

## Research Article

## A Wrinkle in Time

## Asymmetric Valuation of Past and Future Events

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**ABSTRACT**—A series of studies shows that people value future events more than equivalent events in the equidistant past. Whether people imagined being compensated or compensating others, they required and offered more compensation for events that would take place in the future than for identical events that had taken place in the past. This temporal value asymmetry (TVA) was robust in between-persons comparisons and absent in within-persons comparisons, which suggests that participants considered the TVA irrational. Contemplating future events produced greater affect than did contemplating past events, and this difference mediated the TVA. We suggest that the TVA, the gain-loss asymmetry, and hyperbolic time discounting can be unified in a three-dimensional value function that describes how people value gains and losses of different magnitudes at different moments in time.

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The Past is dead, and has no resurrection; but the Future is endowed with such a life, that it lives to us even in anticipation.

—Herman Melville (1850/1923, p. 143)

Many things determine how much a person will value a marriage proposal, a bite of chocolate, a root canal, or a tropical vacation, and one of them is the event's location in time. Extensive literatures on intertemporal choice (Ainslie, 1975; Loewenstein & Thaler, 1997), temporal construal (Trope & Liberman, 2003), delay of gratification (Mischel, Cantor, & Feldman, 1996), and time discounting (Herrnstein, 1997; McClure, Laibson, Loewenstein, & Cohen, 2004) suggest that the value of future events decreases with their temporal distance from the present. But not all judgments and decisions involve future events. When a manager tries to decide how much praise a hardworking employee deserves, or a jury tries to decide how

much compensation an accident victim deserves, each is attempting to determine the value of an event that has already happened. We suggest that the value of past events also decreases with their temporal distance from the present, but that it decreases more sharply than does the value of future events, thus creating a fundamental asymmetry—a “wrinkle in time,” so to speak—such that future events are valued more than equivalent events in the equidistant past (Parfit, 1984). We refer to this as the *temporal value asymmetry*, or TVA.

There are at least two reasons why people might rationally value future events more than past events. First, knowledge of the future is often less certain than knowledge of the past, and the TVA may reflect attempts to compensate for this fact. Jurors may award more money to an accident victim whose suffering is in the future simply because there is some possibility that this future suffering will be greater than anticipated. Second, valuations can change the future, but not the past. A monetary award to an accident victim cannot alleviate past suffering, but it may alleviate future suffering (e.g., by allowing the victim to purchase better medical care). In short, because the future is more uncertain and more changeable than the past, there are circumstances under which people may rationally value future events more than past ones.

We suspect, however, that the TVA occurs even when these rational considerations are moot. The primary function of affect is to prepare organisms for action, and thus affect tends to be aroused by those events that actions can influence (Frijda, 1988). Future events meet this criterion and past events do not, and research shows that people experience more intense affect when they contemplate future than past events (D'Argembeau & Linden, 2004; Van Boven & Ashworth, 2007). Because people often use their current affective states as information about the value of the events they are contemplating (Bechara & Damasio, 2005; Gilbert & Wilson, 2007; Loewenstein, O'Donoghue, & Rabin, 2003; Loewenstein, Weber, Hsee, & Welch, 2001; Schwarz, 1990; Van Boven & Loewenstein, 2003), they may value future events more than past events even when there is no rational reason to do so. Jurors may award an accident victim more money for future suffering than for past suffering not

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because they are uncertain about the duration of the victim's future suffering, and not because they believe that a large award would ameliorate it, but simply because they feel worse when they imagine suffering yet to come than when they imagine suffering now ended.

The studies reported here demonstrate (a) that people value events in the future more than equivalent events in the equidistant past, (b) that they do so even when they consider such valuations to be irrational, and (c) that they do so in part because the contemplation of future events produces greater affect than does the contemplation of past events.

## STUDY 1

### Method

One hundred twenty-one participants on the Harvard University campus were asked to imagine that they had agreed to spend 5 hr entering data into a computer and to indicate how much money it would be fair for them to receive. Some participants imagined that they had completed the work 1 month previously, and others imagined that they would complete the work 1 month in the future. Participants indicated (a) how difficult they thought the work would be (or was) and (b) how qualified they thought they were (or had been) to complete the work, using a pair of 7-point scales ranging from 0 (*not at all*) to 6 (*extremely*).

### Results and Discussion

Participants believed that they should receive 101% more money for work they would do 1 month later ( $M = \$125.04$ ) than for identical work that they had done 1 month previously ( $M = \$62.20$ ),  $t(119) = 2.22$ ,  $p = .03$ ,  $d = 0.41$ . This difference emerged despite the fact that participants did not (a) expect the work to be more difficult in the future than in the past ( $M_s = 1.70$  and  $1.83$ , respectively),  $t(113) = 0.46$ ,  $p = .65$ , or (b) believe they were more qualified to do the work in the future than in the past ( $M_s = 5.05$  and  $4.81$ , respectively),  $t(113) = 1.04$ ,  $p = .30$ .<sup>1</sup>

## STUDY 2

In Study 2, we investigated whether people value the future more than the past even when they believe it is irrational to do so. One way to determine whether people consider their valuations to be rational is to measure these valuations in both between- and within-persons designs (Hsee, Loewenstein, Blount, & Bazerman, 1999; Irwin, Slovic, Lichtenstein, & McClelland, 1993). For example, when people are asked to place a value on both the health of migrant farm workers and the health of endangered

animals, they provide higher values for the workers than for the animals; but when people are asked to place a value on just one of these, they provide higher values for the animals than for the workers (Kahneman & Ritov, 1994). This pattern of data suggests that people actually value animals more than farm workers (as revealed by the between-participants valuations) but consider these valuations to be irrational (as revealed by the within-participants valuations). Study 2 traded on this logic.

### Method

#### Study 2a

In Study 2a, 100 people on the Harvard University campus read two stories (in counterbalanced order) describing a woman who had been seriously injured by a drunk driver. In one story, participants learned that the accident had happened 6 months previously and that the woman had undergone 6 months of painful rehabilitation and was now fully recovered, and in the other story, they learned that the accident had just happened and that the woman's doctors were completely certain that she would be fully recovered after undergoing 6 months of painful rehabilitation. After reading each story, participants were told that the woman had sued the driver's insurance company, were asked to imagine that they were members of the jury that was hearing the case, and were instructed to award compensatory damages between \$0 and \$10 million, in increments of \$500,000.

#### Study 2b

In Study 2b, 97 people on the Harvard University campus read two stories (in counterbalanced order) asking them to imagine that a friend had offered to let them use his vacation home. In one story, participants imagined that they had just returned from a 1-week stay at the vacation home, and in the other story, they imagined that they were about to go to the vacation home and would return 1 week later. After reading each story, participants were shown descriptions of eight wines and asked to pick the most appropriate wine as a thank-you gift for their friend. The descriptions included the wines' prices, which ranged from \$10 to \$400. All participants were told to assume that their friend would not receive the wine until 1 week after they had returned from the vacation home; in this way, we ensured that they would not think that their wine choice might influence their friend (and thus influence their future vacation).

#### Study 2c

In Study 2c, 55 people at a train station in Boston read two stories (in counterbalanced order and in exchange for a candy bar) asking them to imagine that they had agreed to help a neighbor move out of his apartment. In one story, they were asked to imagine that moving day had been 1 week in the past, and in the other story, they were asked to imagine that moving day was 1 week in the future. After reading each story, participants were asked to imagine that, as a token of his appreciation,

<sup>1</sup>Degrees of freedom differ across measures in Studies 1, 3, and 5 because some participants failed to complete all questions.

the neighbor had given them a coupon that allowed them to go to a Web site and select a bottle of wine. Participants were shown the eight wine descriptions used in Study 2b and asked to choose one for themselves. To ensure that participants did not think that their wine choice might influence their neighbor (and thus influence their future experience), we told all participants to assume that they would not receive the wine until 1 week after moving day and that their neighbor would not know which bottle they had selected; in this way, we ensured that they would not think that their wine choice might influence their neighbor (and thus influence their future experience).

### Results and Discussion

We compared participants' responses to the first story they read (the between-persons analysis; see Table 1). Participants awarded an accident victim 42% more money when they imagined her suffering in the future than when they imagined her suffering in the past,  $t(98) = 2.02, p < .05, d = 0.41$ ; they gave a friend a bottle of wine that was 37% more expensive when they imagined using his vacation home in the future than when they imagined using it in the past,  $t(95) = 2.24, p = .03, d = 0.46$ ; and they chose for themselves a wine that was 71% more expensive when they imagined helping a neighbor move in the future than when they imagined helping him move in the past,  $t(53) = 2.05, p < .05, d = 0.56$ . We also compared participants' responses to the two stories they read (the within-persons analysis; see Table 1). There were no differences in Study 2a,  $F(1, 98) = 1.8, p = .18$ ; Study 2b,  $F(1, 95) = 0.23, p = .63$ ; or Study 2c,  $F(1, 53) = 0.45, p = .51$ .

In summary, between-person analyses showed that participants valued the future event more than the past event, but within-person analyses indicated that they valued the events equally. This pattern of results suggests that participants valued the future event more than the past event, but considered this asymmetry irrational.

**TABLE 1**  
*Valuations (in U.S. Dollars) of Past and Future Events in Studies 2a, 2b, and 2c*

Study	Order of valuation	
	Past event first	Future event first
Study 2a: jury-award story		
Past suffering	<b>2.50 (2.42)</b>	3.49 (2.81)
Future suffering	2.62 (2.69)	<b>3.55 (2.75)</b>
Study 2b: vacation-home story		
Past vacation	<b>89.17 (60.22)</b>	129.06 (86.66)
Future vacation	91.73 (76.57)	<b>121.98 (82.24)</b>
Study 2c: moving-day story		
Past move	<b>75.69 (78.06)</b>	120.86 (114.21)
Future move	73.77 (81.56)	<b>129.24 (110.74)</b>

**Note.** Standard deviations are in parentheses. The valuations for Study 2a are in millions of dollars. Bold entries indicate the values that constitute the between-persons comparisons.

### STUDY 3

The contemplation of future events evokes more intense affect than does the contemplation of past events (D'Argembeau & Linden, 2004; Van Boven & Ashworth, 2007). In Study 3, we sought to investigate whether this temporal asymmetry in affective experience mediates the TVA.

### Method

One hundred forty-eight participants on the Harvard University campus were asked to read either the past or the future version of the "moving day" story used in Study 2c. After choosing a bottle of wine, they were asked to imagine the events of moving day and to report how tired, stressed, and dreadful they felt "right now," using 7-point scales ranging from 0 (*not at all*) to 6 (*extremely*). Participants then used similar scales to indicate (a) how difficult they thought the work would be (or had been), (b) how long they thought the work would take (or had taken), and (c) how personally satisfying they thought the work would be (or had been).

### Results and Discussion

Participants who imagined helping their neighbor move in the future chose a bottle of wine that was 38% more expensive ( $M = \$162.24$ ) than the wine chosen by participants who imagined helping their neighbor move in the past ( $M = \$117.96$ ),  $t(119) = 2.23, p = .03, d = 0.41$ . This effect occurred despite the fact that participants did not expect the future and past work to differ in difficulty ( $M_s = 4.07$  and  $4.00$ , respectively), length ( $M_s = 4.25$  and  $4.31$ , respectively), or satisfaction ( $M_s = 3.63$  and  $3.75$ , respectively), all  $t_s < 1$ .

Why did this effect occur? Participants who contemplated a future moving day rather than a past moving day felt more tired ( $M_s = 3.65$  and  $2.70$ , respectively),  $t(137) = 3.03, p = .003, d = 0.52$ ; more stressed ( $M_s = 3.19$  and  $2.01$ , respectively),  $t(137) = 3.98, p < .001, d = 0.68$ ; and more dreadful ( $M_s = 2.62$  and  $1.51$ , respectively),  $t(137) = 3.77, p < .001, d = 0.64$ . Because these three measures were highly correlated ( $\alpha = .80$ ), we averaged them to create an index of negative affect. Using the method outlined by Baron and Kenny (1986), we sought to determine whether this index mediated the effect of temporal location on valuation of the work. The analysis revealed that temporal location influenced the index of negative affect,  $t(137) = 4.31, p < .001$ . When the index of negative affect was added to the model, it had a significant effect on the valuation of the work,  $t(136) = 3.18, p = .002$ , and the effect of temporal location was no longer significant,  $t(136) = 0.63, p = .53$ . This reduction in the effect of temporal location was significant (Sobel  $z = 2.55, p = .01$ ), which indicates that the effect of temporal location on valuation was fully mediated by the negative affect participants experienced when they imagined the work. We also tested the reverse causal path. Specifically, when temporal location and the price of the wine were included in a

model that predicted the negative-affect index, temporal location remained a highly significant predictor,  $t(136) = 3.92, p < .001$ , and the change in the effect of temporal location was only marginally significant (Sobel  $z = 1.79, p = .074$ ). In short, our data provide stronger evidence for mediation of the TVA by affect than for mediation of affect by the TVA.

#### STUDY 4

If affective reactions to the contemplation of past and future events mediate the TVA, then the TVA should be stronger when people value events that elicit more intense reactions. Self-relevant and self-irrelevant events differ in many ways, and one of these ways is that the former generally elicit more intense affect than do the latter. In Study 4, we investigated whether the TVA is stronger when people contemplate a self-relevant event than when they contemplate a self-irrelevant event.

#### Method

One hundred eighty-two people from a study pool in Boston read a version of the story used in Study 1 and received a candy bar in exchange. The story involved doing data-entry work 1 month previously or 1 month in the future. Some participants (*self-relevant* condition) were asked to imagine that they would do (or had done) the work, and others (*self-irrelevant* condition) were asked to imagine that a randomly selected person from the local area would do (or had done) the work. Participants indicated the amount of money that they or the other person should receive (or should have received) for the work, how difficult they thought the work would be (or was), and how stressed they felt when they thought about the work. They made these ratings on 7-point scales ranging from 0 (*not at all*) to 6 (*extremely*).

#### Results and Discussion

Participants' valuations of the work were submitted to a 2 (temporal location: past or future)  $\times$  2 (relevance: self-relevant or self-irrelevant) analysis of variance (ANOVA), which revealed a main effect of relevance,  $F(1, 178) = 5.86, p = .02, \eta_p^2 = .03$ , and a main effect of temporal location,  $F(1, 178) = 10.17, p = .002, \eta_p^2 = .05$ , which were qualified by a Temporal Location  $\times$  Relevance interaction,  $F(1, 178) = 4.15, p = .04, \eta_p^2 = .02$ . As Table 2 shows, participants believed they deserved 60% more money for their future work than for their past work, but that another person deserved the same amount of money for his or her future and past work. Participants' estimates of the difficulty of the work were submitted to a 2 (temporal location)  $\times$  2 (relevance) ANOVA, which revealed no significant effects, all  $F$ s  $< 1$ .

Participants' reports of how stressed they felt when they thought about the work were submitted to a 2 (temporal location)  $\times$  2 (relevance) ANOVA, which revealed a Temporal Location  $\times$  Relevance interaction,  $F(1, 178) = 9.41, p = .04, \eta_p^2 = .02$ . As

**TABLE 2**

*Ratings of Past and Future Events in Study 4*

Rating	Temporal location of work	
	Past	Future
Self-relevant condition		
Valuation (in U.S. dollars)*	49.76 (28.75)	79.67 (64.12)
Difficulty	2.53 (1.49)	2.69 (1.58)
Stress*	1.80 (1.41)	2.91 (1.79)
Self-irrelevant condition		
Valuation	47.56 (19.66)	54.15 (24.44)
Difficulty	2.62 (1.39)	2.54 (1.26)
Stress	1.64 (1.37)	1.85 (1.28)

**Note.** Standard deviations are in parentheses. Asterisks indicate ratings that differed significantly between the two temporal locations,  $p < .05$ .

Table 2 shows, participants felt more stressed when they thought about their future work than when they thought about their past work,  $F(1, 178) = 12.96, p < .001, \eta_p^2 = .07$ , but they felt equally stressed when they thought about another person's future and past work,  $F(1, 178) = 0.43, p = .51, \eta_p^2 = .002$ . Using the method outlined by Baron and Kenny (1986), we sought to determine whether feeling stressed mediated the effect of temporal location on the valuation of work. The analysis revealed that relevance and temporal location interacted to influence the valuation of work,  $t(178) = 2.08, p = .04$ . When feeling stressed was added to the model, it had a significant effect on the valuation of work,  $t(177) = 6.33, p < .001$ , and the interaction term dropped to nonsignificance,  $t(177) = 1.25, p = .21$ . This reduction was significant, Sobel  $z = 1.98, p < .05$ , which indicates that the interactive effect of relevance and temporal location on the valuation of work was fully mediated by the stress participants felt when they imagined the work.

#### STUDY 5

In Studies 1 through 4, the TVA emerged when participants valued hypothetical events. In Study 5, we sought to determine whether the TVA would emerge when participants valued a real event.

#### Method

Six hundred thirty-three Harvard undergraduates answered questions (by e-mail) about their winter break. About half the participants answered these questions 17 days before the beginning of the break (the *future* condition), and the rest answered the questions 17 days after the end of the break (the *past* condition). Participants were asked to indicate (a) where they would be traveling or had traveled; (b) whether they would be visiting or had visited family, friends, both, or neither; (c) the length of the trip; (d) how enjoyable they thought their winter break would be or was (on a scale ranging from 0, *not at all enjoyable*, to 6,

*extremely enjoyable*); and (d) how much they would be or would have been willing to pay to extend or to have extended their winter break by 3 days. Participants were told to assume that they could extend or could have extended their trip “without missing any of your other obligations.”

### Results and Discussion

Participants who were contemplating a future winter break were willing to pay 24% more to extend it ( $M = \$113.30$ ) than were those who were contemplating a past winter break ( $M = \$91.09$ ),  $t(583) = 2.08$ ,  $p = .04$ ,  $d = 0.17$ . Also, ratings of enjoyment were higher among participants who were contemplating a future break ( $M = 4.77$ ) than among those who were contemplating a past break ( $M = 4.54$ ),  $t(631) = 2.57$ ,  $p = .01$ ,  $d = 0.21$ . Participants in the two conditions did not differ in whom they intended to visit or had visited ( $\chi^2 < 1$ ), where they were traveling or had traveled ( $\chi^2 < 1$ ), or how long their trips would be or had been ( $t < 1.3$ ,  $p > .20$ ).

### GENERAL DISCUSSION

More than 2,000 years ago, Seneca the Younger suggested that rational people should not fear death because the future they will miss by failing to live longer is no more valuable than the past they already missed by failing to have been born earlier. “If anyone pities the dead,” he wrote, “he must also pity those who have not yet been born (Seneca, trans. 1932, p. 73).” But Seneca’s plea for “temporal neutrality” (Parfit, 1984) has fallen on generations of deaf ears because, whether it is rational or not, people do care more about the future than about the past. Our studies show that people value events in the future more than they value equivalent events in the equidistant past (Studies 1 and 5), that they do so even when they consider this asymmetry irrational (Studies 2a–2c), and that one reason why they make these asymmetrical valuations is that contemplating future events produces greater affect than does contemplating past events (Studies 3 and 4). The TVA was robust across many kinds of judgments, from valuations of another person’s suffering (Study 2a) and generosity (Study 2b), to valuations of one’s own labors (Studies 1, 2c, 3, and 4) and pleasures (Study 5). These findings have both practical and theoretical implications.

### Practical Implications

Our studies suggest that establishing the value of an event before it happens will be advantageous to people who profit by it and disadvantageous to those who pay for it. For example, accident victims may be wise to seek compensation before they recover from their injuries, employees may be wise to establish the value of exceeding their performance goals before they do so, and so on. Likewise, consumers may be wise to establish the price of a good or service after it is delivered or consumed (“How much do I owe you for washing my car?”), rather than before (“How much

would you charge to wash my car?”). The fact that people appear to consider the TVA irrational may also be used to one’s advantage. A defense attorney who hopes to minimize the award to an accident victim whose suffering lies in the future may wish to ask jurors to consider first how much they would award the victim if his or her suffering had happened in the past.

### Theoretical Implications

Prospect theory’s (Kahneman & Tversky, 1979) value function describes how people value events of different magnitudes (e.g., winning \$1 or losing \$2) at a single point in the future. The familiar S-shaped function incorporates two well-established facts about valuation: (a) Each additional unit increase in the magnitude of a future event has a diminishing impact on the valuation of that event (*diminishing marginal utility*), and (b) future losses have a larger impact on valuations than do future gains of the same magnitude (*the gain-loss asymmetry*). What is missing from this value function is a third well-established fact about valuation, namely, that as the temporal distance of a future event increases linearly, the present value of that event decreases hyperbolically (*hyperbolic time discounting*; Ainslie & Haslam, 1992; Laibson, 1997). Theorists have had no reason to integrate these three facts in a single three-dimensional value function (Value  $\times$  Magnitude  $\times$  Time) because the S-shaped relationship between the value and the magnitude of an event was assumed to remain constant over time. Our studies suggest that this assumption is incorrect. When the value function is extended into both the future and the past, a second asymmetry emerges, such that value decreases more sharply in the past than in the future (the TVA). Many features of such a three-dimensional value function are not yet known, largely because researchers have paid so little attention to the psychological processes underlying the valuation of past events. We hope the discovery of a wrinkle in time will change that.

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