Organizational Behavior and Human Decision Processes
Vol. 88, No. 1, May, pp. 430–444, 2002
doi:10.1006/obhd.2001.2982, available online at http://www.idealibrary.com on IDEAL®

The Future Is Now: Temporal Correction in Affective Forecasting

Daniel T. Gilbert

Harvard University

Michael J. Gill

Lehigh University

and

Timothy D. Wilson

University of Virginia

Decisions are often based on predictions of the hedonic consequences of future events. We suggest that people make such predictions by imagining the event without temporal context (atemporal representation), assuming that their reaction to the event would be similar to their reaction to the imagined event (proxy reactions), and then considering how this reaction might change were the event displaced in time (temporal correction). In a laboratory study, control participants based their predictions of future food enjoyment on the temporal location of its consumption, whereas cognitively loaded participants based their predictions on their current hunger. In a field study, shoppers based their food purchases on the temporal location of its consumption, whereas shoppers for whom this information was not salient based their purchases on their current hunger. These findings

This research was supported by Research Grant RO1-MH56075 from the National Institute of Mental Health. We are grateful to the management of HEB's Central Market in Austin, Texas, for generously allowing us to conduct Study 2 on their premises and for helping us with many aspects of data collection. We also thank Lisa Hiza and Jennifer Hunter for assistance in the execution of these studies; members of our laboratory groups for various contributions to this work; and Jay Koehler, George Loewenstein, Matt Lieberman, and many anonymous reviewers for helpful comments on an earlier draft of this article.

Address correspondence and reprint requests to Daniel Gilbert, Department of Psychology, William James Hall, 33 Kirkland Street, Harvard University, Cambridge, MA 02138. Fax: (617) 495-3892. E-mail: dtg@wjh.harvard.edu.

0749-5978/02 $35.00

suggest that predictions of future hedonic reactions may initially be based on the hedonic reactions one experiences as one imagines the event atemporally, and that this initial prediction is then corrected with information about the time at which the event will actually occur.

Key Words: affective forecasting; predicted subjective utility; intertemporal choice; hedonic psychology; correction processes.

Few of us have experienced a glass of Château Cheval Blanc '47 or a mouthful of termites, but most of us would choose between the two with considerable confidence because most of us can predict how each of these gustatory experiences would feel. Indeed, we make predictions about the subjective quality of future experiences so easily and so naturally that we generally do not think about these predictions until they go awry. Only when the tropical vacation that we anticipated with delight turns out to be disappointingly dull, or when we find ourselves happily immersed in a household chore that we spent weeks carefully avoiding, do we pause to wonder how predictions of our own hedonic reactions to future events can be so badly mistaken. Research has shown that such predictions are susceptible to a variety of errors and biases (Buehler & McFarland, in press; Frederick & Loewenstein, 1999; Gilbert, Brown, Pinel, & Wilson, 2000; Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; Kahneman & Snell, 1990, 1992; Loewenstein & Adler, 1995; Loewenstein & Frederick, 1997; Loewenstein & Schkade, 1999; Mellers, Schwartz, & Ritov, 1999; Mitchell, Thompson, Peterson, & Cronk, 1997; Rachman, 1994; Read & van Leeuwen, 1998; Snell, Gibbs, & Varey, 1995; Wilson, Wheatley, Meyers, Gilbert, & Axsom, 2000). But while errors in the prediction of future hedonic reactions are well-documented, relatively little is known about the basic psychological processes by which such predictions are made. How, exactly, does one decide that they will be annoyed or amused by the theater next week, delighted or dejected by the party next month, excited or exhausted by the bicycle trip next year?

FORECASTING BY PROXY

One of the ways in which people predict their hedonic reactions to future events is by the use of mental proxies (Hoch & Schkade, 1996; Kahneman, 1994; Kahneman & Miller, 1986). For example, if we wish to predict how we would feel upon finding our spouse in bed with the letter carrier on New Year's Eve, we might imagine the event and then take note of how we react to the mental image. Because real and imagined events activate many of the same neural and psychological processes (e.g., Kosslyn et al., 1999; McGuire, Shah, & Murray, 1993), reactions to imaginary events can provide useful information about one's likely reaction to the events themselves (Finucane, Alhakami, Slovic, & Johnson, 2000; Kahneman & Tversky, 1982; Sanna, 2000; Schwarz, 1990; Taylor, Pham, Rivkin, & Armor, 1998). If the mental image of rapid breathing and flailing mailbags induces pangs of jealousy and waves of anger, then we may properly expect a real infidelity to do so with even greater intensity. Indeed, we are hard pressed to predict that something will amuse or delight us when the mere thought of it makes us feel angry, sad, or nothing at all (Bechara, Tranel, Damasio, & Damasio, 1996). Just as mental images are proxies for actual events, so our reactions to these mental images may serve as proxies for our actual reactions to the events themselves.

Although how we feel when we imagine the future is often a good indicator of how we will feel when we experience the future we are imagining, there are some important exceptions. For instance, if a person who has just been turned down for a promotion were to predict how much she would enjoy receiving a stock dividend the following week, she might find it difficult to feel happy in the present, and might take her unhappiness to mean that she would not feel happy upon receiving a check in the future (Loewenstein, O'Donoghue, & Rabin, 2000). Because her feelings at the moment of prediction were a joint product of her mental image of the future dividend *and* of the rejection she just experienced, those feelings would provide an imperfect proxy for her future reactions to the dividend alone. In short, when a person's hedonic reactions are "contaminated" (Wilson & Brekke, 1994) by factors other than the mental representation of the future event, those feelings may be poor proxies for the person's later reactions to the event itself.

One problem, then, with using our hedonic reactions to a mental image to make predictions is that our current reactions can be contaminated by our current circumstances and hence may be poor proxies for the future reactions they are meant to predict. A second problem is that mental images often fail to specify the temporal location of the events they are meant to represent (Friedman, 1993). Although an event's temporal location is sometimes indicated by an imageable feature of the event (e.g., a full moon, a snowdrift, a calendar on the wall), in many cases—perhaps even in most cases—the temporal location of an event does not influence its representation in any imageable way. Receiving a dividend check next week *looks* very much like receiving a dividend check next month, enduring an employment interview today *looks* very much like enduring an employment interview tomorrow, and discovering an infidelity on New Year's Eve *looks* very much like discovering an infidelity on Purim, Halloween, or Russian Orthodox Easter. Indeed, a moment's introspection reveals that one's mental image of the event *finding one's spouse in bed with the letter carrier on New Year's Eve* changes dramatically when one substitutes *barber* for *spouse*, or *conversation* for *bed*, but not at all when one substitutes *Thanksgiving* for *New Year's Eve*. In short, images represent who, what, and where much more easily than when.

The fact that we make predictions by using mental images that may lack information about the temporal location of events stands in puzzling contrast to the fact that our predictions are generally quite sensitive to temporal location. For example, the temporal location of a future event influences how we construe it (Liberman & Trope, 1998; Trope & Liberman, 2000), how often we think about it (Fingerman & Perlmutter, 1995), how much we value it (Ainslie, 1992; Laibson, Repetto, & Tobacman, 1998; Loewenstein & Elster, 1992;

Loewenstein & Prelec, 1992; Loewenstein & Thaler, 1989; Mischel, Cantor, & Feldman, 1996), and how optimistic we are about it (Bjoerkman, 1984; Shepperd, Ouellette, & Fernandez, 1996). Even small children think differently about near and far future events (Friedman, 2000; Mischel, Shoda, & Rodriguez, 1989). If we predict our future hedonic reactions by using mental images that do not represent the temporal location of future events, then how can our predictions be sensitive to these temporal locations?

We propose that people sometimes predict their hedonic reactions by (a) imagining events without temporal information (*atemporal representation*), (b) using their hedonic reactions to those mental images as the basis for a preliminary prediction (*proxy reactions*), and then (c) correcting or adjusting their forecasts by explicitly considering the event's temporal location (*temporal correction*). For instance, when a man predicts how he would feel if he were to catch his wife *inflagrante delecto* on New Year's Eve or Christmas, he may initially imagine the two events identically, experience identical hedonic reactions, and hence generate identical predictions. Only after generating these preliminary predictions ("I'd be angry for months") might he consider information about the temporal location of the event ("People do all sorts of foolish things on Year's Eve") and then use that information to correct or adjust his forecast ("So maybe I'd just be angry for weeks"). Although his reactions to the actual event may well depend on the time at which it happens (e.g., it may be worse to experience betrayal on a holiday that symbolizes family and religion than on a holiday famous for ribaldry and intoxication), he may consider these differences only as an afterthought.

What are the consequences of considering the temporal location of an event only after we have made a preliminary prediction based on our hedonic reactions to an atemporal mental image? Research in a variety of domains has demonstrated that the correction of initial inferences requires time, motivation, and cognitive resources, and that when any of these is lacking, undercorrection or insufficient adjustment will result (Gilbert, in press; Tversky & Kahneman, 1974; Wilson & Brekke, 1994). As such, inferences that are achieved via a correction process tend to be biased toward their initial rather than final stages (Gilbert, 1991). If people do indeed make predictions by first generating atemporal mental images which serve as proxies and only then executing temporal corrections, then a shortage of time, motivation, or cognitive resources should cause their predictions to be overly influenced by their current feelings and insufficiently influenced by their knowledge of the event's temporal location. We explored this possibility in two studies.

THE PRESENT STUDIES

The consumption of food is one of life's most common hedonic experiences. Because people rarely have immediate and unlimited access to every food item they might desire at a particular moment, they must plan their consumption ahead of time (making reservations at a restaurant weeks before dining out, shopping for ingredients days before preparing a meal, etc.). Effective planning requires that people make reasonable predictions in the present about what they will enjoy in the future, and thus this domain is naturally suited to research on affective forecasting (e.g., Kahneman & Snell, 1992; Read & van Leeuwen, 1998; Simonson, 1990). In addition, people have hedonic reactions to mental images of food, they have theories about how pleasurable different foods are at different times, and they find questions about how much they enjoy particular foods to be relatively straightforward and easy to answer. For all of these reasons, we examined people's predictions about their hedonic reactions to future consumption of food. Study 1 was a laboratory study that attempted to determine whether people use temporal correction to generate such predictions, and Study 2 was a field study that attempted to determine whether this method of prediction had real-world consequences.

STUDY 1

We asked participants to predict how much they would enjoy eating spaghetti on the following day, and considered the variation of three factors. First, we manipulated the event's *temporal location* by asking participants to predict their hedonic reactions to eating spaghetti either the next morning or the next evening. Research suggests that people have strong preferences about the time of day at which they consume particular foods (Birch, Billman, & Richards, 1984; Kramer, Rock, & Engell, 1992), and thus we expected participants to expect to enjoy a spaghetti dinner more than a spaghetti breakfast. Second, we estimated participants' *proxy reactions* to the food they were imagining by measuring how hungry they were just prior to making their predictions. Research suggests that hunger causes people to rate foods more positively (Lozano, Crites, & Aikman, 1999), and thus we expected hungry participants to experience more positive hedonic reactions than sated participants to the mental image of spaghetti. Finally, we manipulated *temporal correction* by asking some participants to perform a difficult tone detection task while making their predictions. Research suggests that "cognitively busy" people (who are performing two attention-demanding tasks at once) have difficulty correcting preliminary judgments (Gilbert, in press; Kahneman, 1973; Wegner & Bargh, 1998), and thus we expected that busy participants would be less likely than nonbusy participants to execute a temporal correction.

Our theory suggests that people represent future events atemporally, use their proxy reactions to make a preliminary forecast, and then execute temporal corrections when they can. As such, we expected the predictions of busy participants to be influenced by their current levels of hunger but not by the temporal location of the event they were considering. On the other hand, we expected the predicitions of nonbusy participants to be influenced by the temporal location of the event and influenced minimally, if at all, by their current level of hunger.[1]

[1] The logic of our theorizing did not allow us to predict with certainty whether nonbusy participants would be influenced minimally or not at all by their current levels of hunger. If their temporal corrections were sufficient, then the influence of their hunger would presumably be eradicated; if their corrections were insufficient, then the influence of their hunger would presum-

Method

Participants. Participants were 61 nonvegetarian female undergraduates who participated in exchange for credit in their introductory psychology course.[2]

Procedure. Participants arrived at the laboratory and reported their current hunger (among other things) on a 7-point scale. The experimenter explained that they would be asked to answer questions about their "likes and dislikes" while listening to a series of tones. Participants were randomly assigned to the busy or nonbusy condition. *Busy* participants were instructed to press a button when they heard a particular three-tone sequence (high, medium, low), whereas *nonbusy* participants were instructed to press a button when they heard a high tone. Previous studies have shown that the first of these tasks is considerably more demanding than the second (Gilbert & Silvera, 1996). After 90 s of practice, participants performed the tone detection task while predicting their enjoyment of five future activities on a 9-point scale. Each item began with the phrase "How much would you enjoy . . ." and ended with a description of a particular activity (e.g., "going to the beach") and a particular time ("this summer"). The critical item asked participants to predict how much they would enjoy a taste of spaghetti with meat sauce in either the morning or the evening of the next day. After completing this task, participants were shown a list of the five activities and the five times and asked to recall how they had been paired during the task.

Results

Excluded data. Two participants missed 75% or more of the tones (the average error rate was 7%), one participant had previously participated in a study that used the same tone detection task, and one participant was unable to recall correctly which activities had been paired with which times. The data from these participants were excluded.

Predictions. We performed a pair of multiple regressions in which participants' predictions were regressed on (a) their reported hunger at the time of prediction and (b) the time at which the spaghetti was to be eaten. The analyses revealed that the predictions of busy participants were influenced by their current hunger ($\beta = .41$, $p < .04$), but not by the time at which the spaghetti was to be eaten ($\beta = .13$, $p > .50$). Conversely, the predictions of nonbusy participants were influenced by the time at which the spaghetti was to be eaten ($\beta = .62$, $p < .002$), but not by their hunger ($\beta = .23$, $p > .20$). Comparisons of these betas revealed that busy participants were influenced less than nonbusy participants by the time at which the spaghetti was to be eaten, $z = 1.92$, $p < .03$ (one-tailed), but that busy and nonbusy participants were influenced

---

ably be extant but reduced. Past research suggests that even when people are not under cognitive load, their current hunger can exert an effect on their predictions (Read & van Leeuwen, 1998).

[2] Pretesting indicated that males believed that spaghetti would taste equally good in the morning and the evening, and thus only females were eligible to participate.

equally by their current hunger, $z = .68$, $p > .25$ (one-tailed). This pattern of results is consistent with our suggestion that both groups of participants imagined the event atemporally and based their preliminary predictions on the feelings they experienced at the time they imagined the events, but that only nonbusy participants then used information about the event's temporal location to correct their preliminary predictions.

We sought to confirm these results with a second round of analyses. First, we classified participants as *hungry* or *not hungry* based on a median split. Next, we submitted the participants' predictions to a 2 (hunger: hungry or not hungry) × 2 (busyness: busy or nonbusy) × 2 (time of day: morning or evening) weighted contrast ANOVA. The weights (shown in Table 1) reflect the hypothesis that hunger (but not time of day) will influence the predictions of busy participants, and that time of day (but not hunger) will influence the predictions of nonbusy participants. As Table 1 shows, this contrast was highly reliable, $F(1, 49) = 12.3$, $p < .0029$, and the residual between-groups variability was nonsignificant, $F(6, 49) = 1.12$, $p = .36$.

In summary, the results of Study 1 are consistent with the suggestion that both busy and nonbusy participants used their hedonic reactions to a mental image of spaghetti to make preliminary predictions about how much they would enjoy eating it the next day—despite the fact that their hedonic reactions were in part a function of their current and temporary level of hunger. Nonbusy participants then used what they knew about the time at which the spaghetti was to be eaten to correct their preliminary predictions, and thus came to realize that they would enjoy the spaghetti more the next evening than the next morning. Busy participants, on the other hand, could not use what they knew about the time at which the spaghetti was to be eaten to correct their preliminary predictions, and thus continued to expect that they would enjoy the spaghetti more if they were hungry at the time they made the prediction.

TABLE 1

Participants' Forecasts in Study 1

	Busy		Not busy	
	Hungry	Not hungry	Hungry	Not hungry
Time of day				
Morning				
Mean (*SD*)	7.8 (1.3)	5.1 (1.7)	5.4 (1.9)	4.0 (2.0)
Contrast weight	+1	−1	−1	−1
N	5	9	9	5
Evening				
Mean (*SD*)	7.3 (1.4)	6.5 (1.9)	6.0 (2.8)	7.3 (1.5)
Contrast weight	+1	−1	+1	+1
N	11	4	2	12

Note. Larger values indicate greater predicted enjoyment.

STUDY 2

Study 2 was an attempt to examine our hypothesis in a consequential, real-world setting, and it differed from Study 1 in two important ways. First, in Study 1 we asked participants to make verbal predictions. However, verbalizing one's predictions can sometimes influence the nature of those predictions (Sherman, 1980; Wilson & Klaaren, 1992), and thus in Study 2 we covertly measured behaviors that were based on hedonic predictions rather than explicitly measuring the predictions themselves. Second, whereas in Study 1 we created a situation in which people were naturally *likely* to consider an event's temporal location and then *decreased* that likelihood with an experimental manipulation that diminished the cognitive resources that some participants could devote to the task, in Study 2 we created a situation in which people were naturally *unlikely* to consider an event's temporal location and then *increased* the likelihood that some participants would do so with an experimental manipulation that increased the availability of temporal information. We did all this by conducting a field experiment at a local grocery store. We reasoned that when people come to a grocery store without a shopping list, they normally browse items and try to determine how much they will enjoy eating them in the future. As such, their purchases may be regarded as a rough behavioral index of their predicted hedonic reactions. Of course, people buy food items for many other reasons as well ("Bok choy is good for me" or "My kids have been asking for doughnuts"), but it seemed reasonable to assume that at least *some* portion of people's grocery purchases are predicated on their beliefs about the foods they will enjoy eating in the coming days.

We manipulated two independent variables. First, we manipulated shoppers' *proxy reactions* by sating some shoppers before they shopped. We assumed (as in Study 1) that hungry shoppers would experience more positive hedonic reactions to the mental image of food than would sated shoppers. Second, we manipulated *temporal correction* by asking shoppers to list the items they intended to buy for the coming week, and then nonchalantly giving some of them a copy of that list while they shopped. Grocery lists often provide information about the timing of future food consumption ("The salami is for my bag lunches" or "The artichokes go with the salmon I'm grilling on Friday;" Block & Morwitz, 1999). We reasoned that shoppers who had grocery lists would use the temporal information contained therein to correct their preliminary predictions ("The tuna looks great, but I won't want it one day after eating salmon") and would thus refrain from purchasing items that might be appealing in the present but that their list suggested would not be appealing in the future. In other words, we expected only those shoppers who were hungry *and* who did not have a list to buy more items than they had originally intended.

We were well aware that (a) purchases are predicated on factors other than hedonic forecasts, and (b) grocery lists do not always contain temporal information. But these real-world complexities merely suggested that our manipulations might be too weak to create the predicted effects and that our measure might be too noisy to detect them.[3] Importantly, they did not provide an alternative explanation for the predicted effects.

Method

Participants. Participants were 51 males and 84 females who volunteered to participate as they entered a grocery store.

Procedure. A female experimenter was positioned behind a table outside the entrance to a grocery store. A sign on the table read “Taste Test and Survey Study.” When shoppers approached the table, they were invited to participate in “a study of food preferences, as well as shopping preferences and patterns.” Interested shoppers were asked to answer a few questions, including “What is your zip code?” and “Did you bring a grocery list?” Shoppers who indicated that they had a grocery list were told that the experimenter had already collected enough data from people who lived in their zip code area and were thus ineligible to participate.

Eligible shoppers completed a questionnaire that asked them (among other things) to list the items they intended to purchase that day. After doing so, shoppers who were assigned to the *lisftul* condition were nonchalantly given a copy of their list, and shoppers who were assigned to the *listless* condition were not.[4] Next, shoppers were assigned to the *hungry* condition or the *sated* condition. Shoppers in the sated condition were asked to eat a muffin (approximately 100 g) and rate its appeal before they shopped. After they did so, they were asked to stop by the experimenter’s table when they finished shopping to complete a brief questionnaire. Shoppers in the hungry condition ate nothing and were asked to stop by the experimenter’s table when they finished shopping, at which time they would be asked to taste and rate a food item.

When shoppers exited the grocery store, they were asked to indicate (a) their current level of hunger on a 7-point scale, and (b) whether they had used a list while shopping. With the shopper’s and the store’s permission, the experimenter either photocopied the shopper’s receipt or recorded a code number from the receipt that was later used by the store to help the experimenter determine the items the shopper had purchased.

Results

Excluded data. Of the 135 shoppers, 10 did not return to the experimenter’s table, 10 did not have receipts for their purchases, and 4 failed to complete one or more critical measures. These 24 shoppers were distributed evenly across conditions, χ^2 $(1, N = 24) = 2.0$, $p > .15$, and their data were excluded

[3] This may be why some previous research has failed to find any effect of shoppers’ current hunger on grocery purchases (Mela, Aaron, & Gatenby, 1997).

[4] We collected data during morning and afternoon sessions on each day of the week. To keep shoppers from detecting our manipulations, we assigned all shoppers in a single session to the same randomly chosen experimental condition. Data for each condition were collected on at least 3 different days of the week.

from all analyses, leaving 44 males and 67 females who ranged in age from 12 to 80 years ($M = 40$ years) in the data set.

Manipulation checks. Shoppers' self-reports of hunger were submitted to a 2 (hunger: hungry or sated) × 2 (list: listful or listless) analysis of variance (ANOVA), which revealed only the predicted main effect of hunger, $F(1, 107) = 4.1$, $p < .05$, such that hungry shoppers reported being hungrier ($M = 3.6$) than did sated shoppers ($M = 2.8$) after they exited the store. Shoppers' reports of their use of a grocery list were submitted to a 2 (report: did use list or did not use list) × 2 (hunger: hungry or sated) × 2 (list: listful or listless) log-linear analysis, which revealed an effect of report, $Z = 3.8$, $p < .001$, such that shoppers were more likely to report that they did not use a list than that they did, as well as the predicted effect of list. Whereas 51% of listful shoppers reported using a list, no listless shoppers reported doing so, $Z = 3.9$, $p < .001$

Unplanned purchases. A judge who was blind to the shopper's experimental condition coded each item that the shopper had purchased as *planned* or *unplanned*. If a shopper listed a category such as "vegetables," then any vegetable was considered to be a planned item. However, if the shopper listed a specific item such as "carrots," then other vegetables were considered to be unplanned items. Cosmetics, kitchenware, and other inedible items were excluded. The number of unplanned food items was divided by the total number of items purchased to produce a proportion of unplanned food items, and this index was submitted to analysis, which revealed that the hunger manipulation affected only listless shoppers. Listless shoppers purchased a larger proportion of unplanned food items when they were hungry (51%) than when they were sated (34%), $F(1, 109) = 5.8$, $p < .02$, but listful shoppers purchased the same proportion of unplanned food items when they were hungry (36%) and when they were sated (28%), $F(1, 109) = 1.2$, $p = .27$. A weighted contrast analysis showed that the mean in the hungry/listless condition was significantly greater than the other three, $F(1, 107) = 10.0$, $p = .002$; residual between-groups variability, $F(2, 107) < 1$, $p = .52$

We also calculated the proportion of each shopper's total expenditure that had been devoted to unplanned food items. Analysis of this index revealed that listless shoppers spent a larger proportion of their total dollars on unplanned food items when they were hungry (49%) than when they were sated (30%), $F(1, 109) = 6.2$, $p < .02$. However, listful shoppers spent the same proportion of their total dollars on unplanned food items when they were hungry (36%) and when they were sated (29%), $F = .86$, $p = .36$. A weighted contrast analysis showed that the mean in the hungry/listless condition was once again significantly greater than that in the other three, $t(107) = 2.8$, $p = .006$; residual between-groups variability, $t(107) = .71$, $p = .60$

Internal analyses. Almost half the shoppers in the listful condition indicated that they had not used the list when shopping. These shoppers may have been functionally listless and their inclusion in the listful condition may therefore have influenced the previous analyses. We reclassified shoppers according to their own claims and the pattern of results was unchanged. Self-proclaimed listless shoppers purchased a larger proportion of unplanned items when they were hungry (49%) than when they were sated (33%), $F(1, 109) = 6.9$, $p < .01$, but self-proclaimed listful shoppers purchased the same proportion of unplanned items when they were hungry (32%) as when they were sated (24%), $F(1, 109) < 1$, $p = .64$. A weighted contrast analysis showed that the mean in the hungry/listless condition was significantly greater than that in the other three, $F(1, 107) = 11.5$, $p = .001$; residual between-groups variability, $F(2, 107) < 1$, $p = .63$. In addition, self-proclaimed listless shoppers spent a larger proportion of their dollars on unplanned food items when they were hungry (48%) than when they were sated (29%), $F(1, 109) = 8.7$, $p < .004$. However, self-proclaimed listful shoppers spent the same proportion of their dollars on unplanned food items when they were hungry (32%) as when they were sated (32%), $F(1, 109) = .02$, $p = .88$. A weighted contrast analysis showed that the mean in the hungry/listless condition was significantly greater than that in the other three, $t(107) = 2.8$, $p < .008$; residual between-groups variability, $t(107) = .10$, $p = .91$

GENERAL DISCUSSION

It is difficult to know just how much one will love a marriage partner, be engaged by a new job, or grieve over a dead parent, because each of these is a complex event whose details cannot easily be anticipated. When the future is uncertain, predictions about hedonic reactions to the future are understandably inexact. On the other hand, there are few things about a bite of spaghetti tomorrow that one cannot in principle know today, and thus we might expect people to predict with exceptional accuracy how they will feel about such an event when it happens. The foregoing studies suggest that in some instances, people imagine future events without reference to the time at which they are scheduled to happen, and use their hedonic reactions to these images as proxies for their future reactions. If they consider the temporal location of the event at all, they seem to do so subsequently and effortfully. As such, their temporal corrections are, in some circumstances, insufficient.

The ability to project oneself forward in time is one of our most important and uniquely human capacities, but research shows that people often have trouble with such “mental time travel” (Wheeler, Stuss, & Tulving, 1997), and that this trouble usually takes the form of not traveling far enough. For example, research on *empathy gaps* and *projection bias* suggests that people who are in one psychological state (e.g., unaroused or bored) have considerable difficulty predicting how they will think, feel, and act when they are in the opposite psychological state (e.g., aroused or curious), and that they tend mistakenly to predict that they will feel later as they feel now (Loewenstein, 1996; Loewenstein et al., 2000; Loewenstein, Prelec, & Shatto, 1998). Research on *immune neglect* indicates that people who have not rationalized a negative outcome have difficulty predicting how they will feel once they have done so, and that they tend to predict that they will feel later as they would feel now

(Gilbert et al., 1998). Research on *diversification bias* suggests that people have trouble predicting how much they will enjoy variety among hedonic experiences that are distributed over time (Ariely & Levav, 2000; Ratner, Kahn, & Kahneman, 1999; Simonson, 1990) and that they mistakenly predict that they will enjoy the amount of variety among temporally distributed future experiences (e.g., a snack eaten every Monday for 5 weeks) that they would enjoy among current experiences (e.g., five snacks eaten now; Read & Loewenstein, 1995). Why do people display such a robust *presentism*—that is, a tendency to overestimate the extent to which their future experience of an event will resemble their current experience of the same event? Our research suggests that one reason may be that people sometimes consider the temporal location of events only after they have first imagined the events happening in the present, and because correction is often insufficient, predictions of future states are strongly anchored on present states.

This tendency will bias forecasts in some instances, but surprisingly, it may debias them in others. Economists and psychologists have amassed considerable evidence to suggest that people are notoriously shortsighted and that they undervalue the future far more than a rational analysis suggests they should (Ainslie, 1992; Laibson et al., 1998; Loewenstein & Prelec, 1992; Loewenstein & Thaler, 1989). People smoke, gamble, and fail to save for retirement in part because they value future health and wealth less than current pleasures. One possibility is that people do not use mental images to make these sorts of predictions. Young smokers, for example, are probably not inclined to imagine their reactions to emphysema at age 70 by first generating a mental image of themselves sputtering and wheezing, experiencing their reaction to that image, and then correcting for time. One way to combat shortsightedness, then, may be to encourage people to represent future events as though they were happening in the present ("Imagine learning you have emphysema") and to then adjust for the event's actual temporal location ("How would your reaction change if you learned it in 50 years?"). If people were to consider the temporal location of a far future event only after reacting to its atemporal representation, shortsightedness might be ameliorated or reduced. Indeed, Ebert (2001) has recently discovered that the tendency to discount the value of far future events relative to near future events is greatly reduced when people make their valuations under cognitive load—a finding that fits quite nicely with our theorizing and our results.

The present studies provide some useful suggestions about the psychological processes underlying predictions of future hedonic reactions, but it is important to note their limitations. First, both of our studies focused on people's predicted reactions to food and both used hunger as a means of estimating people's proxy reactions to mental images of food. Hunger may have other effects, of course, and it remains to be seen whether the present results generalize to stimuli that are less biologically fundamental, such as promotions, divorces, and financial windfalls. Second, while our findings are consistent with the notion of atemporal representation and temporal correction, the studies contained no direct measures of cognitive process and hence do not preclude other information-processing accounts. The correction account has been useful in many domains (Gilbert & Gill, 2000), and often explains data that other accounts cannot (e.g., Gilbert, Giesler, & Morris, 1995; Keysar, Barr, Balin, & Brauner, 2000), but future research must determine whether it is the best account of forecasting phenomena. What our studies clearly show is that the temporal location of a particular kind of event is less likely to influence people's forecasts when that information is less available or more difficult to use, and that the effects demonstrated in the hothouse of the laboratory have measurable consequences in the real world.

REFERENCES

Ainslie, G. (1992). *Picoeconomics: The strategic interaction of successive motivational states within the person.* Cambridge: Cambridge Univ. Press.

Ariely, D., & Levav, J. (2000). Sequential choice in group settings: Taking the road less traveled and less enjoyed. *Journal of Consumer Research,* **27,** 279–290.

Bechara, A., Tranel, D., Damasio, H., & Damasio, A. R. (1996). Failure to respond automatically to anticipated future outcomes following damage to prefrontal cortex. *Cerebral Cortex,* **6,** 215–225.

Birch, L. L., Billman, J., & Richards, S. S. (1984). Time of day influences food acceptability. *Appetite,* **5,** 109–116.

Bjoerkman, M. (1984). Decision making, risk taking and psychological time: Review of empirical findings and psychological theory. *Scandinavian Journal of Psychology,* **25,** 31–49.

Block, L. G., & Morwitz, V. G. (1999). Shopping lists as an external memory aid for grocery shopping: Influences on list writing and list fulfillment. *Journal of Consumer Psychology,* **8,** 343–375.

Buehler, R., & McFarland, C. (in press). Intensity bias in affective forecasting: The role of temporal focus. *Personality and Social Psychology Bulletin.*

Ebert, J. E. J. (2001). The role of cognitive resources in the valuation of near and far future exports. *Acta Psychologica,* **108,** 155–171.

Fingerman, K. L., & Perlmutter, M. (1995). Future time perspective and life events across adulthood. *Journal of General Psychology,* **122,** 95–111.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making,* **13,** 1–17.

Frederick, S., & Loewenstein, G. F. (1999). Hedonic adaptation. In D. Kahneman, E. Diener, & N. Schwartz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 302–329). New York: Russell Sage Foundation.

Friedman, W. J. (1993). Memory for the time of past events. *Psychological Bulletin,* **113,** 44–66.

Friedman, W. J. (2000). The development of children's knowledge of the times of future events. *Child Development,* **71,** 913–932.

Gilbert, D. T. (1991). How mental systems believe. *American Psychologist,* **46,** 107–119.

Gilbert, D. T. (in press). Inferential correction. In T. Gilovich, D. W. Griffin, & D. Kahneman (Eds.), *The psychology of judgment: Heuristics and biases.* Cambridge: Cambridge Univ. Press.

Gilbert, D. T., Brown, R. P., Pinel, E. C., & Wilson, T. D. (2000). The illusion of external agency. *Journal of Personality and Social Psychology,* **79,** 690–700.

Gilbert, D. T., Giesler, R. B., & Morris, K. A. (1995). When comparisons arise. *Journal of Personality and Social Psychology,* **69,** 227–336.

Gilbert, D. T., & Gill, M. J. (2000). The momentary realist. *Psychological Science,* **11,** 394–398.

Gilbert, D. T., Pinel, E. C., Wilson, T. D., Blumberg, S. J., & Wheatley, T. P. (1998). Immune neglect: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology,* **75,** 617–638.

Gilbert, D. T., & Silvera, D. S. (1996). Overhelping. *Journal of Personality and Social Psychology,* **70,** 678–690.

Hoch, S. J., & Schkade, D. A. (1996). A psychological approach to decision support systems. *Management Science,* **42,** 51–64.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice-Hall.

Kahneman, D. (1994). New challenges to the rationality assumption. *Journal of Institutional and Theoretical Economics,* **150,** 18–36.

Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review,* **93,** 136–153.

Kahneman, D., & Snell, J. (1990). Predicting utility. In R. Hogarth (Ed.), *Insights in decision making.* Chicago: Univ. of Chicago Press.

Kahneman, D., & Snell, J. (1992). Predicting a change in taste: Do people know what they will like? *Journal of Behavioral Decision Making,* **5,** 187–200.

Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty* (pp. 201–208). Cambridge: Cambridge Univ. Press.

Keysar, B., Barr, D. J., Balin, J. A., & Brauner, J. S. (2000). Taking perspective in conversation: The role of mutual knowledge in comprehension. *Psychological Science,* **11,** 32–38.

Kosslyn, S. M., Pascual-Leone, A., Felician, O., Camposano, S., Keenan, J. P., Thompson, W. L., Ganis, G., Sukel, K. E., & Alpert, N. M. (1999). The role of area 17 in visual imagery: Convergent evidence from PET and rTMS. *Science,* **284,** 167–170.

Kramer, F. M., Rock, K., & Engell, D. (1992). Effects of time of day and appropriateness on food intake and hedonic ratings at morning and midday. *Appetite,* **18,** 1–13.

Laibson, D., Repetto, A., & Tobacman, J. (1998). Self-control and saving for retirement. *Brookings Papers on Economic Activity,* **1,** 91–196.

Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology,* **75,** 5–18.

Loewenstein, G. F. (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes,* **65,** 272–292.

Loewenstein, G. F., & Adler, D. (1995). A bias in the prediction of tastes. *Economic Journal,* **105,** 929–937.

Loewenstein, G. F., & Elster, J. (1992). *Choice over time.* New York: Russell Sage Foundation.

Loewenstein, G. F., & Frederick, S. (1997). Predicting reactions to environmental change. In M. H. Bazerman, D. M. Messick, A. E. Tenbrusel, & K. A. Wade-Benzoni (Eds.), *Environment, ethics, and behavior* (pp. 52–72). San Francisco: New Lexington.

Loewenstein, G. F., O'Donoghue, T., & Rabin, M. (2000). *Projection bias in predicting future utility.* Unpublished manuscript, Carnegie–Mellon University.

Loewenstein, G. F., & Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *Quarterly Journal of Economics,* **57,** 573–598.

Loewenstein, G. F., Prelec, D., & Shatto, C. (1998). *Hot/cold intrapersonal empathy gaps and the under-prediction of curiosity.* Unpublished manuscript, Carnegie–Mellon University.

Loewenstein, G. F., & Schkade, D. (1999). Wouldn't it be nice?: Predicting future feelings. In D. Kahneman, E. Diener, & N. Schwartz (Eds.), *Well-being: The foundations of hedonic psychology* (pp. 85–105). New York: Russell Sage Foundation Press.

Loewenstein, G. F., & Thaler, R. (1989). Anomalies: Intertemporal choice. *Journal of Economic Perspectives,* **3,** 181–193.

Lozano, D. I., Crites, S. L. J., & Aikman, S. N. (1999). Changes in food attitudes as a function of hunger. *Appetite,* **32,** 207–218.

McGuire, P. K., Shah, G. M. S., & Murray, R. M. (1993). Increased blood flow in Broca's area during auditory hallucinations in schizophrenia. *Lancet,* **342,** 703–706.

Mela, D. J., Aaron, J. I., & Gatenby, S. J. (1997). Relationships of consumer characteristics and food deprivation to food purchasing behavior. *Physiology and Behavior,* **60,** 1331–1335.

Mellers, B. A., Schwartz, A., & Ritov, I. (1999). Emotion-based choice. *Journal of Experimental Psychology: General,* **128,** 332–345.

Mischel, W., Cantor, N., & Feldman, S. (1996). Principles of self-regulation: The nature of willpower and self-control. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 329–360). New York: Guilford.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science,* **244,** 933–938.

Mitchell, T. R., Thompson, L., Peterson, E., & Cronk, R. (1997). Temporal adjustments in the evaluation of events: The "rosy view". *Journal of Experimental Social Psychology,* **33,** 421–448.

Rachman, S. (1994). The overprediction of fear: A review. *Behavior Research and Therapy,* **32,** 683–690.

Ratner, R. K., Kahn, B. E., & Kahneman, D. (1999). Choosing less-preferred experiences for the sake of variety. *Journal of Consumer Research,* **26,** 1–15.

Read, D., & van Leeuwen, B. (1998). Predicting hunger: The effects of appetite and delay on choice. *Organizational Behavior and Human Decision Processes,* **76,** 189–205.

Sanna, L. J. (2000). Mental simulation, affect, and personality: A conceptual framework. *Current Directions in Psychological Science,* **9,** 168–173.

Schwarz, N. (1990). Feelings as information: Informational and motivational functions of affective states. In E. T. Higgins & R. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (Vol. 2., pp. 527–561). New York: Guilford Press.

Shepperd, J. A., Ouellette, J. A., & Fernandez, J. K. (1996). Abandoning unrealistic optimism: Performance estimates and the temporal proximity of self-relevant feedback. *Journal of Personality and Social Psychology,* **70,** 844–855.

Sherman, S. J. (1980). On the self-erasing nature of errors of prediction. *Journal of Personality and Social Psychology,* **39,** 211–221.

Simonson, I. (1990). The effect of purchase quantity and timing on variety-seeking behavior. *Journal of Marketing Research,* **27,** 150–162.

Snell, J., Gibbs, B. J., & Varey, C. (1995). Intuitive hedonics: Consumer beliefs about the dynamics of liking. *Journal of Consumer Psychology,* **4,** 33–60.

Taylor, S. E., Pham, L. B., Rivkin, I. D., & Armor, D. A. (1998). Harnessing the imagination: Mental simulation, self-regulation, and coping. *American Psychologist,* **53,** 429–439.

Trope, Y., & Liberman, N. (2000). Temporal construal and time-dependent changes in preference. *Journal of Personality and Social Psychology,* **79,** 876–889.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science,* **185,** 1124–1131.

Wegner, D. M., & Bargh, J. A. (1998). Automaticity and mental control. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., pp. 446–496). New York: McGraw-Hill.

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a general theory of episodic memory: The frontal lobes and autonoetic consciousness. *Psychological Bulletin,* **121,** 331–354.

Wilson, T. D., & Brekke, N. (1994). Mental contamination and mental correction: Unwanted influences on judgments and evaluations. *Psychological Bulletin,* **116,** 117–142.

Wilson, T. D., & Klaaren, K. (1992). The role of affective expectations in affective experience. In M. S. Clark (Ed.), *Review of personality and social psychology: Emotion and social behavior* (Vol. 14, pp. 1–31). Newbury Park, CA: Sage.

Wilson, T. D., Wheatley, T., Meyers, J., Gilbert, D. T., & Axsom, D. (2000). Focalism: A source of durability bias in affective forecasting. *Journal of Personality and Social Psychology,* **78,** 821–836.

Received August 15, 2001; published online April 25, 2002