Mental time travel and construal level associations: Functional past- and future-directed thinking

THESIS

Presented in Partial Fulfillment of the Requirements for graduation
"with Research Distinction in Psychology" in the undergraduate colleges of
The Ohio State University

By
Kathleen R. Hudson

The Ohio State University
April 2018

Research Distinction Examination Committee:
Professor Kentaro Fujita, Advisor
Professor Jennifer Cheavens

Abstract

Mental time travel, the ability to mentally project one's self backward and forward in time, is thought to be crucial for goal attainment (Suddendorf & Corballis, 2007). Construal level theory suggests the way people think about temporally distant (relative to near) events is by engaging in greater cognitive abstraction (Trope & Liberman, 2003). Whether this process is the same for past vs. future events, however is unclear. We explore whether past and future processes rely on similar mechanisms (Buckner & Carroll, 2007). We also examine the functionality of these processes, suggesting that those who do not engage in abstraction to think about temporally distant events will have more difficulty attaining their goals. We explore whether difficulties for individuals with depression stem from employing dysfunctional cognitive tendencies with respect to thinking about the past and future (Strauman, 2002; Trivedi & Greer, 2014). Thus, this study aims to address two questions: 1) whether cognition is similar between thinking about the past and future, and 2) what constitutes functional cognition in mental time travel and how this relates to goal attainment and well-being. We recruited 251 participants from the Department of Psychology's Research Experience Program. We assess the tendency to use abstraction to think about past and future events using an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Participants also complete the Beck Depression Inventory to measure depressive severity and other well-being and goal attainment questionnaires (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Data was analyzed utilizing D Score algorithm (Greenwald, Nosek, & Banaji, 2003) for IAT reaction times, and Process Dissociation Procedure (PDP; Jacoby, L.L. 1991) for error rates. As we predicted, we found non-significant differences between past and future versions of the IAT, suggesting people likely engage in similar abstraction processes when thinking about the past vs. future. Participants with

more depressive symptoms, relative to those with fewer, did not show differences in association strengths on reaction time measures. Participants with more depressive symptoms, relative to fewer, did show weaker associations between distant time and abstraction on error rate measures; this may be due to this measurement's greater sensitivity for measuring associations. Overall, evidence suggests past and future rely on similar mechanisms, and although mixed, some evidence supports predictions about the functionality of abstract thinking with distant time.

Keywords: mental time travel, construal level theory, functional thinking, depression, temporal distance

Acknowledgements

I would first like to thank my thesis advisor, Dr. Kentaro Fujita, for the time and resources he has contributed to my thesis, and especially for supporting my summer work on the project. I would like to thank my graduate mentor, Nicole Dusthimer Bevan, for the incredible amount of effort she has contributed to my thesis as well as my personal and professional growth. I would also like to thank the other graduate and thesis students in the Fujita lab for their feedback and help throughout the process. Lastly, I would like to thank Arts and Sciences and Social and Behavioral Sciences at Ohio State for providing personal and project expense funding, respectively.

Introduction

Mental time travel is a fundamental aspect of human existence; it is used to relive past experiences and pre-live future ones. People are not solely engaged in the present, but think of known past events or those possibly to come, which contributes to much of what guides human thought and behavior. This engagement in past and future thinking is used to effectively interact with and plan in an environment (Suddendorf & Corballis, 2007). For instance, a student may reflect on the actions which led to good grades previously, and picture the grades they wish to receive later, which can help them engage in useful behaviors to secure their goals.

Mental Time Travel and Self-Regulation

Mental time travel may function as a highly adaptive tool for self-regulation. Self-regulation includes multiple systems that enable purposeful monitoring and regulating of thoughts, behaviors, emotions, and motivations (Bandura, 1991). The ability to regulate this variety of processes is critical for people to successfully navigate their environments. Self-regulatory systems can impact all aspects of life and provide the basis for intentional human action, from engaging in activities like skipping a concert when you must study, to focusing on proofreading a paper. Functional cognition about the future and past is important for adaptive regulation of thoughts and subsequent behaviors. To successfully self-regulate, it is important to not only respond to the current environment, but also react to what has already happened and behave in anticipation for what is expected to come. The ability to change one's behavior to secure future needs is an advantage offered by mental time travel, through the imagining of future circumstances as well as past occurrences (Suddendorf & Busby, 2005). For instance, students might imagine poor performances on their upcoming exams based on previous exam results, which influences their choice to study more in the present. Projecting oneself backward

and forward in time may allow one to consider information that then guides behavior (Schacter & Addis, 2007). Mental time travel offers the ability to not only reflect on the past, but to plan for future scenarios, and plan for them well (Suddendorf & Corballis, 2007).

Construal Level Theory

Construal level theory (CLT; Liberman & Trope, 2008; 2014; Trope & Liberman, 2003; 2010) suggests that people represent objects and events through different levels of abstraction. People engage in cognitive abstraction to traverse dimensions of psychological distance, which involves distancing the self from the here and now (Trope & Liberman, 2008). Psychological distance refers to any removal of an event from the here and now, across the dimensions of temporal distance, spatial distance, social distance, and hypotheticality (Trope & Liberman, 2010). Temporal distance, events that can be near (tomorrow) or far (a year ago) from the self, is central to understanding psychological distance in the context of mental time travel. Therefore, our focus will be on this type of psychological distance. People tend to conceptualize temporally distal and proximal events differently from one another because these events tend to have different information available (Trope & Liberman, 2003). Details about more distant future events are often unavailable or unreliable, prompting individuals to engage in high-level construal to think about more essential event features to help imagine and plan for that future (Trope & Liberman, 2003). As events become nearer in time, individuals engage in more low-level construal to incorporate available specific information into event representations and conceptualize more immediate demands. One might broadly imagine a distant summer day as simply warm and sunny, but would imagine more specific aspects of the weather tomorrow like amount of cloud cover, or strength and direction of the wind.

According to Construal Level Theory, people engage in high-level construal to represent increased psychological distance, whereas people engage in low-level construal to represent decreased psychological distance (Liberman & Trope, 2014). Specifically, engaging in high-level construal focuses on abstract, essential features, whereas engaging in low-level construal focuses on concrete, specific features. For instance, someone studying may regard this activity as gaining knowledge if engaged in high-level construal, but may regard this activity as practicing notecards if engaged in low-level construal. This process allows people to conceptualize events in a manner that aligns with the type of information that event has available. Engaging in more abstraction in the context of distant time may then be considered functional as it allows individuals to plan properly for their goals.

If people indeed habitually engage in abstraction to think about distant events, people should form an association between temporal distance and high-level construal. Bar-Anan, Trope, and Liberman (2006) tested this idea through versions of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The strength of an association may indicate the degree to which people repeatedly pair two concepts together, such as the extent people tend to construe distant time abstractly or near time concretely. Bar-Anan and colleagues considered this idea when examining individual differences in how people think about time. Participants responded more quickly, therefore displaying stronger associations, while pairing stimuli of congruent concepts (i.e. temporally distant and high-level, abstract words or temporally proximal and low-level, concrete words).

Abstraction in proper contexts is important to consider when engaging in mental time travel. Functional associations between abstract thinking and distant time may be crucial for goal attainment. Deficits may lead to poor self-regulation which is a suggested feature of depression

(Strauman, 2002). Inability to abstract during prospection may interfere with production of positive scenarios with positive hedonic consequences (Gilbert, & Wilson, 2007). Without a hedonic incentive present, individuals may be less likely to engage in goal attaining behavior. If one is not able to imagine the scenario of receiving a good test score and associated positive feelings, they may be less inclined to study. Decisions about distant future events have been demonstrated to rely on the desirability of the end state rather than the process of attaining that state (Liberman & Trope 1998). Lack of abstraction when imagining future goals could then put the focus on a perhaps difficult process of achieving a goal, rather than the positive outcome of the goal itself. This might influence choices to be myopic, i.e. failing to strive for the goal, and become less focused on the outcome. Someone who tends to abstract more when thinking about a distant goal may be able to stay motivated and be more likely to reach their more clearly pictured end state than someone who does not tend to abstract when thinking about goals.

Mental Time Travel and Depression

Depression is a common mental health disorder, with a lifetime prevalence of 16.6% (Kessler et al., 2005). Cognitive impairments have been identified as a main characteristic of depression (Trivedi & Greer, 2014). Engagement in too much abstraction has been proposed as a feature in individuals with depression, which is evident in the suggested component of overgeneralized memory (Williams et al. 2007). Individuals with depression may find it difficult to separate specific memories, and this may impact the functional construction of future events. If someone cannot recall how they've scored on specific tests in the past, they may find it difficult to estimate how they will score on specific tests in the future, and find it difficult to study appropriately. Galfin and Watkins (2011) found that patients in palliative care experience increased rumination, uncertainty, and abstract thinking, which were all related to psychological

distress. To help reduce excessive abstraction, concreteness training methods might be an effective tool for reducing depressive symptoms (Watkins, Baeyens, & Read, 2009).

However, there is also evidence to support that depressed individuals tend to abstract less than healthy controls (Braff & Beck, 1974). Smith, Tracy, and Murray (1993) showed that subjects with depressive symptoms struggle with abstraction. These subjects were impaired on high-level categorization tasks, but not low-level family-resemblance tasks. Individuals with sad moods have shown fewer tendencies to use global features during task completion than those in happy moods (Gasper & Clore, 2002). Ross and Wilson (2002) found that individuals who have lower self-esteem, which is shown to be strongly related to depression, are less able to distance themselves from negative events than those who have high self-esteem (Sowislo & Orth, 2013). These examples show depression may lead to fewer tendencies to engage in abstraction. There is conflicting evidence as to whether people with depression think abstractly more or less than healthy controls. Whether individuals with depression abstract more or less in general does not indicate whether they abstract in functional contexts; it could be that they do or do not abstract at the wrong times (Watkins, Moberly, & Moulds, 2008). For example: a student may receive a poor grade on an exam, and, rather than accounting for it as one instance of their academic performance, generalize this result to all future exams and assume they will keep receiving bad grades. Alternatively, this student may receive a good grade on another exam, and, instead of generalizing this result to assume they are able to keep receiving good grades, regard this performance as situational and not assume it will happen again. Individuals with depression may struggle to beneficially self-regulate in these instances where it can be helpful or unhelpful to abstract.

Functionality in Mental Time Travel and CLT

Previous research has examined how associations between temporal distance and abstraction relate to the outcome of depression (Fujita, Lazarus, Darwin, & Cheavens, 2015). Fujita et al. found that individuals with more, relative to fewer, depressive symptoms tended to display weaker associations between abstractness and distant time. Because individuals with depression are a group that appears to display cognitive dysfunction and poor well-being (Trivedi & Greer, 2014), these findings may suggest that engaging in abstraction is a functional approach to thinking about distant time. This research, however, seems to contradict previous work which suggests individuals with depression have overgeneralized memories, i.e. overly abstract memories (Williams et al. 2007). Construal level theory assumes similar principles apply to both past and future dimensions, thus less abstraction in one direction may then imply less abstraction in the opposite direction (Trope & Liberman, 2003). However, differences in abstraction when engaging in mental time travel between the past and future have not been explicitly tested; Bar-Anan et al.'s (2006) method conflates the past and future when measuring these associations. Thus, differences remain unclear, particularly in the context of depression.

Present Research

This study aims to replicate previous research conducted by Bar-Anan, Trope, and Liberman (2006) that found people hold time-construal associations, and research conducted by Fujita et al. (2015) that found these associations may relate to important outcome measures, namely depression. This work expands on these findings by considering potential differences for past and future time-construal associations. It is unknown whether the construal of past or future events, or both, account for these functional patterns. The relative associations people hold

between abstractness and distant time can offer insight into the symmetry or differences of past and future representation.

Some might expect the known past to be more concrete because there is already specific information available, whereas the unknown, hypothetical future does not contain the same specific information. For instance, you have knowledge of the last exam you took and all the questions on it, but you do not know what specifically will be on the next exam you take. However, it remains unclear whether past and future thinking is symmetrical or asymmetrical. One might infer the past and future are represented at different levels of abstraction because some have found differences in mechanisms activated while remembering vs simulating future events (Weiler, Suchan, & Duam, 2010). However, many have found more similarities than differences; evidence shows that past and future thinking largely relies on similar systems, suggesting past events inform how future events might be played out (Buckner & Carroll, 2007; Schacter & Addis, 2007). Amnesic patients with damage affecting memory systems in both hemispheres have struggled to construct not only past experiences, but future scenarios as well (Hassabis, Kumaran, Vann, & Maguire, 2007). Impairment of future event construction when memory systems are not functional may indicate that past and future thought shares a reliance on similar systems.

Differences between the past and future may change how we understand the relationship between time-construal associations and depression. People may consider the past and future no differently, or perhaps this difference may explain discrepancies between Fujita et al. (2015) findings and previous depression literature. We predict to find no differences between past and future associations, based on previous research examining these mechanisms. I.e., whether associations tend to be weaker or stronger in the past or future, the relative strengths of those

associations between participants should be the same. We predict construal level and temporal distance to exhibit association strengths that are dependent on temporal distance mentally traveled, rather than temporal direction mentally traveled.

Methods

Participants

Participants (279) enrolled in the Department of Psychology's Research Experience Program (REP) at The Ohio State University participated in the study and received partial course credit. We recruited 37 REP participants based on pre-screened responses to the Beck Depression Inventory (BDI; Beck, et al, 1961); i.e., they had scores within the upper third of the distribution. We designed the latter procedure to ensure sufficient variability in depressive symptoms among participants. We excluded non-native English speakers from analyses, because IATs rely on fast processing and facility with the language presented in the task to test associations. Participants that responded too quickly (less than 300 milliseconds for 10% or greater of IAT trials) or who had high error rates (40% or greater on trials) were excluded, as suggested by Greenwald and colleagues (2003). The resulting number of participants was 251.

Design

The experiment was a 2x2x2 mixed design. We measured associations between temporal distance (near vs. distant) and construal level (high-level vs. low-level) within subjects using the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). We measured whether the temporal distance referred to the past and future between subjects. Participants also completed questionnaires to assess outcome measures, and demographic questions.

Materials and Procedure

Implicit Association Test. Each IAT contained seven blocks, including five practice blocks and two critical blocks. Trial blocks presented followed the same sequence introduced by Greenwald, McGhee, and Schwartz (1998). Stimuli appeared in the center of participant computer screens and were sorted to category labels in the top corners using their corresponding keys on the keyboard. Blocks 1 and 2 were practice blocks allowing participants to learn stimuli and key mappings of category labels for construal-level (abstract/concrete) and temporal distance (distant time/near time), respectively. Participants received feedback on these practice blocks for incorrect answers, or for responding too quickly or slowly. Participants then sorted stimuli to either congruent (abstract/distant time; concrete/near time) or incongruent (concrete/distant time; abstract/near time) combined category labels first for practice block 3 and critical block 4, depending on condition. Pairings were switched the next critical stage. Block 5 was practice for the reversed position of abstract/concrete category labels; labels were paired with the opposite key than they were originally and appeared on the opposite side of the screen. Practice block 6 and critical block 7 then presented either the congruent or incongruent position of the combined category labels not yet completed by the participant. This was counterbalanced from the original position in blocks 3 and 4. We randomly assigned participants to one of four IATs. Each subject sorted either past or future stimuli, and saw either compatible or incompatible trials first. Counterbalancing both past and future conditions allowed for testing of potential order effects.

We adapted IAT word stimuli and category labels from Bar-Anan, Trope, and Liberman (2006). Participants sorted IAT temporal stimuli into past-oriented category labels “near time” (seconds ago, minutes ago, hours ago, yesterday, earlier today) and “distant time” (months ago, years ago, decades ago, childhood, 2000) or future-oriented category labels “near time” (seconds from now, minutes from now, hours from now, tomorrow, later today) and “distant time”

(months from now, years from now, decades from now, old age, 2034). We randomly assigned 124 participants to IAT blocks that use past-oriented language, and 123 participants to blocks with future-oriented language. All participants sorted construal-level stimuli into category labels "concrete" (detailed, specific, defined, particular, precise) and "abstract" (general, theoretical, generalized, broad, universal). We asked participants to sort stimuli words to into category labels using either the "S" key or the "L" key.

Outcome measures. Five questionnaires measuring participants' self-assessment of their levels of well-being and self-regulation followed IAT trials. Each condition presented the same questionnaires in the same order, question order was randomized in each. Participants first completed the BDI. Participants chose a statement best describing them from options like "I do not feel sad, I feel blue or sad, I feel blue or sad all the time and I can't snap out of it, I am so sad and unhappy that I can't stand it" (Beck, et al, 1961).

As exploratory measures, participants then completed the Self-Control Scale, questions such as "I am good at resisting temptation" were asked, with values rated from 1 "not like me at all" to 5 "very much like me" (Tangney, Baumeister, & Boone, 2004). Participants completed Consideration of Future Consequences next, questions such as "I only act to satisfy immediate concerns, figuring the future will take care of itself" were asked and rated on a 5-point scale from "extremely uncharacteristic" to "extremely characteristic" (Strathman, Gleicher, Boninger, & Edwards, 1994). Participants completed a Ruminative Responses Scale, rating how often they would "think about a recent situation, wishing it had gone better" and other similar questions from 1 "almost never" to 4 "almost always" (RRS; Nolen-Hoeksema & Morrow, 1991). Participants then rated statements on the Satisfaction With Life Scale such as "I am satisfied with my life" from 1 "strongly disagree" to 7 "strongly agree" (SWLS; Diener, Emmons, Larsen, &

Griffin, 1985). As they are not directly related to the central hypotheses of the present research, they are not discussed further. Participants last completed demographic questions, such as age, year in school, and gender, and were debriefed.

Results

To determine differences in the extent less vs. more depressed individuals associate abstract (concrete) and temporal distance (proximity), and the extent these associations differ between the past and future, we utilized the d-score algorithm for IAT responses recommended by Greenwald, Nosek, and Banaji (2003); this included a 600ms penalty for incorrect responses. We coded blocks with abstract/distant time and concrete/near time as compatible, and blocks with concrete/distant time and abstract/near time as incompatible. This scoring procedure provides a summary index in which higher IAT d-scores (positive) suggest stronger associations between high-level (low-level) construal and temporal distance (proximity).

We also analyzed error rate data using process dissociation procedures (Jacoby, 1991); this included the Snodgrass Correction. Unlike D-scores, PDP allows us to look at different processes, where A parameter assesses the influence of associative processes and C parameters assess the influence of more controlled processes in performance on the IAT. As the A parameter controls for participants controlled processes (i.e. when they are carefully selecting or correcting responses), it may provide a more precise assessment of the role of associations in participants' IAT performance. The A parameters additionally allow independent measures of associative processes for near time (A-near parameters) vs distant time (A-far parameters).

Participant BDI scores were calculated by summing responses (M = 10.12, SD = 9.79), as performed by Beck, et al, (1961), such that higher scores indicated more depressive severity and

lower scores indicated less severity. BDI score values were skewed, many participants tended to report fewer depressive symptoms and had lower scores. To correct for this, we log-transformed the values (M = 0.87, SD = 0.42); all further analyses were performed using log-transformed BDI values. We also measured other various outcome measures, but we did not analyze these findings and do not present them.

Preliminary Analyses

D-score. If participants do hold time-construal associations, we would expect d-scores significantly different from zero. More positive, rather than negative, scores would indicate stronger associations for congruent pairings. We determined participants did have associations using a one-sample t-test ($t(245) = 7.00$, $p < 0.001$, $M = 0.23$, $SD = 0.51$). Participants overall had congruent associations, such that they reacted more quickly when responses for distant time (near time) and abstract (concrete) concepts were paired.

Next, we were interested in order effects between compatible and incompatible conditions on d-scores, and ran an independent-samples t-test. Incompatible conditions were coded as -1 and compatible conditions were coded as 1. We found a significant difference, which indicates there was an order effect on association strength. There were stronger associations for congruent pairings for conditions where participants saw compatible trials first (M =0.32, SD = 0.49), rather than incompatible trials first (M = 0.14, SD = 0.53) ($t(244) = 2.81$, $p < 0.01$). Because of these findings, we controlled for order effects in all further d-score analyses.

We then performed an ANCOVA to determine association differences between the past and future while controlling for order effects. Past conditions were coded as -1 and future conditions were coded as 1. We found a non-significant difference, where the past tends to have more congruent associations (M = 0.30, SD = 0.51) than the future (M = 0.17, SD = 0.52) (F(2,

243) = 3.41, p =0.07). Although this may suggest to some that there is a difference in how people construe the past and future, the specific pattern of this result is unexpected (the distant past is construed more abstractly than the distant future), rendering it somewhat difficult to interpret these results.

PDP. As one might expect, d-score assessments of time-construal associations were correlated with PDP assessments of these same associations. Specifically, d-scores were correlated significantly with both A-near (r = 0.47, p < 0.001) and A-far (r = 0.53, p < 0.001) parameters, and that A-near and A-far parameters correlated significantly with each other (r = 0.14, p = 0.02). We proceeded to run the same analyses for PDP parameters as we did for d-scores. All following findings for both A-near and A-far are consistent with d-score findings. We first looked at whether participants displayed associations. If participants exhibited associations based on error rates, we would expect A parameter values significantly different from zero. We found this result through conducting a single-sample t-test for both A-near (t(246) = 39.55, p < 0.001, M = 0.54, SD = 0.22) and A-far (t(246) = 36.65, p < 0.001, M = 0.54, SD = 0.23) parameters, showing participants hold stronger associations for congruent concepts of both near time/low-level construal and far time/high-level construal.

We performed an independent-samples t-test to determine if there were order effects for PDP results between compatible and incompatible conditions. Order effects were found for both A-near and A-far parameters. Stronger congruent associations for A-near parameters occurred in conditions where participants had compatible trials first (M = 0.59, SD = 0.21) rather than conditions with incompatible trials first (M = 0.49, SD = 0.21) (t(245) = 3.83, p < 0.001). The same effect was found for A-far trials, such that stronger congruent associations occurred in the conditions where participants had compatible trials first (M = 0.59, SD = 0.22) rather than

incompatible trials first (M = 0.50, SD = 0.24) (t(245) = 3.31, p =0.001). Because of these findings, we controlled for order effects in all further PDP analyses.

We then performed an ANCOVA to determine association differences between past and future conditions for both A parameters, while controlling for order effects. We found no significant difference between A-near parameters for past (M = 0.53, SD = 0.21) and future (M = 0.55, SD = 0.22) conditions (F(2, 243) = 0.12, p = 0.73), and a non-significant difference between A-far parameters for past (M = 0.56, SD = 0.22) and future (M = 0.52, SD = 0.24) conditions (F(2, 243) = 2.32, p =0.13). A-near and A-far parameters both show no significant differences between past and future conditions which aligns with our predictions. However, given striking similarities to the d-score results, one might interpret the marginally significant results of the A-far parameter as noteworthy. Specifically, those in past conditions tended to display stronger associations between compatible pairings of distant time and high-level construal than those in future conditions.

Regression Analyses

Given our preliminary findings, we decided to test predictions about depression and our association measures, first starting with effects of condition and depression on associations. For all analyses, we used regression models through SPSS Process Macro developed by Hayes (2013). Every regression analysis we report used Process model 1 with mean-centered products.

D-score. We first tested effects of condition and depression on association outcomes. We regressed participant condition and log-transformed BDI scores, and the interaction of these variables on d-scores. Contrary to prediction, there was no significant effect of BDI on d-score (b = 0.10, SE = 0.08, t(218) = 1.22, p = 0.22). The effect of condition was marginally significant (b = -0.11, SE = 0.07, t(218) = -1.63, p = 0.11), with past vs. future conditions tending to exhibit

stronger congruent associations. There was no significant interaction of condition and BDI on d-score (b = -0.01, SE = 0.16, t(218) = -0.07, p = 0.95). These findings are shown in Figure 1.

PDP. We repeated the same regression analyses detailed above, but for A-near and A-far PDP parameters. We again regressed participant condition and log-transformed BDI, and the interaction of these variables on the A parameters. There was no significant effect of BDI on A-near parameters (b = -0.02, SE = 0.03, t(221) = -0.67, p = 0.50), nor of condition (b = -0.01, SE = 0.03, t(221) = 0.38, p = 0.70). There was also no significant interaction between condition and BDI on the A-near parameter (b = -0.04, SE = 0.07, t(221) = -0.57, p = 0.57).

However, A-far parameter results revealed more interesting patterns. Although there was no effect of past vs. future on A-far parameters (b = -0.01, SE = 0.03, t(221) = -0.38, p = 0.71), higher BDI predicted lower A-far parameters (b = -0.08, SE = 0.04, t(221) = -2.08, p = 0.04). In line with our predictions, those who reported higher depressive symptoms displayed a less robust tendency to associate temporal distance with abstract, high-level concepts. This pattern appeared to be consistent across the past and the future conditions. There was no significant interaction between condition and BDI on the A-far parameter (b = 0.00, SE = 0.07, t(221) = -0.06, p = 0.95). These findings are shown in Figure 2.

Discussion

In this study, we replicated Bar-Anan et al. (2006) findings, showing that people tend to associate temporal distance and cognitive abstraction. Greater cognitive abstraction tends to be associated with greater temporal distance while less cognitive abstraction tends to be associated with less temporal distance. This is consistent with construal level theory, which proposes people engage in more cognitive abstraction to represent more distant events (Trope & Liberman, 2003).

We see this result both with the measure of associations based on reaction time (d-score; Greenwald, et al., 2003) and with the measure of associations based on error rate (PDP; Jacoby, 1991). PDP error analyses additionally offers evidence that these processes are based on associations between the concepts, rather than just controlled processes of inhibition or categorization.

We also replicate work by Fujita et al. (2015), finding that stronger temporal-construal associations tend to be related to less depressive symptoms. Although depression did not predict significantly weaker time-construal associations on the IAT d-score measure, it did on the PDP measures. Although those with high vs. low depressive symptoms did not differ in the degree to which they associated temporally near events with low-level construal, they did significantly differ in the degree to which they associated temporally distant events with high-level construal. Those with increased depressive symptoms tended not to associate distant events with cognitive abstraction. Thus, this research supports the ideas that people tend to engage in more cognitive abstraction to think about more distant time, and that cognitive abstraction is functional in the context of mental time travel. This weakened time-construal association for people with depressive symptoms, who have shown to struggle with self-regulation and other functional cognition, offers evidence of the functionality of this relationship.

While previous work has tested whether time-construal associations exist, and whether these associations are functional, no past research has explored the difference between these associations for the past and future. Construal level theory would suggest that engagement in abstraction remains relatively consistent between the past and future. Although there were no significant differences on the d-score and A parameters between the past and the future, there were marginally significant findings that may be worth exploring. Participants tended to hold

stronger congruent associations for the past, particularly for associations of distant time/abstract. This suggests participants may engage in greater abstraction when mentally representing the distant past rather than distant future. This finding is unexpected because if we had predicted past and future differences, we would suggest the past is more concrete. The future has not happened yet, but the past has, so we may expect the future to be more distant, and the past to be more proximal, on the dimension of hypotheticality. Similarly, we may then have predicted the past as more concrete than the future along the dimension of temporal distance, however we surprisingly found the opposite pattern instead. We do not have a clear explanation for these results, and these potential differences are not statistically significant. Because of this, we might suggest these findings are spurious; however, future work should attempt to replicate these results and further explore any potential differences.

Our findings suggest that those with greater depressive symptoms not only struggle to engage in abstraction to conceptualize the distant future, but the distant past as well. This lack of difference in abstraction between the past and future may be interpreted as conflicting with previous work on overgeneralized memory, which might suggest individuals with depression construe the past events more abstractly. These findings, however, may alternatively serve to highlight a distinction between information that is abstract vs. vague. We use the term abstraction to refer to differences in how and what types of information people process. By contrast, research in overgeneralized memory appears to use the term to refer to vagueness – having less information encoded about an event. If abstraction is related to the type of information available, while overgeneralized memory is related to the amount, the potential difference between these processes may lie in the quality of information vs the quantity of information. Engaging in more vs. less abstraction to represent an event may result in generating

different qualities of information (i.e. broad, essential vs. idiosyncratic, specific event features) rather than different amounts of information. Overgeneralized remembering may be considered as vague and lacking in amount of information, but the quality of the information might remain relatively the same.

While this work offers preliminary evidence to suggest abstraction is a functional mechanism for mental time travel, it should be noted that we do not directly test this proposition. We only assessed associations between the concepts of abstract/concrete and near/distant time. Time-construal associations may offer some indication of the degree one abstracts to represent different temporal distances. However, it is not a direct measure. Future work may address this by utilizing measures that more directly assess abstraction as a function of temporal distance, and how this relates to cognitive dysfunction. Because abstraction appears to be functional in the context of cognitively representing temporal distance, further studies might test the functionality of abstraction across other dimensions of psychological distance (hypotheticality, social distance, and spatial distance) may be warranted.

Additionally, it should be noted that we sampled from college students and their depression scores were skewed towards having fewer depressive symptoms than we would expect from a normal population. This sample is not ideal for generalizing our results to populations diagnosed with depression. However, even with this skewed sample, we still find differences in time-construal associations based on depression scores, which provides a basis for future work. Still, further studies might consider sampling from populations that are clinically depressed. Future work may also explore how different processes for those with depression relates more specifically to self-regulation, and how this impacts goal pursuit and planning.

References

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248-287.

Bar-Anan, Y., Liberman, N., & Trope, Y. (2006). The association between psychological distance and construal level: Evidence from an implicit association test. *Journal of Experimental Psychology: General, 135*(4), 609-622.

Beck, A. T., Ward, C., & Mendelson, M. (1961). Beck depression inventory (BDI). *Archives of General Psychiatry, 4*(6), 561-571.

Braff, D. L., & Beck, A. T. (1974). Thinking disorder in depression. *Archives of General Psychiatry, 31*(4), 456-459.

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences, 11*(2), 49-57.

Diener, E. D., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71-75.

Fujita, K., Trope, Y., Liberman, N., & Levin-Sagi, M. (2006). Construal levels and self-control. *Journal of Personality and Social Psychology, 90*(3), 351-367.

Fujita, K., Darwent, K., Lazarus, S., Cheavens, J. (2015.) *Depressive symptomology and the association between abstraction and temporal distance: A preliminary test of the functional benefits of abstraction in mental time travel.* Manuscript submitted for publication.

Galfin, J. M., & Watkins, E. R. (2012). Construal level, rumination, and psychological distress in palliative care. *Psycho-Oncology, 21*(6), 680-683.

Gasper, K., & Clore, G. L. (2002). Attending to the big picture: Mood and global versus local processing of visual information. *Psychological science*, *13*(1), 34-40.

Gilbert, D. T., & Wilson, T. D. (2007). Prospection: Experiencing the future. *Science*, *317*(5843), 1351-1354.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464-1480.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of personality and social psychology*, *85*(2), 197-216.

Hassabis, D., Kumaran, D., Vann, S. D., & Maguire, E. A. (2007). Patients with hippocampal amnesia cannot imagine new experiences. *Proceedings of the National Academy of Sciences*, *104*(5), 1726-1731.

Jacoby, L.L. (1991). A Process Dissociation Framework: Separating Automatic from Intentional Uses of Memory. *Journal of Memory and Language, 30*(5), 513-541.

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*(6), 593-602.

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*(1), 5-18.

Liberman, N., & Trope, Y. (2008). The psychology of transcending the here and now. *Science*, *322*(5905), 1201-1205.

Liberman, N., & Trope, Y. (2014). Traversing psychological distance. *Trends in Cognitive Sciences, 18*(7), 364-369.

Nolen-Hoeksema, S., & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: the 1989 Loma Prieta Earthquake. *Journal of Personality and Social Psychology*, *61*(1), 115-121.

Ross, M., & Wilson, A. E. (2002). It feels like yesterday: self-esteem, valence of personal past experiences, and judgments of subjective distance. *Journal of personality and social psychology*, *82*(5), 792-803.

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: the prospective brain. *Nature Reviews Neuroscience*, *8*(9), 657-661.

Smith, J. D., Tracy, J. I., & Murray, M. J. (1993). Depression and category learning. *Journal of Experimental Psychology: General*, *122*(3), 331-346.

Sowislo, J. F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin, 139(1),* 213-240.

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*(03), 299-313.

Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: weighing immediate and distant outcomes of behavior. *Journal of Personality and Social Psychology*, *66*(4), 742-752.

Strauman, T. J. (2002). Self-regulation and depression. *Self and Identity, 1*(2), 151-157.

Tangney, J.P., Baumeister, R.F., & Boone, A.L. (2004). High Self-Control Predicts Good Adjustment, Less Pathology, Better Grades, and Interpersonal Success. *Journal of Personality, 72*(2), 271-324.

Trivedi, M. H., & Greer, T. L. (2014). Cognitive dysfunction in unipolar depression: implications for treatment. *Journal of Affective Disorders, 152*, 19-27.

Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review, 110*(3), 403-421.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review, 117*(2), 440-463.

Watkins, E. R., Baeyens, C. B., & Read, R. (2009). Concreteness training reduces dysphoria: proof-of-principle for repeated cognitive bias modification in depression. *Journal of abnormal psychology, 118*(1), 55-64.

Watkins, E., Moberly, N. J., & Moulds, M. L. (2008). Processing mode causally influences emotional reactivity: distinct effects of abstract versus concrete construal on emotional response. *Emotion, 8*(3), 364-378.

Williams, J. M. G., Barnhofer, T., Crane, C., Herman, D., Raes, F., Watkins, E., & Dalgleish, T. (2007). Autobiographical memory specificity and emotional disorder. *Psychological bulletin, 133*(1), 122.

Williams, J. M. G., Ellis, N. C., Tyers, C., Healy, H., Rose, G., & Macleod, A. K. (1996). The specificity of autobiographical memory and imageability of the future. *Memory & Cognition, 24*(1), 116-125.

Supplemental Materials

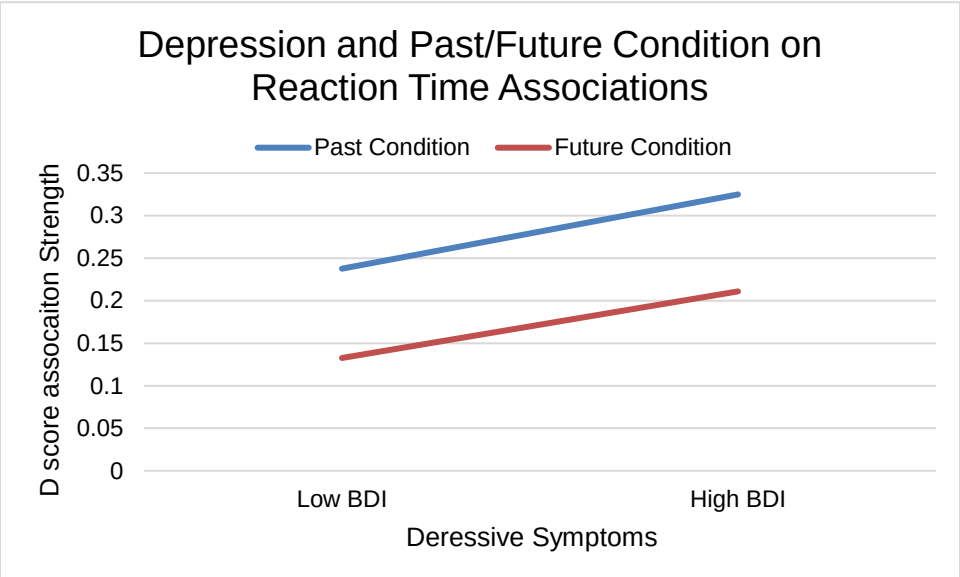

Figure 1

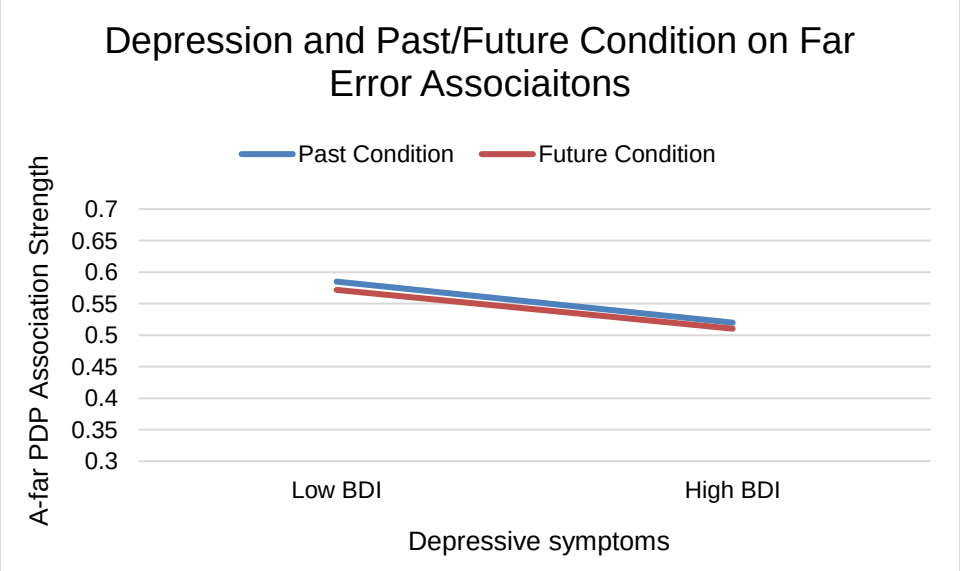

Figure 2