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ALTERING IMPULSIVE DECISION MAKING WITH AN ACCEPTANCE-BASED PROCEDURE

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Abstract

Delay discounting is one facet of impulsive decision making and involves subjectively devaluing a delayed outcome. Steeply discounting delayed rewards is correlated with substance abuse and other problematic behaviors. To the extent that steep delay discounting underlies these clinical disorders, it would be advantageous to find psychosocial avenues for reducing delay discounting. Acceptance-based interventions may prove useful as they may help to decrease the distress that arises while waiting for a delayed outcome. The current study was conducted to determine if a 60–90 minute acceptance-based training would change delay discounting rates among 30 undergraduate university students in comparison to a waitlist control. Measures given at pre- and post-training included a hypothetical monetary- delay discounting task, the Acceptance and Action Questionnaire-II, and the Distress Tolerance Scale. Those assigned to the Treatment group decreased their discounting of delayed money, but not distress intolerance or psychological inflexibility when compared to the Waitlist Control group. After the waiting period, the control group received the intervention. Combining all participants' pre- to post-treatment data, the acceptance-based treatment significantly decreased discounting of monetary rewards and increased distress tolerance. The difference in AAQ-II approached significance. Acceptance-based treatments may be a worthwhile option for decreasing delay discounting rates and, consequently, affecting the choices that underlie addiction and other problematic behaviors.

Keywords

ACT; acceptance; impulsivity; delay discounting; distress tolerance

Impulsivity has many definitions, aspects, and possible mechanisms to its expression (Evenden, 1999) and is evident in many forms of problematic behavior (e.g., substance use, compulsive gambling, self-injurious behavior, aggression). One aspect of impulsivity is impulsive choice – preference for a smaller-sooner reward (SSR) over a larger-later reward (LLR). Selecting the SSR suggests that the subjective value of the LLR is discounted below the objective value of the SSR (e.g., Ainslie, 1975). Such devaluation is referred to as delay discounting, a behavioral process that has received considerable attention both with human and nonhuman subjects (e.g., Madden & Bickel, 2010), in part, because individuals

diagnosed with antisocial personality disorder (Petry, 2002), pathological gambling (Dixon, Marley, & Jacobs, 2003; Petry & Casarella, 1999; Petry, 2001), obesity (Davis, Patte, Curtis, & Reid, 2010; Rasmussen, Lawyer, & Reilly, 2010), problematic pornography viewing (Lawyer, 2008), and substance use (MacKillop et al., 2011; Odum, Madden, Badger, & Bickel, 2000) tend to discount the value of delayed outcomes at a high rate.

Substance use is related to delay discounting in both preclinical and clinical studies. In the nonhuman laboratory, rats that steeply discount delayed food rewards are more likely to learn to press a lever to self-administer an infusion of cocaine (Anker, Perry, Gliddon, & Carroll, 2009; Perry, Larson, German, Madden, & Carroll, 2005). These high-impulsive rats are also more likely to press the lever many times to earn a drug reward when the effort required to obtain that reward is escalated (Diergaarde et al., 2008; Koffarnus & Woods, 2011). Among humans, a limited number of longitudinal studies suggest that steeply discounting monetary rewards is predictive of adolescent cigarette smoking (Audrain-McGovern et al., 2009) and alcohol use (Khurana et al., 2013). Several studies have reported that steeply discounting delayed rewards is predictive of poor outcomes either during or after substance-abuse treatment (e.g., Yoon et al., 2007).

Because steep delay discounting appears to precede and predict substance abuse, research has begun to explore ways in which to produce lasting reductions in delay discounting (e.g., Bickel, Yi, Landes, Hill, & Baxter, 2011; Black & Rosen, 2011; Stein et al., 2013). One strategy that has received relatively little attention is to focus on the aversive properties of the delay (Paglieri, 2013; Scheres, Tontsch, & Lee Thoeny, 2013). Such a strategy is implied if one presumes that a mechanism of delay discounting is that selection of the SSR represents avoidance of the aversive properties of the delay to the LLR. For example, the abstaining cigarette smoker must endure nicotine withdrawal and cue-induced craving while waiting for the delayed benefits of smoking abstinence (i.e., the LLR). If these delay-related aversive events are intolerable, then the smoker will escape/avoid these events by relapsing to smoking (i.e., selecting the SSR). More generally, individuals who demonstrate low distress tolerance may be more likely to avoid delay-related aversive events (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996; Simons & Gaher, 2005). Consistent with this analysis, Dennhardt and Murphy (2011) reported that individuals with low tolerance for distressing events tended to steeply discount delayed consequences.

Distress intolerance and psychological inflexibility are related constructs and describe a general unwillingness to stay in contact with uncomfortable inner experiences which can lead to regulatory actions (through escape or avoidance of those inner experiences) often resulting in negative effects on functioning (Hayes et al., 1996; Simons & Gaher, 2005). Treatments that target these constructs increase access to more powerful, delayed rewards by decreasing attempts to control and/or avoid internal states through acceptance and mindfulness practices (Hayes, Strosahl, & Wilson, 2012; Linehan, 1993). There are promising effects of acceptance-based procedures for a myriad of problematic, impulsive behaviors such as substance use (Gifford et al., 2004; Hernández-López, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009; Petersen & Zettle, 2009), problematic pornography viewing (Towhig & Crosby, 2010), obesity (Forman, Butryn, Hoffman, & Herbert, 2009;

Niemeier, Leahey, Reed, Brown, & Wing, 2012), and problematic gambling (Nastally & Dixon, 2012); problems that correlate with high rates of delay discounting.

Given the good theoretical and empirical fit between therapies that target distress tolerance and psychological flexibility, the present study explored a novel strategy for decreasing delay discounting – using a brief acceptance-based intervention designed to increase willingness to experience discomfort. Because other brief acceptance-based trainings have proven effective in changing target behaviors (e.g., Levin, Hildebrandt, Lillis, & Hayes, 2012) we predicted that our training would decrease delay discounting when compared to a waitlist control group. Additionally, we expected the training to increase psychological flexibility and distress tolerance.

METHODS

Participants

Eligibility Screening—Participants were recruited from the student body at Utah State University through announcements in psychology courses, on-campus fliers, and campus web resources. Participants received credit toward their psychology courses for participation (as determined by their instructor). Eligible participants were at least 18 years of age and could read and communicate in English.

In the initial stage of participation, students gave informed consent and completed a monetary delay-discounting task online. In the task, participants made a series of choices between two hypothetical monetary rewards; one smaller reward was described as delivered immediately (SSR) and the other larger reward after a delay (LLR); this task is described in greater detail in the Measures section. Participants were eligible for further participation if their pattern of choices reflected steep discounting of the value of the LLRs. To quantify delay discounting an indifference point was obtained at a series of delays to the LLR. The indifference point was derived from participant choices and reflected the value of the SSR at which indifference between the SSR and the LLR was predicted to occur. The area under the indifference points across the range of delays to the LLR served as the quantitative measure of delay discounting. Area under the curve (AUC; Green, Myerson, & Warusawitharana, 2001) values range from 0–1, where 0 indicates a strict preference for the SSR and 1 indicates strict preference for the LLR (i.e., no delay discounting). On a rolling basis, participants with $AUC < 0.4$ were invited to participate in the remainder of the study provided that their indifference points systematically declined with increasing delays (no more than one of the indifference points could violate this decreasing trend). An AUC of .4 was selected because it reflects a tendency toward steep discounting (.5 indicates that half of the area of the plot is below the delay discounting curve) among the population sampled.

Assignment to Groups—The training was evaluated through a randomized controlled design with a waitlist condition. The first 34 individuals who met eligibility and agreed to continue their participation provided a second informed consent prior to the first in-person session. Of these, 17 were randomly assigned to the training group and 17 to the waitlist control group. Two participants from the training group withdrew after the first training session; one withdrew because the training elicited distress and the other withdrew due to

external stressors. Two participants from the waitlist group withdrew after the first session because of scheduling conflicts. The remaining 30 participants (training=15; waitlist=15) completed the study (ages 18 to 41, average age = 21.5 years). There were an equal number of male and female participants. Most participants were single (83%), had no previous meditation experience (90%), and did not currently use alcohol (73.3%) or other recreational drugs (80%). The majority was White American (93.3%) and the remaining participants were African American (3.3%) and Latino (3.3%). Independent samples t-tests or chi-square tests revealed no significant differences in any pretreatment measures between groups.

Procedure

During the first in-person session (Time 1) all participants completed the Monetary Delay Discounting Task, the Acceptance and Action Questionnaire (AAQ-II), and the Distress Tolerance Scale (DTS); these tasks are described in detail in the Measures section. Completing these assessments took approximately 30 minutes, after which the waitlist control participants were dismissed.

For participants assigned to the training group, the second portion of the Time 1 session was spent with a graduate-student experimenter (KLM) who conducted a 60–90 minute acceptance-based training session with the participant; this training protocol is described in the subsequent section. The experimenter was supervised by a licensed clinical psychologist (MPT) to ensure adherence to the protocol.

One week after the Time 1 session, all participants returned to the laboratory and completed the same assessment measures (Time 2). Participants assigned to the training group were dismissed after completing these assessments, while those assigned to the waitlist group completed the acceptance-based training protocol during the Time 2 session. One week following the Time 2 session, the waitlist participants returned to the laboratory to complete the assessment measures in a Time 3 session.

Acceptance-Based Training Session

The acceptance-based training session primarily focused on two components of acceptance and commitment therapy (Hayes et al., 2012): acceptance and values. The description here explains processes that were targeted with all participants; however, the training was adjusted based on the participants' particular struggles and reactions to the training.

The training began by explaining to the participant the reason for inclusion in the study and what to expect ("Based on the questionnaires you completed, it seems like impulsive decision making may cause problems for you. Today, we're going to talk about ways you live your life and see if this is true."). The participant was told that distressing topics might be part of the conversation and to be welcoming if distress arises. The participant was asked about decisions that were based on moment to moment feelings and if those decisions led to problems in life.

Then, the therapist discussed internal barriers to healthy decision making. In order to illustrate the short-term effectiveness of strategies the participant might be using to reduce or eliminate unwanted internal experiences, an exercise highlighting the ineffectiveness of the

participant's regulating strategies occurred. Unwanted internal experiences were likened to a leaky pipe and the strategies the participant has previously used to control these experiences were likened to the techniques of a plumber. The participant was asked if the plumber (control strategy) was able to permanently fix the leak (i.e., eliminate internal distress) or if the plumber's techniques produced only temporary reductions in the leak. The goal of this part of the session was for the participant to consider that strategies to not feel distress might only be a short term solution to a chronic issue, and that looking for new ways to react to that leak (internal distress) might be more functional. Consistent with this goal, the experimenter next discussed the process and effects of the human mind, and its inherent drive to control and adjust distress. These were demonstrated through variations of the Polygraph Metaphor (Hayes et al., 2012, p. 182) and the Chocolate Cake Exercise (Hayes, Strosahl, & Wilson, 1999, p. 124).

These demonstrations of the futility of attempts to control mental content led into a discussion about acceptance-based strategies. The acceptance-based strategies were discovered by the participant through the Unwanted Party Guest Metaphor (Hayes et al., 2012, p. 279) and an exercise in which the participant wrote an unwanted thought or feeling on a notecard, and carried it throughout the day representing a willingness to have that inner experience with him or her. The metaphor and exercise were provided to demonstrate the amount of effort the participant has allocated toward removing an unwanted thought/feeling with little or no success. They also highlighted the reduction in effort that could be achieved if one could willingly experience distressing events.

If the participant reacted with fear when asked to "welcome" distressing events, the experimenter assisted the participant in viewing the thought as a thought (i.e., private behavior without literal meaning) and emotions as emotions (i.e., adaptive physical reactions that need not be managed). This was done through an exercise in which an object was held in an open hand to represent the way in which internal experiences can be held in mind: open, welcoming, gentle. This exercise was also used to illustrate the distinction between the person holding the object and the object itself (likened to the distinction of the person holding the thought and the thought itself).

This series of discussions and exercises was designed to aid the participant in seeing that behavior need not be guided by internal experiences (i.e., the seeking/avoidance of pleasurable/aversive thoughts and emotions) but could instead be guided by values. To the latter end, the participant completed the Values Bulls-Eye worksheet (Lundgren, Luoma, Dahl, Strosahl, & Melin, 2012) with guidance from the experimenter. The worksheet is designed to aid in connecting with a values-consistent pattern of behavior and to assess current behavior against that desired pattern. After completing the worksheet, the experimenter asked the participant to consider being at a fork in the road (a variation of the Passengers on the Bus metaphor; Hayes et al., 2012, p. 250). Choosing one fork would likely lead to a momentary reduction in distress. Past experiences suggest that this choice would not achieve a long-term reduction in distress, nor would it help in living a values-consistent life. The other fork is the path of acceptance of the thoughts, emotions, and experiences that may be encountered while behaving in a way consistent with one's values.

The training session concluded by orienting the participant to a goal-tracking form that the participant was encouraged to use over the next seven days and to return to the lab at the next scheduled session. The five-column form was supplied to encourage continued engagement with the content of the training session. The experimenter guided the participant through completing one line of the form. In the first column the participant wrote the internal experience that was creating a barrier to values-consistent decision-making (e.g., sugar cravings, boredom, fatigue). In the second column the participant wrote his/her reaction to the internal event (e.g., open/willing, angry/unwilling). The next column asked the participant to track what was done in response to the internal experience (e.g., ate a candy bar, stopped doing homework and watched TV, went to the gym and exercised despite feeling fatigued). In the fourth column the participant wrote what occurred to the internal experience after the action noted in the preceding column (e.g., boredom went away for five minutes but returned later and was compounded with feelings of guilt and self-criticism). The final column asked whether the action took the participant closer or further from the values-consistent pattern of behavior identified previously. The full training protocol can be accessed by contacting the corresponding author.

Measures

Background Information—This is a self-report measure that assesses sex, marital status, age, education, ethnicity, previous meditation experience, physical ability to participate, current substance/alcohol use, and psychological diagnoses.

Monetary Delay Discounting Task—This task, based on that used by Rachlin et al. (1991) measures the rate at which the perceived value of a reward decreases as the delay to receive the reward increases. This was used for both the online screening (survey) and in person assessments (computerized). Participants are presented with a series of choices between hypothetical monetary rewards. One reward, the SSR, was available “now” whereas the other, the LLR, was available after one of seven different delays (1 week, 2 weeks, 1 month, 6 months, 1 year, 5 years, and 25 years). The LLR was always \$1000. At each delay in the ascending sequence, the SSR was initially set at \$1000 and decreased following every choice (made by clicking the preferred option) according to the sequence \$1000, \$990, \$960, \$920, \$850, \$800, \$750, \$700, \$650, \$600, \$550, \$500, \$450, \$400, \$350, \$300, \$250, \$200, \$150, \$100, \$80, \$60, \$40, \$20, \$10, \$5, and \$1. The discounted value of the LLR at each delay was the average of the last SSR chosen and the first LLR chose in the descending series of SSR amounts. The test-retest reliability of this task is good ranging from one week ($r = .91$, Beck & Triplett, 2009) to one year ($r = .71$, Kirby, 2009). This delay discounting task is widely used and, like other delay discounting tasks, measures an aspect of impulsivity that is robustly correlated with substance abuse (see review by Madden & Johnson, 2010).

Acceptance and Action Questionnaire-II—(AAQ-II; Bond et al., 2011). This is a 7-item Likert-scale measure of experiential avoidance and psychological inflexibility. Response options range from 1 (never true) to 7 (always). Higher scores indicate greater psychological inflexibility. Although there is no established cutoff for the AAQ-II, scores that fall above a range of 24–28 are associated with clinically relevant levels of

psychological distress (Bond et al., 2011). Across seven samples totaling 3,280 participants, the mean alpha coefficient was .83 and within a community sample, the test-retest reliability was .80 (three months) and .78 (one year; Bond et al., 2011). The correlation with the original AAQ is strong ($r = .82$; Bond et al., 2011).

Distress Tolerance Scale (DTS; Simons & Gaher, 2005)—This is a 15-item self-report measure that assesses beliefs about feeling distressed or upset. These beliefs are rated from 1 (strongly agree) to 5 (strongly disagree). There are four different types of questions: perceived ability to *tolerate* emotional distress, subjective *appraisal* of distress, attention being *absorbed* by negative emotions, and *regulation* efforts to alleviate distress (Simons & Gaher, 2005). The total score is calculated by taking the mean of the four subscale means (after reversing item 6). While there is no cutoff for the DTS, higher scores represent higher levels of distress tolerance. In a college population, the mean score was 3.43 with a standard deviation of 0.76 (Simons & Gaher, 2005). Test-retest reliability is good at six months ($r = .61$; Simons & Gaher, 2005). Internal consistency ($\alpha = .95$) and convergent validity were strong in a substance using population as well (Hsu, Collins, & Marlatt, 2013).

An additional measure of delay discounting was administered, but it is not reported in this paper.

Data Analysis Techniques

Prior to statistical analyses of the data generated within the Monetary Delay-Discounting task, the discounted values of the LLRs were plotted as a function of delay and the results were assessed for nonsystematic responding as defined by Johnson and Bickel (2008). Specifically, a participant's data were deemed nonsystematic and excluded from analyses if a) the discounted value of a LLR was at least 20% greater than the discounted value of the LLR at the next-lowest delay or b) the discounted value of the LLR at the longest delay was not at least 10% less than the discounted value of the LLR at the shortest delay. Based on these criteria, the data of two participants (one from each group) were excluded. After removal of those participants, randomization assurance procedures were replicated. There were no significant differences between the groups at Time 1 on the monetary discounting task, ($p = .393$). As previously described, delay discounting over the range of delays to the LLRs was quantified for each participant in each task using the AUC (Myerson, Green, & Warusawitharana, 2001). AUC calculations tend to produce normal distributions and allow parametric statistics to be used (Odum, 2011). Data were inspected for departures from normality. There were no missing data and normality assumptions were not violated.

A 2 (time) $\times$ 2 (group) mixed between-within subjects analysis of variance (ANOVA) was used to evaluate differences in AUC, AAQ-II, and DTS scores between groups at Time 1 and Time 2. After the Waitlist Control group had completed the acceptance-based training, we further evaluated the effects of the training by examining pre- to post-training data for the Waitlist Control group, as well as the combination of pre-training data across groups (Time 1 for the Training group and Time 2 for the Waitlist Control group) and the post-training data across groups (Time 2 for the Training group and Time 3 for the Waitlist Control group). Nonsystematic Time 3 delay discounting data were identified in two participants in the

Waitlist Control group and were excluded as described previously. After the waitlist period, group equivalency on the AUC, AAQ-II, and DTS at pretraining showed no significant differences between those who immediately received training and those who did not. Dependent t-tests were used to evaluate changes in AUC from pre- to post-training. Cohen's d was used to quantify effect size of these pre- to post-training differences with difference score in the numerator and the standard deviation of the difference scores in the denominator.

RESULTS

Figure 1 shows the delay discounting data for the Training and Waitlist Control groups at Times 1 and 2. This figure represents the median indifference points at each of the assessed delays. The sum of the area contained by the adjacent trapezoids created between successive median indifference points in each data series is the average AUC for that specific group and time. The mean AUC calculated from indifference points from individual participants (and SDs) derived from these data are shown in Table 1. A significant group $\times$ time interaction was detected ($F(1, 26) = 4.658, p = .04$, partial $\eta^2 = .152$) and the main effects of time ($F(1, 26) = 10.725, p = .003$, partial $\eta^2 = .292$) and group ($F(1, 26) = 4.098, p = .053$, partial $\eta^2 = .136$) were significant. The significant interaction indicates that the amount by which AUC values increased over time depended on group, with the Training group showing a larger increase (i.e., less discounting of LLRs) at Time 2 than the Waitlist Control group.

Scores on the AAQ-II (measure of experiential avoidance and psychological inflexibility) did not change from Time 1 to Time 2 ($p = .202$) and were unaffected by training ($p = .281$). Likewise, the time $\times$ group interaction was not significant ($p = .377$). Scores on the DTS (measure of distress tolerance) were also unaffected by time ($p = .092$) or training ($p = .447$) and the interaction was not significant ($p = .491$).

Pre- to post-treatment measures among the Waitlist Control group revealed a significant increase in DTS scores, $t(14) = -2.49, p = .026$, but no change in delay discounting AUCs, $p = .267$, or AAQ-II scores, $p = .132$. However, when pre- and post-training scores were combined across groups as in Figure 2, the increase in AUC values from pre- to post-training was significant ($t(25) = -2.911, p = .007$, Cohen's $d = .57$). Likewise, the analysis of the combined DTS scores revealed a significant increase from pre- to post-training ($t(29) = -2.665, p = .012$, Cohen's $d = .49$) whereas the increase in AAQ-II scores only approached significance ($t(29) = 1.972, p = .058$; Cohen's $d = .36$).

DISCUSSION

This study examined the effectiveness of a brief acceptance-based training on delay discounting rates through a randomized controlled trial waitlist design with undergraduates selected for higher rates of delay discounting. The post-training assessments of the treatment group revealed a decrease in impulsive decision-making; i.e., a reduced tendency to choose smaller more immediate rewards over larger but delayed rewards. After combining the data from pre- to post-training and eliminating the control group, this effect of training on delay discounting was observed and the effect size was moderate. In the combined analysis,

significant reductions were seen for the distress tolerance measure and changes in the measure of psychological inflexibility approached significance. This study is the first known application of an acceptance-based intervention targeting delay discounting.

The significant reduction in delay discounting observed across the Training group and the pre- to post-training combined group after receiving the acceptance-based training is unlikely due to maturational variables because delay discounting appears to be stable over a one-week time frame (Odum, 2011) and because, in the present study, the test-retest reliability of our Monetary Delay-Discounting task was good ($r(13) = .953, p < .001$). Nonetheless, from Time 1 to Time 2 discounting rates declined (main effect of time) but this decrease was more pronounced in the Training rather than the Waitlist Control group (significant time $\times$ group interaction).

The measures of psychological flexibility (AAQ-II) and distress tolerance (DTS) did not significantly change from Time 1 to Time 2 for either group alone. However, when the groups were combined for pre- to post-training analyses, the increase in DTS scores was significant and the increase in AAQ-II scores approached significance. While the increase in DTS scores in the combined analysis was significant, the DTS scores in the Waitlist Control group also increased. Again, the lack of a control group for these analyses limits the interpretations as other nonspecific effects could be accountable for the change. One potential interpretation is that distress tolerance plays a larger role than psychological flexibility in delay discounting. Consistent with this interpretation, substance use disorders are correlated with steep delay discounting (MacKillop et al., 2011) and low distress tolerance (e.g., Daughters et al., 2009; Zvolensky et al., 2009).

Although delay discounting, unless acted upon by an outside force, tends to be a stable trait (Odum, 2011), some researchers have explored interventions by which delay discounting might be reduced (see review by Koffarnus, Jarmolowicz, Mueller, & Bickel, 2013). To the extent that delay discounting is causally related to problematic behavior like substance use and pathological gambling, effective interventions would be useful. Past studies have shown that interventions as diverse as working memory training (Bickel et al., 2011) and mindfulness eating exercises (Hendrickson & Rasmussen, 2013) can impact delay discounting. However, this is the first study to actively target the perception of internal experiences (i.e., cognition, emotion, and bodily sensations) and the importance of values-consistent action on delay discounting.

Six limitations of the present study will be discussed. First, the brevity of our acceptance-based training required quick identification of a target behavior that fit within the model of delay discounting (i.e., choices between small-immediate and large-delayed outcomes). The procedure used to quickly identify the target behavior may have influenced the choices made in the post-training delay discounting tasks. That is, a Hawthorne effect (Mangione-Smith, Elliott, McDonald, & McGlynn, 2002; McCarney et al., 2007), whereby participants behave in accord with the apparent wishes of the experimenter, may play a role in the outcome. Within this procedure, participants were given the rationale for inclusion in the study only before the training and not during the waitlist assessment. This awareness could have altered responding separately from the training and complicates the treatment effects. Future studies

would benefit from a control training group, in which critical components of the acceptance-based training are withheld or add a measure of the awareness of the research targets (Rubin, Paolini, & Crisp, 2010). Second, the sample size of this pilot study was small and replication is called for. Third, the sample was homogenous (mostly Caucasian, university undergraduate students). Future research should evaluate the generality of our findings by replicating the methods with a more diverse sample of participants. Fourth, the severity of problem behavior in the current study was mostly subclinical. Further research needs to be conducted with more severe populations in order to fully assess whether this intervention is effective for reducing delay discounting in the areas in which it is most commonly related and needed (e.g., substance use). Fifth, although the experimenter providing the treatment was supervised throughout the study, the intervention was not coded for adherence to the model. Future studies will benefit from more rigorous treatment adherence procedures and measures to ensure validation of the manipulation. Finally, the present study did not assess the long term effects of the intervention. Doing so would provide information about the lasting impact of the treatment on delay discounting, problematic behavior, and overall functioning. Future studies might assess discounting at several time points throughout treatment and track the relation between acceptance, changes in discounting, and symptom severity.

While the present study has limitations, this study highlights the potential benefits of addressing experiential avoidance/distress tolerance when attempting to change impulsive decision making. Given the growing literature base of delay discounting and problem behaviors, this is an area that shows promise. Interventions that can change the underlying constructs of delay discounting may have a global impact on problematic behaviors.

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Median Indifference Points

Figure 1.

Time 1 and 2 Analysis: Median Indifference Points Obtained in the Delay Discounting Task

Median Indifference Points

Figure 2.
Combined Analysis: Median Indifference Points Obtained in the Delay Discounting Task

Table 1

Time 1 and 2 Analysis: Outcome Means and Standard Deviations

Variable	Time 1				Time 2			
	Training		Waitlist		Training		Waitlist	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
AUC ^a	0.26	0.16	0.22	0.13	0.44	0.22	0.25	0.17
AAQ-II ^b	23.27	10.16	19.07	7.68	21.47	9.71	18.73	7.84
DTS ^b	3.28	0.87	3.55	0.76	3.46	0.74	3.63	0.75

Note. AUC: Monetary Delay-Discounting area under the curve; AAQ-II: Acceptance and Action Questionnaire-II; DTS: Distress Tolerance Scale.

^a
n = 14.

^d
n = 15.

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Table 2

Combined Analysis: Means and Standard Deviations of Outcome Variables

Variable	Pretraining		Posttraining		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
AUC ^a	0.27	0.16	0.39	0.22	-2.911	.007*
AAQ-II ^b	21.00	9.21	19.50	8.80	1.972	.058
DTS ^b	3.46	0.82	3.66	0.80	-2.665	.012*

Note. AUC: Monetary Delay-Discounting area under the curve; AAQ-II: Acceptance and Action Questionnaire-II; DTS: Distress Tolerance Scale.

* significant at $\alpha=.05$.

^a $n=26$.

^b $n=30$.