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Predicting Hunger: The Effects of Appetite and Delay on Choice

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Preferences often fluctuate as a result of transient changes in hunger and other visceral states. When current decisions have delayed consequences, the preferences that should be relevant are those that will prevail when the consequences occur. However, consistent with the notion of an intrapersonal empathy gap (Loewenstein, 1996) we find that an individual's current state of appetite has a significant effect on choices that apply to the future. Participants in our study made advance choices between healthy and unhealthy snacks (i.e., fruit and junk food) that they would receive in 1 week when they were either hungry (late in the afternoon) or satisfied (immediately after lunch). In 1 week, at the appointed time, they made an immediate choice, an opportunity to change their advance choice. Our main predictions were strongly confirmed. First, advance choices were influenced by current hunger as well as future hunger: hungry participants chose more unhealthy snacks than did satisfied ones. Second, participants were dynamically inconsistent: they chose far more unhealthy snacks for immediate choice than for advance choice. An additional hypothesis related to gender differences was also confirmed. © 1998 Academic Press

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At any moment our preferences are the result of a unique constellation of needs and desires that may never be repeated. Consequently, when we make choices that will not come into effect until later, we have to predict our future preferences (Kahneman & Snell, 1990; Kahneman, Wakker, & Sarin, 1997; March, 1978). The easiest way to do this is to take our current desires as a baseline and then to adjust them according to anticipated changes in circumstances. To the degree that our tastes are stable, this procedure will work faultlessly, but what happens when they are not?

In a recent series of articles, Loewenstein (1996; Loewenstein & Schkade, in press) has argued that even when our current tastes are poor or useless guides to future tastes, we persist in weighting them heavily when predicting what we will want. He has focused on preferences that vary due to fluctuations in "visceral states" such as hunger, fear, sexual arousal, or fatigue. These visceral states have profound effects on our desires, yet they are extremely labile and prone to undergo radical changes in the space of a few hours or even minutes. Nonetheless, even when under the influence of such states, decision-makers make future-oriented decisions to satisfy their current preferences instead of those that will be operative when the chosen option is actually experienced. Loewenstein, Prelec, and Shatto (1998) argue that this occurs because it is inordinately difficult for us to imagine what it is like to be in a different visceral state than the one we are currently in and liken this difficulty to the one we have in understanding the feelings and choices that are made by other people. Consistent with this interpretation, they refer to the inability that we have when in one state of arousal to "get in the shoes" of ourselves in a future state as an *intrapersonal empathy gap*.

Loewenstein and his co-workers have focused primarily on what they call the *cold-to-hot* empathy gap, or the gap between a nonaroused (i.e., cold) and an aroused (hot) self when the cold self is doing the predicting. A familiar case occurs when, after a huge dinner, we believe that we will never be able to eat again and may even announce plans to skip breakfast. The next morning, of course, our hunger has returned and we eat the same breakfast as always. In one experiment (Loewenstein *et al.*, 1998), participants were made curious by having them attempt a general knowledge quiz. Participants chose between a chocolate bar and the answers to the quiz questions. Some chose before attempting the quiz, and were therefore not yet curious (they were cold), while others chose after they had become curious about the answers (they were hot). The cold participants were much more likely to take the chocolate bar, suggesting that they underpredicted the motivational power of their curiosity. Related studies have shown that male undergraduates underestimate the effect of sexual arousal on their behavior (Loewenstein *et al.*, 1997) and that people cannot predict the "endowment effect," the fact that merely by possessing a good they will come to value it more (Loewenstein & Adler, 1995).

The intrapersonal empathy gap is only one of two important effects of temporal separation on the outcome of future-oriented choice. A second, which has received much more attention, is dynamic inconsistency, or the tendency for our preferences to change systematically as a function of how far in the future

they are to come into effect.[1] Many researchers have observed that contrary to the conventional account of time preference (the discounted utility model) people are dynamically inconsistent, meaning that their preferences for goods reverse predictably as a function of the delay between choice and consumption (Strotz, 1956; Thaler, 1981). It is widely believed these preference reversals arise from our disposition to give disproportionate weight to short-term benefits and costs when making choices (e.g., Ainslie, 1975; Elster, 1977; Winston, 1980). As a consequence, when consumption is still far away we might plan to have something that is good for us, such as healthy food or exercise, but when consumption becomes imminent we are prone to change our mind and choose something with more immediate appeal that is bad for us in the long run, such as junk food or sloth (Kirby & Herrnstein, 1995; Read *et al.*, in press).

In this paper we present an empirical investigation of both intrapersonal empathy and dynamic inconsistency in a domain where desire fluctuates rapidly and predictably and in which good intentions are notoriously prone to fail in practice—food choice. In a field experiment, participants made *advance choices* for a snack that they would receive at a designated time in 1 week and then, at that designated time, made *immediate choices* (essentially an opportunity to change their minds). Participants were either *hungry* or *satisfied* (not hungry) when they made their advance choices and would be either hungry or satisfied when they made their immediate choices. During advance choices, therefore, participants were not only aware of their current hunger or satisfaction, but also had the opportunity to be aware of their future hunger. There were four experimental groups: HH participants made advance choices when hungry for future consumption when hungry and then later made immediate choices while they were hungry; HS participants made advance choices when hungry for future consumption when satisfied and then made immediate choices when satisfied; and so forth for conditions SH and SS. The snacks between which participants chose were either high-calorie, high-fat *unhealthy snacks* (chocolate bars, crisps, or nuts) or low-calorie, low-fat *healthy snacks* (apples or bananas).

This procedure allowed us to establish the existence of intrapersonal empathy gaps and dynamic inconsistency in food choice, as well as to measure the magnitude of these effects. The intrapersonal empathy gap is measured by taking the difference between advance choices made in the same state of appetite in which a snack will be consumed and those made in a different state. Dynamic inconsistency is measured by taking the difference between advance choices and immediate choices. In the next two sections we briefly expand on the theoretical issues just introduced and describe the hypotheses which were tested in the experiment.

[1] Strotz (1956) incorporated both factors in his seminal study of dynamic inconsistency: "The relative weight which a person may assign to the satisfaction of a future act of consumption (the manner of discounting) may depend on either or both of two things: (1) the *time distance* of the future date from the present moment, or (2) the *calendar date* of the future act of consumption (p. 167)." The calendar date refers to the exact moment of choice, and in our analysis inconsistencies

INTRAPERSONAL EMPATHY GAPS

We address several questions raised by earlier research concerning intrapersonal empathy gaps. The first of these is whether there are hot-to-cold as well as cold-to-hot empathy gaps. A hot-to-cold gap exists when a hot self fails to appreciate the needs of a cold self. Although it is easy to think of real-world cases of cold-to-hot prediction (when we predict our ability to withstand temptation, for instance), hot-to-cold prediction is rarer. This is likely because most of us spend relatively little time in a hot state and when we are hot we are usually so focused on the present that we don't make future-oriented decisions. It does happen, however. Marriages sometimes fail because the hot partners making the decision are unable to anticipate what life will be like when things have cooled down.[2] Many familiar hot-to-cold gaps involve hunger. The "eyes bigger than your stomach" effect occurs when very hungry people order more food than they can or want to eat. Perhaps the best known case, however, is that of grocery shopping while hungry, the major consequence of which is that we fail to take into account the needs of our future selves in two ways: first, we buy things that we will regret having purchased once our hunger passes and we don't buy those things that we later wish we had. In our experiment, a hot-to-cold empathy gap would be indexed by a greater proportion of unhealthy snacks being chosen in condition HS than in SS, an outcome which we advance as Hypothesis 1:

H1: $P_A(\text{HS}) > P_A(\text{SS})$.

We use P_A (HS) to designate the proportion of unhealthy snacks chosen in condition HS and so forth.

The second question is whether we pay any heed at all to future visceral states when predicting future desire. The experiments of Loewenstein and his co-workers (Loewenstein & Adler, 1995; Loewenstein *et al.*, 1997, 1998) were designed to establish the *existence* of the cold-to-hot empathy gap, but not to determine its magnitude. All three of their experiments involve comparisons between a currently hot group predicting for a hot future self (corresponding to HH in our study) and a cold group predicting for the same hot future (SH). A difference between these two groups demonstrates a hot-to-cold empathy gap, but does not tell us about its relative size. To do this, the correct comparison is between a group who chooses for a future when they will be in the same state as their current one and another group in the same state as the first group, but who chooses for a future when they will be in a different state. In our experiment, these comparisons are between HH and HS (the hot-to-cold empathy gap) and between SS and SH (the cold-to-hot empathy gap). If we do take future states into account, then we would observe the following relationship:

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arise because of the intrapersonal empathy gap. Inconsistencies attributable to time distance arise because of the disproportionate weight given to immediate outcomes.

[2] Of course, the decision to marry could also be based on an underweighting of future consequences, a topic which is taken up in the next section.

H2: P_A (HH) > P_A (HS)
P_A (SH) > P_A (SS)

Assuming, for the moment, that there are both cold-to-hot and hot-to-cold empathy gaps, a final question concerns whether it is more difficult to bridge the gap from a cold to a hot state or from a hot to a cold one. In many cases, Cold-to-hot gaps might be more difficult to traverse because they involve bridging the gap from a status quo state to one that is uncommon or at least rarely reflected on. For instance, although we all experience curiosity it is a relatively infrequent emotion, and perhaps those participants in Loewenstein *et al.*'s (1998) study who failed to predict the strength of their future curiosity had never before given it much thought. The counterpart to this suggestion is, of course, that the states being predicted or chosen for in the case of hot-to-cold prediction are usually quite familiar and so should be easier to anticipate. On the other hand, hot-to-cold empathy might be made difficult by the fact that the self doing the empathizing is aroused and hence too focused on his or her immediate needs to care much about what happens in the future (e.g., Easterbrook, 1959). In short, it is an empirical question whether intrapersonal empathizing is easier to do in one direction or the other. On the hypothesis that the cold-to-hot empathy gap and the hot-to-cold empathy gap are equal, we make the following prediction:

H3: P_A(SH) − P_A(SS) = P_A (HH) − P_A (HS).

If we combine H1 through H3 and put them into analysis-of-variance terms, they entail a main effect of both current hunger and future hunger, but no interaction between them.

DYNAMIC INCONSISTENCY

In order to explain dynamic inconsistency, we draw on a useful conceptual distinction between virtues and vices (Wertenbroch, 1998). Virtues and vices are defined relative to one another, in terms of the opportunity costs involved in choosing one over the other. For any pair of goods, a (relative) virtue is one which provides more utility in the long run than its alternative, but less utility in the short term. The traditional Christian virtues, for instance, trade forbearance on earth for an eternity in heaven, while the vices trade earthly pleasure for an eternity in hell. In general, the opportunity costs of choosing virtue are relatively small but come early, while the opportunity costs of choosing vice are larger but come late.

A discrepancy between short-term and long-term gains is a characteristic property of goods that satisfy visceral states, such as those used in our experiment. Some are notorious for giving a lot of pleasure up-front, but at the cost of cumulative or long-term consequences that are markedly less desirable. Cigarettes, alcohol, and other drugs; rich foods; and even video games can fall into this category. This pattern of immediate rewards and delayed costs means that such goods will often be vices relative to their alternatives. A cigarette, for instance, is a vice relative to a stick of gum or even abstinence. In our

experiment, the unhealthy snacks were vices relative to the healthy ones. The unhealthy snacks were concentrated and quickly accessed sources of calories that would lead to rapid hunger cessation, and they also had the highly desirable sensual and gustatory properties of sugar, salt, and fat. From the point of view of momentary pleasure, it is clear that these snacks would have immediate appeal for most people. Indeed, their manufacturers have engineered them for just this purpose. These snacks also have more negative delayed consequences: in the medium term, they can spoil your evening meal, while in the longer term they can contribute to weight problems, heart disease, and hypertension. The healthy snacks were by no means undesirable in the short term, but we did anticipate that they would yield a much smaller up front peak of pleasure,[3] even though everyone would know that in the long run they are "better for you."

Most psychologists and many economists recognize that people put disproportionate weight on immediate gains and losses relative to delayed ones (Ainslie, 1991; Elster, 1979; Strotz, 1956; Winston, 1980), and many models of time preference have been proposed that incorporate such an "immediacy effect" (Ainslie, 1975, 1991; Becker & Mulligan, 1997; Harvey, 1994; Herrnstein, 1961; Loewenstein & Prelec, 1992; Mazur, 1987). One alternative, proposed by Phelps and Pollack (1968), and since put to good use by several recent writers (e.g., Laibson, 1997; O'Donaghue & Rabin, 1997), takes the following form:

$$U^0(u_0, u_1, \ldots, u_T) = u_0 + \beta \sum_{t=1}^{T} \delta^t u_t,$$

where U^0 is the present value of a utility stream, u_t is the utility experienced at each time t, $\delta \leq 1$ corresponds to a constant discount rate, and $\beta \leq 1$ is the immediacy effect—immediate utility is valued more than delayed utility by a factor of $1/\beta$ in addition to the normal level of positive time preference represented by δ. Laibson (1997) refers to this as a quasi-hyperbolic discount function because of its similarity to the familiar hyperbolic discount function (Ainslie, 1975; Kirby, 1997) and for ease of reference we will adopt this term.

A consequence of quasi-hyperbolic discounting is that when choosing between two goods that can be received (and consumed) at the same time, choices can reverse between them, with an advance choice of virtue changing to an immediate choice of vice. This occurs because an early peak of utility is more likely to be outweighed by the long-term opportunity cost if a delay precedes the receipt of a good than if there is no delay. We can illustrate this with a numerical example. Consider a choice between a virtue, which will yield 25 in the period when it is received and 200 in the second, and a vice, which will yield 100 in each of the two periods. For simplicity, assume an immediacy effect of $\beta = .5$ with no other discounting (i.e., $\delta = 1$). If consumption begins immediately, the utility stream is (25, 200) for the virtue and (100, 100) for the vice. Their present value is, therefore:

[3] The reader can judge whether this is true for them: If Snickers bars were exactly as healthy as apples or bananas, would you increase or decrease your consumption of Snickers bars?

Virtue: $25 + (.5 \times 200) = 125$
Vice: $100 + (.5 \times 100) = 150$.

The vice will be preferred. On the other hand, if they are both delayed by one period, then the undiscounted first period gives 0 utility, and the entire stream is discounted by β:

Virtue: $0 + .5 \times (25 + 200) = 112.5$
Vice: $0 + .5 \times (100 + 100) = 100$.

Now the virtue will be preferred to the vice. This result is general: when an initial delay is added to options, vices will be discounted proportionally more than virtues.

Based on the immediacy effect of quasi-hyperbolic discounting, we predicted that our participants would choose more healthy snacks for immediate than advance choice. Put into the notation already introduced, we predicted that:

H4: $P_A(HH) < P_I(HH)$
$P_A(HS) < P_I(HS)$
$P_A(SH) < P_I(SH)$
$P_A(SS) < P_I(SS)$

where $P_I(x)$ indicates the proportion of unhealthy snacks chosen during immediate choice.

A secondary prediction based on the virtue–vice distinction is that the immediacy effect will be greater for women than men. In a recent study of food attitudes, more women than men were found to perceive sweet foods as being unhealthy but pleasurable or, in our terminology, vice-like (Grogan, Bell, & Conner, 1997). Women and men did not, however, differ in their long-term intention to eat sweet snacks. Grogan *et al.* did not investigate actual snack choices in their study, but if their findings are generally true (i.e., for unhealthy snacks in general and for women and men in general), we would expect that in advance choice women would take fewer unhealthy snacks than men (or at least they would not choose more), but would make more immediate choices for unhealthy snacks:

H5: $P_A(\text{men}) \geq P_A(\text{women})$
$P_I(\text{men}) < P_I(\text{women})$.

A MANIPULATION CHECK

A final hypothesis takes the form of a manipulation check. Many of our hypotheses are based on the premise that people have a greater desire for unhealthy snacks when they are hungry than when they are satisfied. The best index of this preference is what they choose during immediate choice. We predicted that people would choose more unhealthy snacks when they were hungry than when they were satisfied:

H6: $P_I(HH), P_I(SH) > P_I(HS), P_I(SS)$.

METHODS

Participants

The participants were 200 employees of various firms in Amsterdam, 116 (58%) of whom were female. The firms included banks, insurance companies, a hospital, the University of Amsterdam, and several shops. We chose institutional employees because they could be relied on to be at their place of work 1 week after their first contact and because they worked a full day. Because we wished to conceal the fact that we were conducting an experiment, we did not ask participants for their age or any other details. However, we estimated the age of all participants to be between 20 and 40 years of age. We obtained permission from managers to conduct the study in the banks, insurance companies, and the hospital. We did not obtain such permission from the shops or the university because of their more open setting.

A note about how the groups were formed is in order. We designed the study with the goal of 50 participants in each group. However, we knew that we would have some shrinkage and so we tested 60 people in each group during the first week. In the second week we looked for all 60, but once we had found 50 who met our conditions we stopped looking so energetically for the remaining subjects and so those found above 50 were not necessarily found at the right time of day or even on the right day. Therefore, we had precisely 50 reliable participants in each of the four conditions. (We should note that we did look conscientiously for all participants to whom we had promised a snack and in the end only 14 could not be found at all). The results reported below are based on the first 200 participants actually tested in the correct circumstances.

Design

We used two dependent measures. The first was *advance choice* in which participants chose a snack that they would receive for consumption at a specific time in 1 week, and the second was *immediate choice* in which participants chose for immediate consumption. Every participant made one advance choice followed by an immediate choice 1 week later. Immediate choices were made when the time came for the advance choice to come into effect. Therefore, immediate choice provided each participant with an opportunity to change his or her advance choice.

We manipulated the hunger state of the participants by varying the time of day when they made their choices: choices were either made when most participants would be *hungry* (late afternoon) or when they would be *satisfied* (immediately after lunch). When speaking in general terms, we will refer to the state of hunger or satisfaction during advance choice as hunger/a and that during immediate choice as hunger/i.

The Snacks

Participants chose between snacks that had been either judged healthy or unhealthy by a pretest group of 18 people. They rated a list of 13 snacks,

including 5 pieces of fruit, 5 chocolate bars, and 3 salty snacks. The chocolate bars and salty snacks were chosen because they were popular in the Netherlands. The snacks rated healthiest were apples and bananas (rated "healthiest" by 7 and 6 participants respectively). The chocolate bars rated least healthy were Mars bars and Snickers bars (6 ratings of "least healthy" each) and two salty snacks, paprika-flavored crisps and borrelnoten (3 and 2 ratings each). We included only two healthy items in the final set because many pretest participants judged them to be the only healthy snacks which were convenient to eat. For example, they rejected oranges because they were "too messy" to be eaten at the workplace. In the analyses reported below we do not distinguish between sweet and salty snacks.

We also conducted a separate test of the judged healthiness of the items that we had chosen. Eighteen additional participants, chosen from the same population as our experimental participants, rank ordered the snacks from most to least healthy. The average ranks were as follows: apples (1.33), bananas (1.67), crisps (3.91), borrelnoten (4.08), Mars bars (4.67), and Snickers bars (5.33). As is clear from these ratings, everyone ranked the apple and banana as the two most healthy snacks.

Procedure

On the first day, we approached participants and told them that we were giving away free snacks to people at their workplace and that in 1 week we would return and give them their snack. We showed them which snacks were available and told them on what day and at what time of day (i.e., either "after lunch time" or "in the late afternoon, around 4:30 or 5:00") we would return to give them their snack. We then asked them to choose the snack they would want when we returned (this was *advance choice*). We then left, promising to return in 1 week with their snack. One week later we returned at the promised time of day and again asked each participant what snack they wanted right away (this was *immediate choice*). At this point, we made no reference to the fact that they had already chosen a snack and told them that they could have any snack they wanted. Many people felt that they should take the snack they had originally chosen, but we reminded them that they could have any snack they wanted and emphasized that we had plenty of each kind of snack. Some asked if we knew what their advance choices were, but we denied any such knowledge and "proved" it by showing them a list containing only their names with no record of their choices. Once the participants had made their immediate choice we gave them the snack they chose.

RESULTS

Figure 1 depicts the percentage of unhealthy snacks chosen during both advance and immediate choice. We conducted a four-dimensional analysis of variance testing all four factors of interest (time of choice, hunger/a, hunger/i, and sex). This complex analysis is presented in an appendix. For the

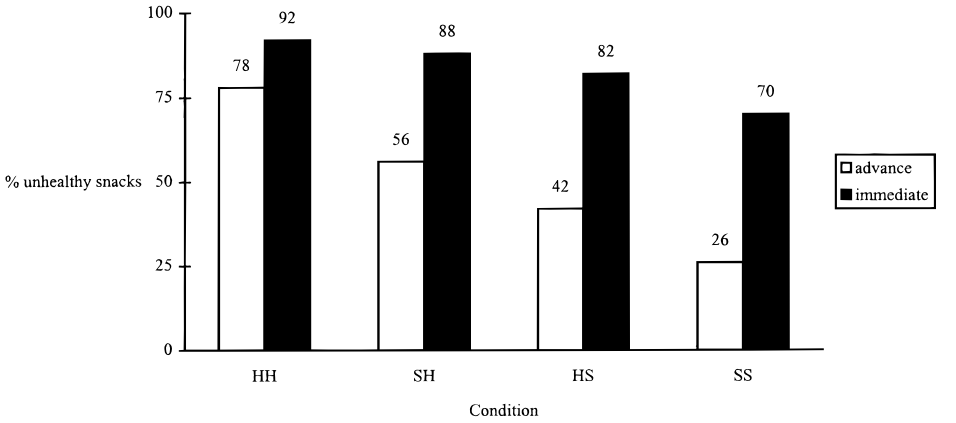

FIG. 1. Percentage of unhealthy snacks chosen in all conditions

hypothesis tests below we report simpler two dimensional ANOVAs or *t* tests. All significant results reported below are also significant in the four dimensional ANOVA.

Hypotheses 1 through 3: Concerning Intrapersonal Empathy Gaps

As can be seen in Fig. 1, the proportions of unhealthy snacks chosen for advance choice were ordered by condition according to the predictions of H1 through H3: P_A(HS) was greater than P_A(SS), P_A(HH) was greater than P_A(HS), and P_A(SH) was greater than P_A(SS). Moreover, as postulated by H3, the cold-to-hot and the hot-to-cold empathy gaps were approximately equal in size: P_A(SH) − P_A(SS) = 30%; P_A(HH) − P_A(HS) = 36%. The composite hypothesis was tested by means of a 2 × 2 analysis of variance on advance choices, with hunger/a and hunger/i treated as a repeated measure. The analysis confirmed a main effect of both hunger/a [F(1,196) = 8.5, $p < .004$] and hunger/i [F(1,196) = 23.6, $p < .001$] on advance choice with no interaction ($F < 1$). The absence of an interaction supports the claim that hunger/i and hunger/a have an independent and additive effect on choice. To summarize, we found support for the claim that there is a hot-to-cold as well as a cold-to-hot empathy gap, that neither empathy gap is complete (i.e., participants did take future hunger or satisfaction into account), and that the empathy gaps are of about equal size.

An additional question is whether the effects of hunger/a differed in magnitude from those of hunger/i. We investigated this by examining the ANOVA regression coefficients. As expected, given its much greater F value, the coefficient for hunger/i (.32) was greater than that for hunger/a (.19), but the two coefficients did not differ significantly even when the p value was set at a modest .2. There is no sound statistical basis, therefore, for concluding that hunger/i had a greater effect on advance choice than hunger/a.

Hypothesis 4 and 5: The Immediacy Effect

According to Hypothesis 4, we expected more choices of unhealthy snacks for immediate choice than for advance choice. As is clear from inspecting Fig.

TABLE 1

Percentage Who Change Their Minds Conditioned on Whether They Made an Advance Choice for an Unhealthy or Healthy Snack

Condition	Direction of change[a]		P_A(h)[b]
	P(h→un)	P(un→h)	
HH	82% (11)	5% (39)	22%
SH	82% (23)	7% (27)	44%
HS	69% (28)	0% (22)	56%
SS	62% (37)	8% (13)	74%

[a] P(h→un) is the percentage who changed from a healthy to an unhealthy snack. The number in parentheses is the number of participants who initially chose either a healthy or an unhealthy snack.

[b] The percentage who chose a healthy snack during advance choice. That is, the base rate for P(h→un).

1, this is exactly what happened. We tested this formally by conducting four separate repeated measures t tests comparing the proportion of healthy and unhealthy snacks chosen in each condition. Each comparison revealed a significant difference in the predicted direction, with more unhealthy snacks chosen during the immediate than the delayed choice: HH, $t = 2.19$, $p<.05$; HS, $t = 5.72$, $p < .001$; SH, $t = 4.11$, $p < .001$; SS, $t = 5.76$, $p < .001$.

Another way of looking at this is through the probability that a participant would change their mind from an unhealthy to a healthy snack or from a healthy to an unhealthy snack. Table 1 gives the percentage of participants who made either a healthy or unhealthy advance choice and then changed their mind. Although the great majority of those who first chose a healthy snack changed their mind, almost nobody changed their mind when their first choices was unhealthy.

Figure 2 is a comparison of the percentage of unhealthy snacks chosen by

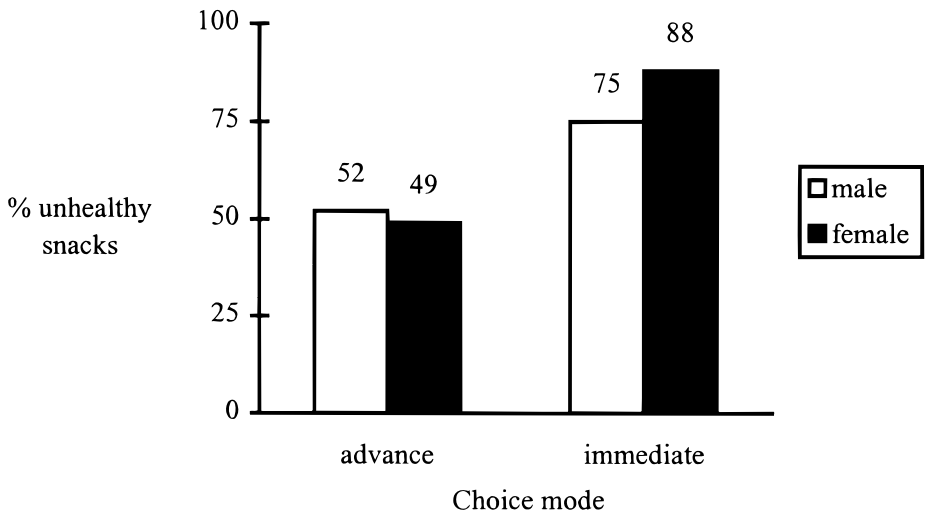

FIG. 2. Percentage of unhealthy snacks chosen as a function of sex and choice type.

males and females for both advance and immediate choice. Because the proportion of females differed slightly in each condition, the figure shows weighted means with equal weight given to each group. Formal analyses confirmed what is suggested by the figure: females chose slightly (but nonsignificantly) fewer unhealthy snacks during advance choice, but significantly more during immediate choice. A 2×2 analysis of variance with sex and time of choice as the two factors revealed an interaction between time and sex [$F(1,198) = 5.3$, $p < .05$], as well as an effect of time [$F = 71.3$]. Two separate t tests revealed no effect of sex for advance choices ($t < 1$), but a sizable effect for immediate choices immediate choices [$t(198) = 2.19$, $p < .05$]. The lack of a sex effect for advance choice is consistent with Grogan *et al.'s* (1997) finding that men and women did not differ in their planned consumption of sweet foods.

Hypothesis 6

Figure 1 shows that, as anticipated, participants who were hungry during immediate choice (those in conditions HH and SH) chose more unhealthy snacks than did those who were satisfied (HS and SS). A t test comparing immediate choices made by hungry and satisfied participants indicates that this difference is reliable, $t(198) = 2.60$. $p < .01$.

The Effect of Advance Choice on Subsequent Immediate Choice: A Post Hoc Investigation

Figure 1 also suggests that immediate choices were influenced by the advance choices that had preceded them. That is, if we rank order the conditions by the percentage of unhealthy snacks chosen during advance choice and the percentage chosen during immediate choice, we see that the rankings are the same (HH > SH > HS > SS) although the range is somewhat greater for advance choice. If, when participants made their immediate choices, they had completely disregarded their earlier advance choices and based their immediate choices only on whether they were hungry or satisfied *at that moment*, we would have observed the following pattern:

$$P_I(\text{HH}) = P_I(\text{SH} > P_I(\text{HS}) = P_I(\text{SS}).$$

The conditional analysis presented in Table 1 suggests a way of understanding what is going on. Observe that for the two conditions in which people are hungry during immediate choice (HH and SH), the likelihood of changing from a healthy to an unhealthy snack is equal (82%). Likewise, in the two conditions in which people are satisfied during immediate choice, the likelihood of switching is also approximately equal (HS = 69%, SS = 62%) and, most importantly, lower than that of the hungry participants. However, the base rate for choices of healthy items (as given in Table 1) differs greatly across the two conditions. For instance, only 22% of HH participants initially chose a healthy snack, as compared to 44% of SH participants, yet 82% of both of these subgroups changed to an unhealthy snack during immediate choice. However, because the base

rate of initial healthy choices was higher for the SH group, the proportion of immediate choices for healthy snacks is also higher. Similar statements can be made when comparing HS and SS. One way to interpret this is that participants anchored their immediate choices on their advance choices. Consequently, the effect of being hungry or satisfied during immediate choice was on the disposition of participants who had made an advance healthy choice to *change their mind*. Hungry participants were more likely to change their mind (in the direction of an unhealthy snack) than were satisfied ones.

Although this analysis is post hoc, we think that it points to an interesting issue for further research. It suggests that if people plan to eat healthily, they are more likely to do so, even if they are subjected to the temptation of hunger when the time of consumption arrives. That is, although you are very likely to break down and order a hamburger when you go to McDonalds, it is still a good idea to plan to eat a salad. More generally, if you promise to control yourself in the future (perhaps by using a condom, refusing the third drink, or skipping dessert) you are more likely to do so than if you have made no such promise. This may explain why people are generally time consistent despite having hyperbolic time preferences—although their desires may change, they stick to their plans.

DISCUSSION: ON INTRAPERSONAL PREDICTION

One question that can be raised in response to our results is how much of the difference between advance and immediate choice is due to an inability to predict future desires (a true "empathy gap") and how much is due to an attempt to impose the "better judgment" of advance choice on a future self? In the theory section we deliberately defined empathy gaps as being the difference between two kinds of *advance* choice—one made when in the same state as you will be in at the moment of consumption and one made when in a different state. We did not define it another way which might, on the face of it, seem at least as appropriate—as the difference between advance choices made in one state and immediate choices made in a different state. Defined this way, the empathy gap would appear much greater because all groups wanted more unhealthy snacks during immediate choice than during advance choice.

We chose the first definition because the second confounds the immediacy effect, that people are more likely to want vices at the moment of consumption than some time earlier, with the empathy gap. As long as participants are aware that their preferences will change from advance to immediate choice then there is no empathy gap, only inconsistencies in desire. It is only when they do not know what they will want that we can speak of an empathy gap. The much-cited case of Ulysses and the Sirens (e.g., Elster, 1977; Schelling, 1984), for instance, is not an example of an intrapersonal empathy gap because Ulysses knew that his preferences would change, but wanted to impose his current preferences on his future self. We believe that the difference between advance and immediate choice in our experiment was also not caused by an empathy gap. Hungry participants choosing in advance for a future hungry

self were, on average, exactly as hungry as they would be during immediate choice. The same argument can be made concerning the participants in condition SS. Participants in both these groups could know their future desires merely by consulting their current preferences, yet they still chose more unhealthy snacks for immediate choice than for advance choice. We suggest that these participants were like those smokers who want to quit and promise to do so after a "last cigarette." It is not that they are unaware of the strength of their desire for cigarettes (after all, they are presently experiencing exactly that desire) but only that they are willing to impose a requirement for self-control on their future selves that they are not willing to impose on their current selves.

A second question is what factors influence the size of the empathy gap? In the studies by Loewenstein and his colleagues they deliberately chose situations that would not be part of the everyday experience of their participants and for which they may have never made any plans or to which they had never given advance consideration (see Loewenstein & Adler, 1985, for their rationale). In our study, we equally deliberately chose a situation that was as mundane as possible, just like going to the snack machine. Yet a substantial empathy gap remained. Empathy gaps are caused by the imperfect ability of decision-makers to project themselves into circumstances different than those in which they find themselves. The accuracy with which they can make such projections is determined by the accuracy of their mental models of motivation and its vicissitudes. That people often have poor or inaccurate mental models is well established. Kahneman and Snell (1990, 1992), for instance, found that people greatly overpredicted the satiating effects of repeated consumption in the domains of music and food. Likewise, Read and Loewenstein (1995) found that people predicted they would want more variety in their snacks than they actually wanted when the time came, perhaps due to this same overprediction of satiation. Read and Loewenstein (in press) showed that participants who had not experienced a source of pain (immersion of their hand in ice cold water) greatly underestimated the amount of pain that it would cause. Other studies by Loewenstein and colleagues have already been described above, showing that people underestimate the changes that curiosity and ownership will make to their desires.

This imperfect ability to project oneself into the future is paralleled by the much-studied imperfect ability to project oneself into the past. It has been many years since the model of memory as a strictly reproductive process has been replaced with one viewing it as partially constructive in which the past is inferred from cues available in the present (e.g., Bartlett, 1932, Loftus, 1979). A consequence of such a process is that the memory of past desires and preferences are guided by current desires and by how desires change over time (Nisbett & Wilson, 1977; Ross, 1989). For instance, remembered social attitudes are based much more on what we currently believe than on what we actually believed in the past (Goethals & Reckman, 1973). Likewise, the widespread theory that people get more conservative as they age leads people to remember themselves as once being more liberal than they actually were (Ross, 1989),

and the theory that menstruation is associated with great psychological distress predicts remembered distress better than it does actual distress (McFarland, Ross, & DeCourville, 1989).

Cognitive and social psychologists have made great progress in their systematic exploration of how people "postdict" their pasts. Their strategy has been to unearth the theories people have that relate current knowledge to the past and then to examine how much our memories are caused by these theories as opposed to the actual events. Prediction will, of course, be even more dependent on such theories than will recollection, since even the most plausible recollections can come in conflict with physical evidence and with other, inconsistent, recollections. For instance, someone who wants to believe that they were liberal in the past may be stymied by the presence of "vote Nixon" buttons in their desk drawer, books by William F. Buckley, Jr. on their bookshelf, or by their certain memory that they protested against the Equal Rights Amendment. Predictions cannot be disconfirmed by the presence of such evidence.

APPENDIX

We analyzed the effects of all factors in our experiment by conducting a $2 \times 2 \times 2 \times 2$ analysis of variance. We included three repeated measures: hunger/a, the state of hunger during the advance choice; hunger/i, the state of hunger during the immediate choice; and sex. Time of choice, either immediate or advance, was the single between-subjects factor. The results of the analysis are presented below. As can be seen, there were five significant effects: A main effect of time of choice, a main effect of hunger/a, a main effect of hunger/i, an interaction between time and hunger/i, and an interaction between time and sex.

Source of variance	MS_e	F	p
Time of choice[a]	.13	70.81	.00
Time × hunger/a	.13	1.48	.23
Time × hunger/(i)[a]	.13	7.03	.01
Time × sex[a]	.13	4.67	.03
Time × sex × hunger/a	.13	1.53	.22
Time × sex × hunger/i	.13	.20	.65
Time × hunger/a × hunger/i	.13	.42	.52
Time × sex × hunger/a × hunger/i	.13	.80	.37
Hunger/a[a]	.23	8.64	.00
Hunger/i[a]	.23	25.22	.00
Sex	.23	.95	.33
Sex × hunger/a	.23	.31	.58
Sex × hunger/i	.23	1.97	.16
Hunger/a × hunger/i	.23	.14	.71
Sex × hunger/a × hunger/i	.23	.48	.49

All $df = 1, 196$.

[a] Significant at $p < .05$.

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