

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Representations of Time Affect Willingness to Wait for Future Rewards

Permalink

<https://escholarship.org/uc/item/115087zp>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 37(0)

Authors

Thorstad, Robert

Nie, Aiming

Wolff, Phillip

Publication Date

2015

Peer reviewed

Representations of Time Affect Willingness to Wait for Future Rewards

Robert Thorstad (rthorst@emory.edu)

Aiming Nie (anie@emory.edu)

Phillip Wolff (pwolff@emory.edu)

Department of Psychology, Emory University
38 Eagle Row Atlanta, GA 30322

Abstract

How do representations of the future shape behavior? Prior research has shown that people's willingness to wait for a future reward decreases with increases in time. At the same time, this research has also shown that such effects can depend on the vividness of the future reward, as well as, on individual differences. The present research offers a potential explanation for these additional effects in demonstrating how representations of the future can depend not only on objective distances in time, but also on how distances in time are construed. In a series of three experiments using a delay discounting paradigm, we show that participants who represent the future as close to the present are more likely to wait for future rewards than those who represent the future as far, even when the objective distances are held constant. Applications are discussed to public policy issues such as global warming, and to episodic future thinking.

Keywords: psychological distance; delay discounting; episodic future thinking.

Introduction

How do representations of the future shape behavior? Consider a long-term public policy issue such as global warming, whose solution requires foregoing smaller short-term gains for a larger long-term reward. President Obama has recently emphasized that one reason global warming does not receive sufficient attention is *psychological distance*: the American public is insufficiently motivated by threats of global warming because the consequences are construed as distant from the present (Warrick, 2013). This possibility suggests that in addition to objective temporal distance, the psychological distance with which individuals construe the future might affect its motivating value for behavior.

Recent work in economics offers support for the possibility that behavior depends on how people think about the future. According to Chen's (2013) *linguistic savings hypothesis*, many behaviors depend on whether the future is construed as being a part of the present or as separate from the present. If the future is viewed as part of the present, then it may be construed as psychologically close, whereas if the future is viewed as beyond the present, then it may be construed as psychologically distant. Interestingly, languages can differ in their grammar with respect to whether the future must explicitly be marked. In particular, some languages require linguistic markers that distinguish the future from the present (strong future-time reference (FTR) languages), whereas other languages do not require distinguishing the future from the present. For example, in

English, if it is going to rain, a future marker like *will* is usually included in the sentence, "it *will* rain tomorrow." In contrast, in a language like German, present and future do not need to be distinguished. For example, to say that it is going to rain, it is perfectly acceptable to say "it rains tomorrow." Chen (2013) shows that speakers of languages that do not require explicit future markers (and hence conflate the future with the present) tend to engage in more monetary and health-related future behaviors than speakers of languages that do require that the future be distinguished from the present.

Why do explicit linguistic markers affect behavior? Chen's research is conducted using survey data at the level of large groups and, as a consequence, he is not able to test hypotheses about psychological mechanisms. One possibility is that Chen's result is a linguistic manifestation of a more general psychological phenomenon: that representational distance affects behavior. This view – what one might call a *representational distance* view – argues that the future is more motivating when it is construed as close to the present than when it is construed as distant from the present. On this account, speakers of low-FTR languages behave in future-oriented ways because the lack of explicit future markers leads to construals of the future as closer to the present.

Intriguingly, one might have predicted a nearly opposite pattern of results. It seems equally intuitive that speakers of languages that require that the future be distinguished from the present would tend to be more aware of the future, and possibly, then, more likely to engage in behaviors that have positive future consequences. According to what we might call the *future priming* view, future oriented behaviors like saving money and eating should be more likely to occur for those who speak languages that require that the future be distinguished from the present than not.

We therefore set out to directly test between the future priming and psychological distance accounts using a well-understood laboratory task of future behavior: delay discounting. In a delay discounting paradigm, participants are asked to choose between large future rewards and smaller present rewards. A standard finding is that preference for future rewards declines hyperbolically with increasing delay, although there are substantial individual differences (Peters & Buchel, 2011; Bickel, Odum, & Madden, 1999; Alessi & Petri, 2003).

Individual differences in delay discounting represent a case where at the same interval of *objective* time, the *subjective* value of a reward differs between participants.

What might explain these individual differences? Recent work has shown that participants asked to vividly imagine the future show an increased willingness to wait for future rewards (Peters & Büchel, 2010; Benoit, Gilbert, & Burgess, 2011). We suggest that an important cause of individual differences in delay discounting is how individuals represent the future – specifically, the representational distance (near or far) with which participants view a given amount of objective time.

Experiment 1

In Experiment 1 we examined whether individuals who think more about the future than the past are more likely to wait for future rewards. The future priming account predicts that individuals who tend to think about the future will be more likely to wait for future rewards, because a tendency to think about the future should increase its salience. We also examined whether specific aspects of individuals' representations of the future, such as whether they represent the future as distant from the present, affect their preference for future rewards. The psychological distance hypothesis predicts that individuals who represent the future as close to the present will be more likely to wait for delayed rewards. The psychological distance hypothesis also predicts that there will be no effect of future priming: that participants who tend to think about the future more than the past will not differ in their preference for future rewards.

The study had two parts. In the first, participants completed a mind wandering task where they were asked to report the contents of their most recent mind wandering episode. Analysis of the content of mind wanderings provides a measure of participants' spontaneous tendency to think about the future versus the past (*future orientation*). In order to ensure task engagement, data were excluded if participants provided only a single-sentence mind-wandering, the reasoning being that if the participants wrote down only a single sentence, then they were probably not especially engaged in the task. Participants also rated their mind wanderings in terms of temporal orientation and rated other characteristics of their representation, including how distantly they represent the mind wandering from the present. In the second part of the study, participants completed a computerized delay discounting task, where they made a series of 175 choices between hypothetical small immediate and larger delayed rewards.

Methods

Participants. 249 participants were recruited for pay via Amazon Mechanical Turk. Participants represented diverse age ($M=35$ years, range=19-62), gender (58% female) and educational backgrounds (61% have a bachelor's degree). 36 participants were excluded for providing a single-sentence mind-wandering; 67 participants were excluded for failing to provide an accurate confirmation code confirming that they completed both experimental tasks.

Materials. Delay discounting questions were composed by fully crossing 7 delay amounts (1 day, 2 days 1 week, 2

weeks, 1 month, 6 months, 2 years) with 25 present reward amounts (rewards ranged from \$9.90 to \$0.10) for a total of 175 experimental trials. 5 practice trials were also created using random delays and present reward amounts.

Procedure. The experiment consisted of two phases. In the first phase, participants were asked to describe the last time they were "thinking about something other than what you were currently doing." Participants rated whether the mind wandering was about the past, present, and future (1-to-7 Likert scales). Finally, participants rated various characteristics of the mind wandering, including a *distance rating* (completed by the last 119 participants), or the extent to which these thoughts were "about events that were close in time to or far in time from the present" on a 1-to-7 Likert scale.

In the second phase, participants completed a computerized version of the delay discounting task. Participants used the arrow keys to choose between \$10 at the delay interval and the present reward amount "today." Discounting trials were presented in random order.

Results and Discussion

Delay discounting data were analyzed by computing a participant's *choice index*, or the percentage of times a participant chose to wait for the larger future reward (Benoit, Gilbert, & Burgess, 2011). Participants' *future orientation* was analyzed by subtracting participants' self-rating of the extent to which the mind wandering was about the past from their self-rating of the extent to which the mind wandering was about the future.

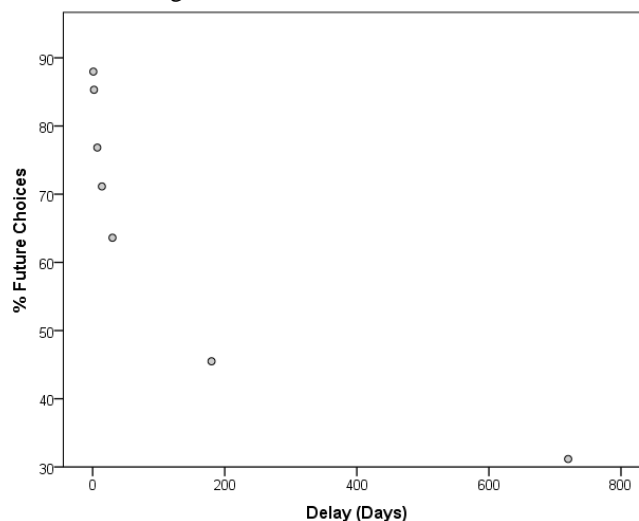


Figure 1. Percent future choices as a function of objective temporal distance in Experiment 1. Participants' preference for future rewards declined with increasing delay.

In order to evaluate the effectiveness of the delay discounting manipulation, we analyzed the influence of objective temporal distance on participants' choices. As in previous studies and as shown in Figure 1, participants were more likely to choose the future reward for shorter intervals

(e.g., 7 days) than longer intervals (e.g., 2 years). This was indicated by ANOVA: choice index declined with increases in time, $F(6,145) = 15.97, p < 0.001$.

According to the *future priming* hypothesis, participants who tend to think about the future should be more likely to wait for future rewards. In order to analyze this hypothesis, a Pearson correlation was conducted for future orientation and delay discounting (choice index). There was no relation between future orientation and delay discounting $r = -0.01, p = 0.92$, suggesting that a simple tendency to think about the future does not affect the motivating value of future rewards. This result provides evidence against the future priming hypothesis, because if the requirement to explicitly mark the future motivates future-oriented behavior by increasing the salience of the future, then individuals who tend to think about the future should have been more likely to wait for future rewards.

By contrast, according to the *psychological distance hypothesis*, what is important is not a tendency to think about the future versus the past, but how participants

assuming a Bonferroni-corrected pairwise $\alpha = 0.025$ (see Figure 2). Thus, for participants who were future-oriented, willingness to wait for a future reward was related to how distantly they viewed the future. This result held even when excluding two participants who provided especially long distance ratings (representational distance = 7); $r = -0.43, p < 0.01$, see the two points on the far right of Figure 2. This result supports the *psychological distance hypothesis* because within participants who think about the future, those who represent the future as close to the present were most likely to wait for future rewards.

Experiment 1 replicated the standard delay discounting finding that reward preference decreases as a function of objective time. In addition, Experiment 1 provided evidence for the psychological distance hypothesis by showing that participants who represent the future, but not the past, as close to the present are more likely to wait for future rewards. This suggests a possible cause for individual differences in delay discounting is in how distance to the future is construed: participants who construe the same

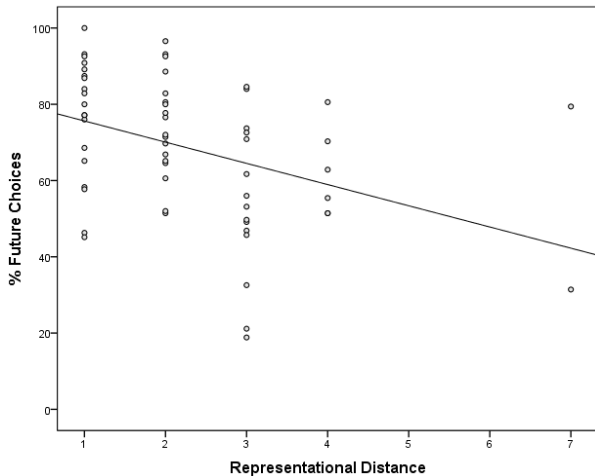


Figure 2. Percent future choices and representational distance for future-oriented participants in Experiment 1. Participants who rated future mind-wanderings as close to the present were more likely to wait for future rewards.

construe an interval of time. We therefore examined whether individual differences in delay discounting at the same intervals of objective time were affected by the distance with which participants represent the future. Participants were divided into two groups: those who were future-oriented (future orientation > 0), and those who were past-oriented (future orientation < 0). Separate Pearson correlations were conducted for each group between representational distance and delay discounting. As mentioned before, representational distance was based on participants' estimate of how distantly they represent the mind wandering from the present. For participants who were future-oriented, distance scores were negatively related to choice index, $r = -0.39, p < 0.01$, which was significant

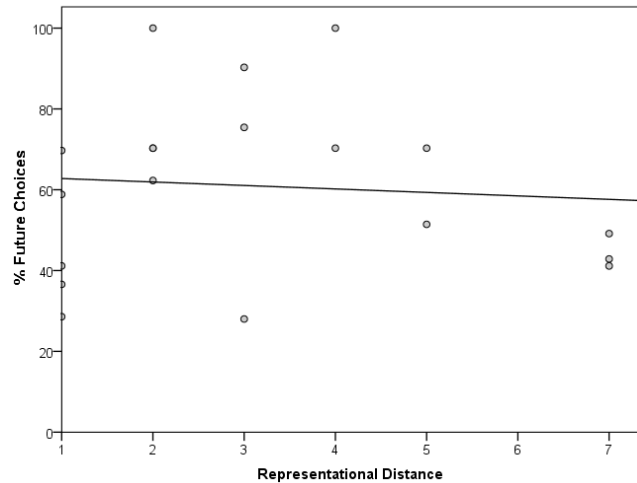


Figure 3. Percent future choices and representational distance for past-oriented participants in Experiment 3. There was no relationship between choice and representational distance for past-oriented participants.

intervals of objective time as close to the present are more likely to wait for future rewards.

An advantage of the mind wandering paradigm is that the effects emerged spontaneously from people's naturally occurring descriptions. However, a potential limitation of this paradigm is that mind wanderings could not be controlled for objective temporal distance. It is therefore possible that mind wanderings rated as distant differed both in psychological distance and objective temporal distance: that is, mind wanderings rated as distant might have been about events that occurred more days in the future than events rated as close. If this is the case, it is possible that our effects are driven by individual's tendency to think about dates that are far in the future, rather than their tendency to

represent the same dates in the future more or less distantly from the present. Experiment 2 aimed to provide additional evidence for the psychological distance hypothesis using a trial-by-trial probe for representational distance. This paradigm allows investigation of the effects of representational distance, controlling for objective temporal distance. If psychological distance reduces the motivating value of the future, then for each discounting decision, participants should be more likely to choose the future reward when they rate the delay interval as close to the present.

Experiment 2

In Experiment 2, participants completed a shortened version of the delay discounting task. Before each discounting trial, participants indicated whether they represent the delay interval as distant from the present. The psychological distance hypothesis predicts that, at each delay interval, participants will be more likely to choose the future reward if they represent the delay as close to the present. The future priming hypothesis predicts that there will be no effect of representational distance.

Methods

Participants. 95 participants were recruited for pay via Amazon Mechanical Turk. While no demographic information was collected for Experiments 2 and 3, participants were recruited in the same manner as Experiment 1 and probably represent diverse age, gender, and educational backgrounds.

Materials. Delay discounting questions were composed by fully crossing 5 delay amounts (1 day, 1 week, 1 month, 6 months, 2 years) with 12 immediate reward amounts (\$9.50-\$4, in intervals of \$0.50) for a total of 60 discounting trials.

Procedure. On a single trial, participants were shown the delay interval and were asked to indicate whether they think this is a “long time” from the present. Participants then indicated on a separate screen their preference for the immediate versus delayed reward. Participants completed 60 trials in random order.

Results and Discussion

Participants were more likely to choose future rewards at shorter delay intervals, consistent with the expected finding that participants’ preferences for future rewards declines with increasing delay. This result was confirmed by a repeated-measures ANOVA for reward choice as a function of delay (1 day, 1 week, etc.), $F(4,376) = 242.38, p < 0.001$.

Importantly, there was a strong effect of construals on reward preference. As shown in Figure 4, participants were more likely to choose the future reward when they construed a given interval of objective time as close to the present than when they construed the same interval as distant from the present. This result was confirmed by calculating the conditional probability of participants’ choosing the future reward at each delay interval, as a function of whether they represented the interval as close to or far from the present. A

paired-sample t-test on the resulting group mean conditional probabilities showed an effect of construal on reward preference, $t(4) = 4.55, p = 0.01$.

Experiment 2 provided strong evidence for the psychological distance hypothesis by demonstrating that participants were substantially more likely to choose the future reward at delay intervals which they represent as close to the present. This effect was obtained while controlling for delay, indicating that for the same amount of objective time, participants’ decisions were influenced by representational distance.

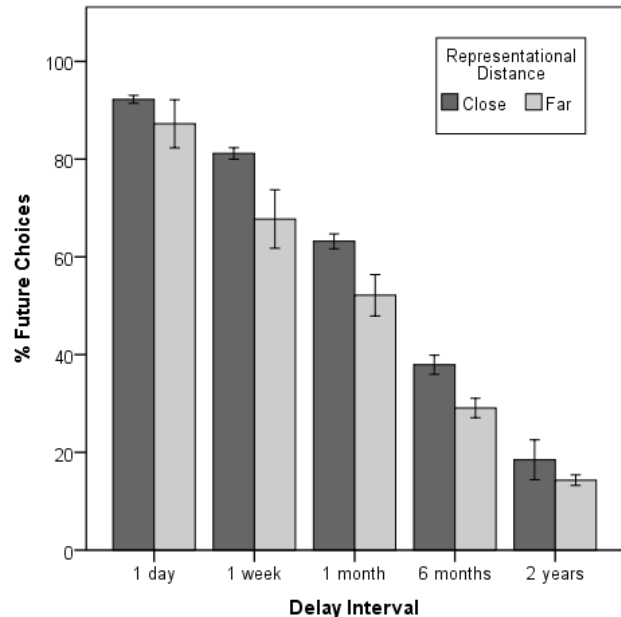


Figure 4. Percent future choices in Experiment 2 as a function of representational distance and delay. Error bars +/- 1 SEM.

A potential worry about Experiment 2 is that participants might have suspected a relationship between the temporal distance and delay discounting tasks. While it is unclear how this would predict a relationship between close representational distance and future-oriented decisions, in Experiment 3, we sought to test for effects of expectations using a blocked design. In Experiment 3, participants completed the delay discounting task and representational distance task in separate blocks, counterbalanced for order. If the effect of representational distance on delay discounting is due to participants’ expectations, participants who complete the representational distance task first should show a stronger relationship between distance and delay discounting than participants who complete the delay discounting task first. By contrast, the psychological distance hypothesis predicts that participants who represent the future as close to the present will be more likely to choose future rewards, and that the magnitude of this relationship will not depend on task order.

Experiment 3

In Experiment 3, representational distance was assessed by asking participants to rate a list of time intervals as close to or distant from the present. Participants also completed the full-length delay discounting task from Experiment 1. Task order was counterbalanced between participants. The psychological distance hypothesis predicts that participants who represent the future as close to the present will be more likely to wait for future rewards, and that there will be no effect of task order on delay discounting.

Methods

Participants. 79 participants were recruited for pay via Amazon Mechanical Turk. 6 participants were excluded for failing to provide an accurate confirmation code confirming that they completed both experimental tasks; 2 additional participants were excluded due to data recording errors.

Materials. The delay discounting task was identical to the task in Experiment 1. The representational distance task was composed of 7 time intervals (1 day, 2 days, 1 week, 2 weeks, 1 month, 6 months, and 2 years).

Procedure. Participants completed two blocks in counterbalanced order. In the discounting block, participants completed the delay discounting task in the same manner as Experiment 1. In the representational distance block, participants rated whether they think each time interval is a “long time” from the present.

Results and Discussion

Participants were more likely to wait for future rewards when they indicated that they represent the future as close to the present. Representational distance responses were scored by computing the smallest interval that participants represented as distant from the present. Participants were divided into a *close* future group (distance > 1 month) and a *far* future group (distance ≤ 1 month). A large distance score indicates a close future representation because a greater number of time intervals were represented as close to the present. As seen in Figure 5, there was a main effect of group, $F(1,78) = 6.74, p = 0.01$, indicating that participants who represent the future as close to the present were more likely to choose the future reward. This result provides converging evidence for the psychological distance hypothesis using a blocked design.

Importantly, there was no effect of participants’ expectations about the relationship between the delay discounting and representational distance tasks. An ANOVA found no effect of block order on delay discounting, $F(1,78) = 0.55, p = 0.46$, indicating that the effect of representational distance was not due to participants’ expectations about a relationship between the representational distance and delay discounting tasks.

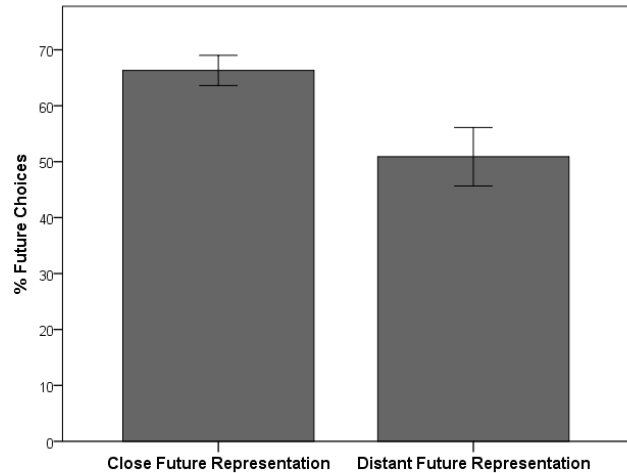


Figure 5. Representational distance and delay discounting in Experiment 3. Participants who represented the future as close to the present were more likely to wait for future rewards. Error bars +/- 1 SEM.

General Discussion

Chen (2013) has shown that speakers of languages which require explicit markers of the future show fewer future-oriented health and savings behaviors. Our studies suggest this is a linguistic manifestation of a more general psychological phenomenon: that representational distance affects the motivating value of the future. Experiment 1 demonstrated that individuals who represent future but not past mind wanderings as close to the present are more likely to wait for future rewards. Experiment 2 demonstrated that for individual discounting decisions, participants who represent the same interval of objective time as close to the present were more likely to wait for future rewards. Experiment 3 confirmed that representational distance in general affects delay discounting, even when participants are not asked to consider representational distance before making discounting decisions.

Recent work has shown that vividly imagining the future increases willingness to wait for future rewards in healthy adults (Peters & Büchel, 2010; Benoit, Gilbert, & Burgess, 2011) and obese adults (Daniel, Stanton, & Epstein, 2013). For example, Benoit, Gilbert, & Burgess asked participants to vividly imagine a specific episode of spending £35 in 180 days at a pub, or merely to estimate what could be bought with it. Participants asked to vividly imagine spending the money were more likely to choose to wait for the future reward. Our results suggest that representational distance is a potential mechanism for these effects. Participants asked to vividly imagine spending £35 in 180 days at a pub might be more likely to represent the delay between the present and this event as part of the near future, and therefore would be more motivated to wait for future rewards. Further research should examine the relationship between episodic future thinking and representational distance, as well as

whether this relationship moderates the effect of episodic future thinking on delay discounting.

Our results also have implications for framing effects on delay discounting. In the date/delay effect (Read, Frederick, Orsel, & Rahman, 2005), participants are more likely to choose a future reward if the delay interval is expressed as a numerical date (e.g. 08/01/2015) than as a delay (e.g. in 6 months). One explanation advanced for the date/delay effect is “differential time estimation” – that participants underestimate the objective length of a date, failing to realize how much time is contained between the present and that date. Our results suggest a different but related explanation. Delay intervals may induce a distant representation of the future by employing explicit linguistic markers – “in 6 months” – to demarcate the future from the present. Instead of underestimating the length of a delay, it may be that phrasing time intervals as delays induces a more distant representation of the future, and that as a consequence participants are less motivated to wait for future rewards.

Previous work has explored the effect of distance on choices in terms of “perceived different selves” (Bartels & Rips, 2010; Hershfield, 2011). On this account, one reason people discount future rewards is because they view their future selves as distant from their present selves, and are less motivated to save for distant future selves. The present work provides converging evidence for this view by demonstrating that distance affects future choices. However, an interesting question for future research is the extent to which representational distance might be a more general mechanism than future self-distance. Subsequent experiments could directly test whether our effects depend on participants representing their self as distant in the future, or whether representational distance is a more general construct encompassing aspects of the future other than the self.

Finally, our results have applications to public policy issues such as global warming, as well as to personal finance decisions such as retirement savings. Our results suggest that one reason important future issues such as global warming receive insufficient attention is that participants represent their effects as occurring in the distant future. Relatedly, one reason individuals may fail to adequately save for retirement is that they represent retirement as occurring in the distant future. Our results suggest that encouraging individuals to represent future problems like global warming, and future life events like retirement, as part of their near future, should increase the motivating value of these events.

Acknowledgments

The authors wish to thank Jason Shepard for his assistance in this research. This project was supported by a grant on Prospective Psychology from The John Templeton Foundation / University of Pennsylvania to the third author.

References

- Alessi, S. & Petri, N. (2003). Pathological gambling severity is associated with impulsivity in a delay discounting procedure. *Behavioural Processes* 64(3), 345-354.
- Bartels, D. & Rips, L. (2010). Psychological connectedness and intertemporal choice. *JEP: General* 139(1), 49-69.
- Benoit, R., Gilbert, S., & Burgess, P. (2011). A neural mechanism mediating the impact of episodic prospection on farsighted decisions. *The Journal of Neuroscience* 31(18), 6771-6779.
- Bickel, W., Odum, A., & Madden, G. (1999). Impulsivity and cigarette smoking: delay discounting in current, never, and ex-smokers. *Psychopharmacology* 146(4), 447-454.
- Chen M.K. (2013). The effect of language on economic behavior: Evidence from savings rates, health behaviors, and retirement assets. *The American Economic Review*, 103(2), 690-731.
- Daniel, T., Stanton, C., & Epstein, L. (2013). The future is now: comparing the effect of episodic future thinking on impulsivity in lean and obese individuals. *Appetite* 71(1), 120-125.
- Hershfield, H. (2011). Future self-continuity: how conceptions of the future self transform intertemporal choice. *Annals of the New York Academy of Sciences*, 1235, 30-43.
- Peters, J. & Büchel, C. (2010). Episodic future thinking reduces delay discounting through an enhancement of prefrontal-medioparietal interactions. *Neuron* 66(1), 138-148.
- Peters, J. & Büchel, C. (2011). The neural mechanisms of inter-temporal decision-making: understanding variability. *Trends in Cognitive Sciences* 15(5), 227-239.
- Read, D., Frederick, S., Orsel, B., & Rahman, J. (2005). Four score and seven years from now: the date/delay effect in temporal discounting. *Management Science* 51(9), 1326-1335.
- Warrick, J. (2013, Sep 23). Obama appeals for ‘ambitious’ effort to stem effects of climate change. *The Washington Post*. Retrieved from www.washingtonpost.com.