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## Reports

Future anhedonia and time discounting<sup>☆</sup>Karim S. Kassam<sup>a</sup>, Daniel T. Gilbert<sup>a,\*</sup>, Andrew Boston<sup>a</sup>, Timothy D. Wilson<sup>b</sup><sup>a</sup> Department of Psychology, Harvard University, William James Hall, 33 Kirkland Street, Cambridge, MA 02138, USA<sup>b</sup> Department of Psychology, University of Virginia, 102 Gilmer Hall, P. O. Box 400400, Charlottesville, VA 22904-4400, USA

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## ABSTRACT

The temporal location of an event influences the way people mentally represent that event. We suggest (a) that such representational differences can produce an affective forecasting error that we call *future anhedonia*, which is the belief that hedonic states will be less intense in the future than in the present, and (b) that future anhedonia plays a role in time discounting (i.e., the tendency to place a smaller present value on present events than on future events). Experiments 1a and 1b demonstrated that people are prone to future anhedonia, Experiments 2a and 2b ruled out artifactual alternatives, and Experiments 3a and 3b demonstrated that future anhedonia plays a role in time discounting. These studies suggest that one reason why people prefer to enjoy benefits in the present and pay costs in the future is that they do not realize how they will feel when those costs and benefits are actually experienced.

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"I'd gladly pay you Tuesday for a hamburger today."

J. Wellington Wimpy

Sooner or later, most people take advantage of themselves. They eat fattening desserts, engage in unprotected sex, use credit cards to finance exotic vacations, take out home equity loans to buy luxury goods, let work pile up while they surf the web—and they enjoy these pleasures knowing full well that they their future selves will have to pay for them. Time discounting is the tendency to put a higher present value on events that will happen in the present than on events that will happen in the future, and numerous studies have found evidence for a "pervasive devaluation of the future" (Ainslie & Haslam, 1992, p. 59). The standard account of this phenomenon suggests that people *know* how miserable they will be when it comes time to pay for their present indulgences, but that they are unwilling or unable to give this knowledge the weight it deserves (Ainslie & Haslam, 1992; Berns, Laibson, & Loewenstein, 2007; Frederick, Loewenstein, & O'Donoghue, 2003; McClure, Laibson, Loewenstein, & Cohen, 2004; Mischel, Shoda, & Rodriguez, 1989; Soman et al., 2005).

We suggest that, in fact, people may *not* know how they will feel when the future arrives. A growing body of work suggests that the temporal location of an event influences the way that event is mentally represented. Representations of present and

future events are not like two photographs with different time stamps, but rather, they are like two photographs taken from different angles with different lenses and different settings (Caruso, Gilbert, & Wilson, in press; McClure et al., 2004; Schacter, Addis, & Buckner, 2007; Trope & Liberman, 2003; Van Boven & Ashworth, 2007). Specifically, representations of future events tend to include central, abstract, and general features of the event whereas representations of present events tend to include peripheral, concrete, and specific features of the event (Trope & Liberman, 2003). As a result of these differences, representations of future events tend to evoke less intense affect than do representations of present events (McClure et al., 2004). Because people often use the affect they feel as they are imagining a future event to predict how they will feel when they experience that event (Gilbert & Wilson, 2007), they may mistakenly believe that they will experience less intense affect when an event happens in the future than when the same event happens in the present. We refer to this belief as *future anhedonia*.

If future anhedonia exists, it may provide a very different solution to the puzzle of time discounting. Why do people so often accelerate benefits so they can experience them in the present and delay costs so they can pay them in the future? It is typically assumed that people know how they will feel when it comes time to pay costs in the future but that for many reasons they underweight this knowledge. But if people mistakenly believe that their future feelings will be less intense than their present feelings, then time discounting may actually reflect their attempt to maximize benefits by enjoying them at their hedonic zenith (the present) and minimize costs by paying them at their hedonic nadir (the future). If a person mistakenly believed that eating a hamburger would be more pleasurable today than next

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Tuesday, or that paying for a hamburger would be less painful next Tuesday than it would be today, then he or she might be inclined to acquire the hamburger on credit today (when its hedonic benefits are high) and pay for it next Tuesday (when its hedonic costs are low). What would appear to an observer to be a reckless disregard for future feelings might actually be a simple inability to predict them.<sup>1</sup>

In Experiments 1a and 1b we sought to determine whether people do, in fact, expect their affective reactions to an event to be less intense in the future than in the present. In Experiments 2a and 2b we explored alternative explanations of this phenomenon. In Experiments 3a and 3b we sought to determine whether this phenomenon plays a role in time discounting.

## Experiments 1a–1b: demonstrating future anhedonia

### Experiment 1a

We asked participants to estimate their present reaction to a present event and their future reaction to a future event.

#### Methods

In a between-participants design, 34 women and 25 men ( $M_{\text{age}} = 19.6$ ,  $SD = 1.52$ ) were asked “If you were given 20 dollars right now, how happy would you be?” or “If you were given 20 dollars 3 months from now, how happy would you be at that time?” They made estimates on a 9-point scale anchored at the endpoints with the phrases *not at all happy* and *extremely happy*.

#### Results

Participants demonstrated future anhedonia. They predicted that they would be happier upon receiving \$20 in the present ( $M = 7.11$ ,  $SD = 1.47$ ) than upon receiving \$20 in the future ( $M = 5.84$ ,  $SD = 1.63$ ),  $t(57) = 3.12$ ,  $p < .01$ .

### Experiment 1b

We sought to determine whether a standard economic measure of value–willingness to pay–would also reveal future anhedonia.

#### Methods

In a within-participants design, 32 women and 33 men ( $M_{\text{age}} = 29.62$ ,  $SD = 14.38$ ) read two scenarios. The *present event* scenario asked participants to predict their reactions to a present event on the same scale used in Experiment 1a (“Imagine that as a promotion, Starbucks® is going to give away several thousand \$25 gift cards today. How happy would you be if someone gave this to you today?”) and also to estimate their willingness to pay (“Another option Starbucks® is considering is to sell the gift cards at a discounted price. Today, what is the maximum amount you would be willing to pay for this gift card?”). The *future event* scenario asked participants to predict their reactions to a future event (“Imagine that as a promotion, Starbucks® is going to give away several thousand \$25 gift cards three months from now. How happy would you be if someone gave this to you three months from now?”) and also to estimate their willingness to pay (“Another option Starbucks® is considering is to sell the gift cards at a dis-

counted price. Three months from now, what is the maximum amount you would be willing to pay for this gift card?”).

#### Results

Participants displayed future anhedonia on both measures. They predicted that they would be happier upon receiving a gift card in the present ( $M = 6.68$ ,  $SD = 1.92$ ) than in the future ( $M = 5.78$ ,  $SD = 2.04$ ),  $t(64) = 4.44$ ,  $p < .001$ , and they predicted that they would pay more for the gift card in the present ( $M = \$12.15$ ,  $SD = 8.02$ ) than they would pay for it in the future ( $M = \$11.48$ ,  $SD = 7.99$ ),  $t(64) = 2.38$ ,  $p < .05$ .

## Experiments 2a and 2b: ruling out artifacts

### Experiment 2a

An artifactual explanation for the results of Experiments 1a and 1b is that participants were confused and that they predicted their *present* reaction to a future event when they were asked to predict their *future* reaction to a future event. In Experiment 2a we asked participants to predict their present reaction to a present event and then to predict either (a) their present reaction to a future event (the *present reaction* condition) or (b) their future reaction to a future event (the *future reaction* condition). We reasoned that if participants were mistaking the latter question for the former question, then the two conditions should produce equivalent estimates. If, on the other hand, participants understood the questions as we intended, then they should predict more intense reactions in the future reaction condition than in the present reaction condition.

#### Methods

In a between-participants design, 71 women, 48 men, and two people who did not report their gender ( $M_{\text{age}} = 19.95$ ,  $SD = 1.02$ ), responded to two questions. Participants in the *present reaction* condition first predicted their present reaction to a present event (“If you were to receive \$20 right now, how happy would you be at this moment?”) and then predicted their present reaction to a future event (“If you were to receive \$20 dollars three months from now, how happy would you be right now about this future moment?”). Participants in the *future reaction* condition first predicted their present reaction to a present event (“If you were to receive \$20 right now, how happy would you be at this moment?”) and then predicted their future reaction to a future event (“If you were to receive \$20 dollars three months from now, how happy would you be in three months when you received those \$20?”). Participants made these predictions on a nine-point scale anchored at the endpoints with the phrases *not at all happy* and *extremely happy*.

#### Results

Participants’ answers to the first question—that is, their predictions of their present reaction to a present event—were the same in the present reaction condition ( $M = 6.75$ ,  $SD = 1.64$ ) and the future reaction condition ( $M = 6.74$ ,  $SD = 1.38$ ),  $t < 1$ . However, participants’ answers to the second question—that is, their predictions of their present reactions to a future event or their future reactions to a future event—were different, indicating that they distinguished between them. Specifically, participants in the future reaction condition predicted that receiving \$20 in the future would make them feel happier in the future ( $M = 6.29$ ,  $SD = 1.63$ ) than participants in the present reaction condition predicted it would make them feel in the present ( $M = 4.94$ ,  $SD = 1.96$ ),  $t(119) = 4.11$ ,  $p < .01$ . Clearly, participants did not mistake a question about their future reaction to a future event for a question about their present

<sup>1</sup> It is worth noting that these predictions are fully consistent with our previous research on impact bias (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; Wilson, Wheatley, Meyers, Gilbert, & Axsom, 2000), which suggests that people expect future events to be more impactful than they actually are. If a person believes that receiving \$20 today will provide 3 units of happiness but that receiving it tomorrow will provide 2 units of happiness, and if receiving \$20 today actually provides 1 unit of happiness, then the person has displayed both future anhedonia ( $3 > 2$ ) and impact bias ( $2 > 1$ ).

reaction to a future event. It is also worth noting that participants in the future reaction condition displayed future anhedonia: they expected to be happier upon receiving \$20 in the present ( $M = 6.74$ ,  $SD = 1.38$ ) than upon receiving \$20 in the future ( $M = 6.29$ ,  $SD = 1.63$ ),  $t(69) = 3.57$ ,  $p = .001$ .

### Experiment 2b

Another artifactual explanation for the results of Experiments 1a and 1b is that participants believed that learning about a future event in the present meant that when the event happened they would have been expecting it, which could reduce the intensity of their reaction to it. In Experiment 2b, participants were explicitly instructed to assume that the present and future events were either expected or unexpected. We predicted that participants would display future anhedonia in both cases.

### Methods

In a between-participants design, 47 women and 27 men ( $M_{\text{age}} = 20.77$ ,  $SD = 1.47$ ) were randomly assigned to conditions. Participants in the *expected* condition were asked to predict their present reaction to an expected present event (“If you knew three months ago that you would receive \$20 in your mailbox today, how happy would you be today upon receiving those \$20?”) and their future reaction to an expected future event (“If you knew today that you would receive \$20 in your mailbox three months from now, how happy would you be when you received those \$20?”). Participants in the *unexpected* condition were asked to predict their present reaction to an unexpected present event (“If you unexpectedly received \$20 in your mailbox today, how happy would you be today?”) and their future reaction to an unexpected future event (“If you were to unexpectedly receive \$20 in your mailbox three months from now, how happy would you be at that time?”). Participants made these predictions on nine-point scales anchored at the endpoints with the phrases *not at all happy* and *extremely happy*.

### Results

Participants displayed future anhedonia in both conditions. They predicted that they would be happier upon receiving \$20 in the present than in the future when the money was expected ( $M_s = 7.10$  and  $6.38$ ,  $SD_s = 1.27$  and  $1.58$ ),  $t(38) = 4.61$ ,  $p < .001$ , and when the money was unexpected ( $M_s = 7.97$  and  $6.80$ ,  $SD_s = 0.82$  and  $1.32$ ),  $t(34) = 6.83$ ,  $p < .001$ .

## Experiments 3a–3b: time discounting

### Experiment 3a

The foregoing studies demonstrate that future anhedonia exists and is not the product of obvious artifacts. But does it play a role in time discounting? One of the most consistent findings to emerge from studies of time discounting is that the discount function is hyperbolic or quasi-hyperbolic (Ainslie & Haslam, 1992; Laibson, 1997; Mazur, 1987). In other words, the present value of an event decreases with its temporal distance from the present, but that decrease is not a linear. Rather, the present value of an event decreases rapidly in the near future and slowly in the far future, which is why people value an event much more when it will happen today than tomorrow but do not value an event much more when it will happen in 100 days than 101 days (Kirby & Herrnstein, 1995). If future anhedonia plays a role in time discounting, then people's predictions of future value should show a pattern similar to their reports of present value. In other words, people should expect their hedonic reactions to a future gain to decrease rapidly in the near future and slowly in the far future. Experiment 3a tested this prediction.

### Methods

In a between-participants design, 81 women and 90 men ( $M_{\text{age}} = 21.2$ ,  $SD = 4.73$ ) were asked one of six questions: “If you were given \$20 (right now, 1 day from now, 7 days from now, 30 days from now, 180 days from now, 365 days from now), how happy would you be when you received it?” Participants answered the question by drawing a slash through a 110 mm line anchored with the phrases *I would be no more happy than I normally am* and *I would become extremely happy*.

### Results

We fit a hyperbolic curve to the data by estimating the parameters of the function  $v = V / (1 + sD)$ , where  $v$  represents the affective value at a given delay,  $D$  represents the delay in days, and  $V$  and  $s$  are constants set by minimizing squared error (Jones & Rachlin, 2006). The resulting fit was significant  $r^2 = 0.73$ ,  $t(161) = 21.2$ ,  $p < 0.001$ , and the hyperbolic function described the data better than did the linear or exponential functions. As Fig. 1 shows, participants expected to experience 18.3 fewer units of happiness when they received \$20 in a year than when they received \$20 today, and they expected 43% of the annual decrease in happiness to occur in the first 24 h, 45% to occur in the first week, 58% to occur in the first month, and 82% to occur in the first six months. Remarkably, the difference between 0 and 1 days was nearly as large as the difference between 1 and 365 days. In short, people's predictions of the future value of events was described by the same function that describes their reports of the present value of those events.

### Experiment 3b

Experiment 3a showed that predictions of future value—like reports of present value—decrease much more rapidly in the near than the far future, which is precisely what one would expect if future anhedonia played a role in time discounting. In Experiment 3b, we explored this possibility directly. We asked participants to predict their present reactions to a present event and their future reactions to a future event. We also asked them to complete a

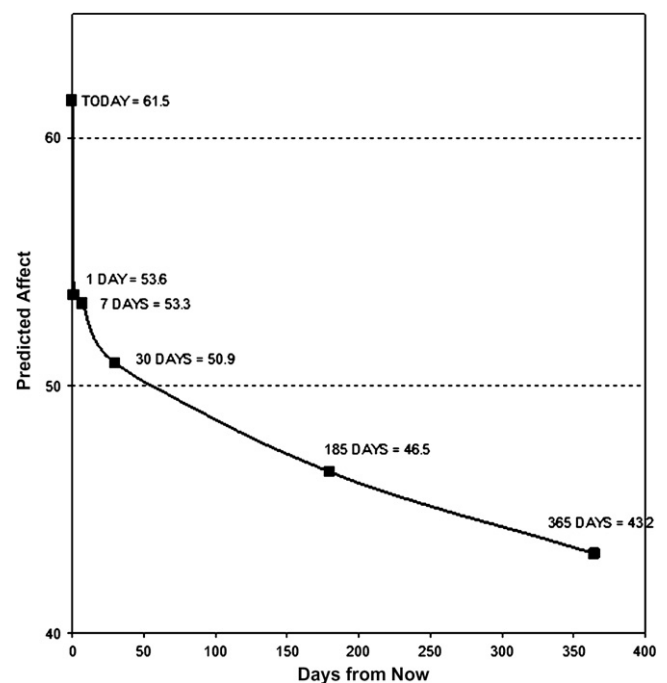


Fig. 1. Predicted affective reactions upon receiving \$20 at six points in time.

standard inter-temporal choice task in which they reported the present value of a present event and the present value of a future event. We expected the inter-temporal choice task to reveal time discounting and we expected that future anhedonia would play a measurable role in it.

### Methods

In a within-participants design, 11 men and 24 women ( $M_{\text{age}} = 27.32$ ,  $SD = 11.69$ ) were asked to complete a standard inter-temporal choice task. Participants were given a sheet of paper listing amounts of money ranging from \$20 to \$60 in \$5 increments. Participants were asked to place check marks next to all the amounts they would prefer to receive in a year rather than receiving \$20 today. Next, participants were asked questions to measure their future anhedonia as in Experiment 1a. Specifically, participants were asked “How happy would you be now if you were given \$20 now?” and “How happy would you be in one year if you were given \$20 dollars one year from now?” They made these estimates on a 9-point scale anchored at the endpoints with the phrases *not at all happy* and *extremely happy*.

### Results

Participants displayed future anhedonia. They predicted that they would be happier upon receiving \$20 in the present ( $M = 6.66$ ,  $SD = 1.94$ ) than upon receiving \$20 in the future ( $M = 6.26$ ,  $SD = 2.08$ ),  $t(34) = 2.23$ ,  $p < .05$ . We calculated for each participant a *future anhedonia index* which was defined as the difference between participants' predictions of their present reaction to a present event and their future reaction to a future event. The mean future anhedonia index was 0.4 ( $SD = 1.06$ ).

Analyses also revealed substantial time discounting on the inter-temporal choice task. We defined a participant's *future equivalent* as the amount of money that would make the participant indifferent to receiving that amount in the future or receiving \$20 in the present. The mean future equivalent was \$31.14 ( $SD = 10.17$ ), which means that participants required a premium of \$11.14 (i.e., an annual interest rate of 56%) to wait one year to receive \$20.

A regression analysis with future equivalent as the dependent measure yielded a significant effect of the future anhedonia index,  $r(35) = 0.36$ ,  $p < .05$ . The participants who were most likely to believe that they would be happier upon receiving \$20 in the present than upon receiving \$20 in the future were the participants who required the largest premiums in order to wait one year to receive \$20. The unstandardized coefficient,  $\beta = 3.39$ , indicates that each unit increase on the future anhedonia index was associated with a \$3.39 increase in the future equivalent. Without future anhedonia, then, the future equivalent would have been  $0.40 * \$3.39 = \$1.36$  less. In other words, future anhedonia accounted for  $\$1.36 \div \$11.14 = 12\%$  of the premium that participants required to wait one year.

### Discussion

In six studies, participants predicted that a monetary gain would bring them less happiness when it happened in the future than when it happened in the present. This future anhedonia was not a result of participants confusing predictions of their future hedonic reaction to a future event with predictions of their present hedonic reaction to a future event, and it was not the result of participants believing that foreknowledge of a future event would change their hedonic reaction to it. Participants' predictions of the future value of future events were described by the same function that described their present valuations of future events, and their predictions explained a portion of their valuations.

Our findings join a growing literature that emphasizes the importance of the mental representation of events in understanding time discounting (Berns et al., 2007; McClure et al., 2004; Soman et al., 2005), but it offers an important addendum to the account on which this literature relies. That account describes time discounting with the expression  $\beta\delta^t * u$  where  $u$  is the expected utility of an event (“How much pleasure do I expect to experience when the event happens?”) and  $\beta$  and  $\delta$  are weights (“How much weight should I give right now to that future pleasure?”). The account suggests that  $\delta$  is larger in the present than in the future (which is why it has the superscript  $t$  denoting the time period) and that  $u$  is constant over time. In other words, people behave indulgently in the present because they are unable or unwilling to give as much weight to future pleasures as to present pleasures, but they expect to derive the same amount of pleasure from a particular event regardless of when it happens. As Soman et al. (2005, p. 353) note, this account assumes that “utility from outcomes is timing independent” and therefore “ $u(x_1)$  is independent of when it occurs.”

Our studies do not challenge the claim that  $\delta$  is larger in the present than in the future, but they do suggest that the assumption about the time independence of  $u$  is wrong. Specifically, they suggest that  $u$  is generally larger in the present than in the future and that the correct description of time discounting is therefore  $\beta\delta^t * u(t)$ . As previous authors have suggested, people demand large premiums to delay pleasures because they weight today's pleasure more heavily than tomorrow's ( $\delta^t$ ); but as our studies show, people also demand large premiums to delay pleasures because they believe that today's pleasures will be greater than tomorrow's [ $u(t)$ ]. It is somewhat ironic that time discounting has so often been described as a form of “shortsightedness” or “myopia” when the expression  $\beta\delta^t * u$  implies that people underweight the future pleasures that they “envison” quite clearly. The standard account of temporal discounting suggests that there is something wrong with people's *decisions* about the future but nothing wrong with their *perceptions* of it. Our studies show that shortsighted perception is, in fact, one of the causes of time discounting. One reason why people appear to be so unconcerned about the future is that they mispredict how they will feel when it arrives.

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