondary items, such as beverages or sides. Menus and promotions of entrée options need not change dramatically to accommodate the preferences of health-conscious consumers who order in advance; rather, restaurants could simply provide the option to substitute, for example, a side salad and bottled water for the more caloric default alternatives of French fries and soda.

The finding that people select higher-calorie meals when they order immediately before consuming points to a possible negative effect of the proliferation over recent decades of fast-food restaurants and packaged snacks and meals, which remove the time delays inherent in advance shopping and time-consuming food preparation (Schlosser 2012). This trend could be reversed through interventions that force, encourage, or incentivize consumers to select meals in advance, not by restricting consumers' choice set or imposing new costs, but by harnessing advance decision making. The three studies presented here, in combination, suggest that an intervention that introduces even a short time delay between ordering and receiving food could yield substantial health benefits.

Conclusions

Our findings support existing theoretical accounts of the relationship between time delay and behavior. We show that time delays lead consumers to order low-calorie meals more often; that shifting the timing of the lunch-order decision from immediately before lunch to some period in advance yields substantial calorie reductions; and that additional time delay leads to a modest but persistent reduction in the overall calorie content of meals. These results support the efficacy of interventions that guide people to make meal-order decisions further in advance. If implemented as a voluntary option for restaurant customers or as a best practice when ordering meals for workplace meetings, advance ordering is a practical intervention that could be implemented widely with beneficial effects. Although not a panacea for the obesity epidemic, advance ordering can be easily combined with other interventions that successfully reduce calorie intake or increase exercise and could potentially have a large impact on ordering and consumption habits. Whether exogenously imposed or voluntarily selected, advance ordering seems to be a practical strategy for mealtime calorie reduction.

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