EFFECTS OF ACCEPTANCE AND COMMITMENT THERAPY ON IMPULSIVE DECISION MAKING

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Abstract

This study examined the transdiagnostic effect of acceptance and commitment therapy (ACT) on impulsive decision making in a community sample. Forty adults were randomized to eight individual sessions of ACT or an inactive control. Participants completed pre-, mid-, and post-assessments for psychological symptoms, overall behavior change, valued living, delay discounting, psychological flexibility, and distress tolerance. Data were analyzed with multilevel modeling of growth curves. Significant interaction effects of time and condition were observed for psychological flexibility, distress tolerance, psychological symptoms, and the obstruction subscale of valued living. No significant interaction effect was found for two delay discounting tasks nor the progress subscale of valued living. The ACT condition had a significantly larger reduction of problem behavior at post-assessment. The results support use of ACT as a transdiagnostic treatment for impulsive behaviors. The lack of change in delay discounting contrasts previous research.

Keywords: transdiagnostic, acceptance and commitment therapy, impulsivity, delay discounting

Effects of Acceptance and Commitment Therapy on Impulsive Decision Making

The Diagnostic and Statistical Manual of Mental Disorders (DSM), the most widely used diagnostic system for mental health disorders in the United States (American Psychiatric Association, 2013), classifies presenting symptomology into categories. This categorical system has enabled communication between health professionals and facilitated exploration and understanding of symptom clusters. Yet, the high rate of comorbid diagnoses (Kessler, Chiu, Demler, & Walters, 2005; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012) suggests the existence of underlying "core processes" that are not captured in the categorical approach (Krueger, 2002). Interventions targeting only one disorder often have a beneficial effect on co-occurring disorders, indicating that shared underlying core processes are being altered (e.g., Borkovec, Abel, & Newman, 1995; Tsao, Mystkowski, Zucker, & Craske, 2005). Moreover, disorder-specific interventions can be inefficient in terms of dissemination and implementation when clinicians need to be well-versed in multiple interventions to treat clients presenting with a range of disorders (Craske, 2012). In light of these issues, a recent shift in mental health research and services has occurred. Transdiagnostic treatments that target topographically different, but functionally similar, behaviors have accumulated.

A transdiagnostic approach to psychopathology addresses many of the disadvantages of the categorical approach. It seeks to identify shared underlying processes across multiple disorders and problematic behaviors (Nolen-Hoeksema & Watkins, 2011), which may increase efficiency in assessment and treatment. For example, if a single treatment package can positively influence a core process that underlies several different dysfunctional behaviors, this could reduce the number of treatments needed. Likewise, assessments could be restructured to assess for common core processes that increase the risk of dysfunctional behaviors. This can inform

treatment providers of the best and most parsimonious course of action, alleviating treatment burden for clients.

Accumulating evidence on the efficacy of transdiagnostic therapeutic approaches suggest that they are at least as efficacious as established diagnosis-specific interventions, such as cognitive behavioral therapy (CBT) for anxiety disorders (Fairburn et al., 2015; Newby, McKinnon, Kuyken, Gilbody, & Dalgleish, 2015; Norton & Barrera, 2012; Pearl & Norton, 2017). Furthermore, transdiagnostic CBT has been found to decrease the rate of clinically significant comorbid diagnoses at posttreatment (66.7% of treatment completers no longer met criteria) to a greater extent than diagnosis-specific CBT used in prior studies (approximately 48.5% of completers; Norton et al., 2013). This suggests that multiple outcome variables can be and are simultaneously modified by transdiagnostic protocols. Additionally, a transdiagnostic psychotherapy has been tested among veterans with affective disorders, providing preliminary supporting evidence for ease of dissemination and implementation (Gros, Szafranski, & Shead, 2017).

Several core processes underlying psychological disorders have been explored in the transdiagnostic literature, including distress tolerance, intolerance of uncertainty, and negativity bias (e.g., Aldao & Nolen-Hoeksema, 2010; Bernstein, Marshall, & Zvolensky, 2011; Mahoney & McEvoy, 2012; Rozin & Royzman, 2001). One process that has been examined in neuroscience and behavioral economics—with nonhuman and human subjects—is delay discounting. Delay discounting describes the devaluation of outcomes when they are delayed. Steeply discounting the value of a larger-later reward often underlies preference for a smaller-sooner reward (Ainslie, 1975), a pattern of choice constituting one of the many facets of impulsivity (Monterosso & Ainslie, 1999).

The degree to which delayed rewards are discounted is correlated with various forms of dysfunctional behavior. For example, a large number of studies reveal steep delay discounting is related to addictive behaviors (e.g., alcohol, tobacco, opiates, stimulants, pathological gambling; MacKillop et al., 2011), obesity (Amlung, Petker, Jackson, Balodis, & MacKillop, 2016), pathological video gaming (Irvine et al., 2013), and problematic pornography viewing (Lawyer, 2008). Given these robust relations between steep delay discounting and behavioral dysfunction, reducing delay discounting may impact these behaviors (Koffarnus, Jarmolowicz, Mueller, & Bickel, 2013).

The literature evaluating clinical efforts to reduce delay discounting is limited mostly to the area of substance-abuse treatment. Some studies have reported positive outcomes using some combination of contingency management, counseling, and shaping of positive behaviors (Landes, Christensen, & Bickel, 2012), whereas other studies have reported mixed or null effects of these manipulations (e.g., Weidberg, Landes, Garcia-Rodriguez, Yoon, & Secades-Villa, 2015). Other approaches to substance-abuse treatment have not produced clear reductions in delay discounting (Secades-Villa, Weidberg, García-Rodríguez, Fernández-Hermida, & Yoon, 2014). Together, these studies suggest that delay discounting can be reduced in a clinical setting, but no method has emerged as reliably effective.

Acceptance and commitment therapy (ACT; Steven C. Hayes, Luoma, Bond, Masuda, & Lillis, 2006) is a psychotherapeutic intervention that has traditionally been seen as a transdiagnostic treatment because of its primary focus on altering function—rather than content or topography—of behaviors. The goal of ACT is to increase situationally appropriate decision making through decreasing the impact of internal events that occur in the short-term and increasing the impact of external future rewards. Successful implementation of ACT results in a

shift from engaging in behaviors for immediate gratification to behaviors that serve the purpose of maintaining meaningful long-term outcomes.

The process that is theorized to underlie this shift is referred to as psychological flexibility (Steven C. Hayes et al., 2006). The opposing process, psychological *in*flexibility, is characterized by persistent attempts to avoid or alter unwanted internal experiences, which result in behaviors that are incongruent with a meaningful life (Steven C. Hayes et al., 2006). Psychological inflexibility occurs across problematic behaviors and is proposed to occur, to varying degrees, in all verbal humans (Steven C. Hayes et al., 2004). Two similar constructs that describe the inability to remain in contact with distressing stimuli, distress intolerance and experiential avoidance, may be present in those with higher delay discounting rates and there is some empirical support for this. Undergraduates with higher levels of experiential avoidance more often chose to receive three electric shocks after a delay than one shock immediately (U = 64.50, z = 2.16, p = .03; Salters-Pedneault & Diller, 2013). Also, higher rates of distress tolerance were significantly related to lower levels of delay discounting in African American (r = -.315, $p < .05$) and European American (r = -.442, $p < .05$) alcohol using undergraduates (Dennhardt & Murphy, 2011); the latter finding has been replicated and extended to show that the relation between distress tolerance and discounting is specific to those evidencing problematic levels of alcohol use (Rung, Johnson, & Madden, 2018).

Although little research has been conducted on the relations between psychological flexibility, distress tolerance, experiential avoidance, and delay discounting, ACT has been successful at reducing dysfunctional behaviors that are related to delay discounting (e.g., Crosby & Twohig, 2016; Hernández-López, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009; Nastally & Dixon, 2012; Niemeier, Leahey, Reed, Brown, & Wing, 2012). It is hypothesized that

an open, welcoming, nonattached stance toward internal experiences results in decision making in favor of the highest overall reward amount (larger delayed rewards). This hypothesis was tested in a pilot study where delay discounting rates were reduced (d = 0.57) by a brief training based on ACT principles in a college sample with mild psychopathology (Morrison, Madden, Odum, Friedel, & Twohig, 2014). The current study expanded on those findings by using a full course of ACT to change delay discounting rates in treatment-seeking individuals with more severe psychopathology. We predicted that ACT would a) reduce problematic target behaviors in comparison to the inactive control condition, b) increase psychological flexibility, distress tolerance, overall well-being, and valued-living, and c) decrease delay discounting rates.

Method

This study was approved by the Utah State University Institutional Review Board. Treatment effect was determined through a randomized controlled trial with an inactive control comparison condition. Participants were screened over the phone and invited for in-person pre-assessment (Time 1) if initial criteria were met. Those that met eligibility criteria at Time 1 were randomly assigned to the ACT or control condition using block randomization (blocks = 10). Eligibility criteria included: a) 18 years of age or older, b) ability to read and communicate in English, c) interested in treatment to modify a specific behavior, d) area under the curve (AUC) value of 0.5 or less on the Delay Discounting Task (DDT), e) Outcome Questionnaire-45.2 total score of 54 or higher, f) stability on any psychotropic medications for 30 days or more, and g) not actively receiving psychotherapy or have not received psychotherapy within the past 30 days (excluding support groups). Recruitment occurred through the local university, health/mental health clinics, and community via online postings, flyers in clinics and public message boards,

contacting local mental health providers, and in-person recruitment in classes at the local university. All participants were self-referred.

Assessments occurred at intake, between sessions 4 and 5 (Time 2), and one week after session 8 (Time 3). Those in the inactive control did not receive an intervention and were instructed not to begin or change psychotropic medications or doses and not to begin psychotherapy during the course of the study. At Time 3, all participants denied beginning or changing any psychotropic medication(s) or participating in therapy outside of the study during their participation. Research participation credit was given for university students based on the course in which they were enrolled, and all participants received $10 per assessment completed (up to $30 per participant).

The ACT intervention was eight 50-minute weekly individual sessions consisting of exercises and discussions to a) assist in noticing the detrimental effects of attempts to control thoughts, emotions, and urges, b) aid in noticing that controlling thoughts, emotions, and urges only work in the short-term, c) teach willingness to experience distress, d) increase the distinction between internal experiences and behaviors, e) increase awareness of values, and f) increase engagement in values-consistent behavior. Two advanced graduate student therapists provided the ACT intervention under the supervision of a licensed psychologist. Both therapists and their supervisor had substantial experience in applied behavior analysis and ACT.

The following assessments were completed at each assessment (with the exception of the CSQ-8 which was only completed by the ACT condition participants at Time 3).

Problem Behavior Severity Questionnaire. This brief self-report questionnaire was face valid and assessed the average frequency (“On average, how often does this behavior occur (please provide a number of times per hour, day, week, or month)?”), duration (“On average,

how much time do you spend on this behavior (please provide a number of minutes/hours per day, week, or month)?)", and perceived impact ("On average, how you rate the impact of this behavior on your life?") of the target behaviors at the time of assessment. The latter item was rated on a seven-point Likert scale from 1 (not at problem at all) to 7 (extreme problem). The frequency and duration were reported retrospectively.

Delay Discounting Task (Rachlin, Raineri, & Cross, 1991; Yi et al., 2008). This measures the rate at which the value of a perceived reward decreases as the delay to receive the reward increases. This task was completed via E-Prime software (Psychology Software Tools, 2012) with set hypothetical choices of smaller amounts of money available immediately and larger amounts of money available after a specified delay. While the larger later reward stayed at $1000, the monetary value of the smaller outcome gradually declined for each delay. The specified delays were 1 week, 2 weeks, 1 month, 6 months, 1 year, 5 years, and 25 years. The specified monetary amounts were $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. Participants were instructed to make decisions as if they were actually receiving the money. Using hypothetical monetary values in delay discounting tasks produces results similar to real monetary rewards (M. W. Johnson & Bickel, 2002; Lagorio & Madden, 2005) and test-retest reliability is strong across various time points (Matusiewicz, Carter, Landes, & Yi, 2013; Weafer, Baggott, & de Wit, 2013).

Opportunity Cost Delay Discounting Tasks (P. S. Johnson, Herrmann, & Johnson, 2015). In the aforementioned delay discounting task, the conditions during the delay are not specified. Depending on the perception of what occurs during that delay (e.g., earn large sums of money, start a new job), responses may differ. To control for this potential variation, two tasks

were given that were explicit about the hypothetical context of the delay. Participants completed the Delay Discounting Task-Free condition (DDT-Free; allowed the participant to "leave the room and go about life as normal" while waiting for the delayed reward), followed by the Delay Discounting Task-Wait condition (DDT-Wait; required the participant to stay in the assessment room alone without access to the computer, could not sleep, and only allowed to leave to use the bathroom and mealtimes while waiting for the delayed reward). Instructions were modified based on the initial tasks researched by P. S. Johnson et al. (2015). Each condition included three questions about the instructions and a practice question and participants could only proceed after displaying understanding. The specified delays were 5 minutes, 10 minutes, 30 minutes, 1 hour, 3 hours, 6 hours, 12 hours, and 24 hours. Using a slider bar ($0-$100), participants selected an immediate monetary value that felt "just as good" as receiving $100 at each delay.

Outcome Questionnaire-45.2 (OQ-45.2; Lambert et al., 1996). This 45-item self-report measure was used to assess levels of common psychological symptoms (overall well-being) and to determine a change in symptoms during treatment. The cutoff for clinically significant levels of symptoms is 63 and a change of 14 points or more indicates clinically significant change in symptoms (Kim, Beretvas, & Sherry, 2010). Higher scores indicate a higher frequency of psychological symptoms and lower well-being. The OQ-45.2 total score has good internal consistency ($\alpha = .93$) and test-retest reliability ($r = .84$; Lambert et al., 1996).

Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011). This is a 7-item self-report measure of psychological inflexibility. Higher scores indicate greater psychological inflexibility. While there is no established cutoff for the AAQ-II, scores that fall above a range of 24-28 are associated with higher levels of psychological distress (Bond et al., 2011). It has good test-retest reliability ($r = 0.81$ at 3 months, $r = 0.79$ at 1 year; Bond et al., 2011).

Distress Tolerance Scale (DTS; Simons & Gaher, 2005). This 15-item self-report measure captures beliefs about feeling distressed. Test-retest reliability is good at 6 months (r = 0.61; Simons & Gaher, 2005). Higher scores indicate higher distress tolerance**.**

Client Satisfaction Questionnaire (CSQ-8; Attkisson & Zwick, 1982; Larsen, Attkisson, Hargreaves, & Nguyen, 1979). This is an 8-item self-report measure of satisfaction with the treatment provided. Higher scores indicate higher satisfaction with treatment. It has strong internal consistency (α = 0.93; Attkisson & Zwick, 1982) and is positively correlated with session attendance (r = 0.56; Attkisson & Zwick, 1982).

Valuing Questionnaire (VQ; Smout, Davies, Burns, & Christie, 2014). This 10-item self-report questionnaire assesses engagement in values during the previous week. There are two factors within the measure that are reported separately: progress and obstruction. The progress subscale (VQ-P; 5-items) measures awareness of and action toward values (higher scores indicate living a more valued life). The obstruction subscale (VQ-O; 5-items) measures the obstacles that interfere with valued living (lower scores indicate living a more valued life). An error occurred when entering the VQ into the survey software and the range of potential responses was limited from one to six when, in actuality, the measure offers the range of zero to six. The restricted values should be considered if comparing this VQ data to other samples.

Statistical Analyses

All non-DDT data were collected online using Qualtrics survey software (Qualtrics, 2005). Data were analyzed using SPSS statistical software (version 21; IBM Corp., 2012).

Delay discounting tasks. The delay discounting data were assessed for systematic responding using the criteria set forth by M. W. Johnson and Bickel (2008). Data are considered to be systematic if neither of the following criteria are met: a) “if any indifference point (starting

with the second delay) was greater than the preceding indifference point by a magnitude greater than 20% of the larger later reward" (JB1; p. 268) or b) "if the last indifference point was not less than the first indifference point by at least a magnitude equal to 10% of the larger later reward" (JB2; p. 268). A computing error occurred when calculating the DDT JB1 for eligibility status (Time 1): criterion was set at a less stringent 21% ($\geq$ \$210), rather than 20% ($\geq$ \$200). For consistency, the 21% criterion was used throughout the other time points for the DDT (20% criterion was maintained for the DDT-Free and DDT-Wait). If either criterion were met in the delay discounting data, it was removed from analyses. Additional data were removed that displayed an inverse discounting function, which suggests confusion with the task (see Rung, Argyle, Siri, & Madden, 2018 for further discussion).

Two measurement incidents from the DDT were excluded from analyses, one for meeting the JB1 criterion at Time 2 (ACT) and one for meeting the JB2 criterion at Time 3 (control). The DDT-Free was not analyzed due to extreme deviations from normality. Non-discounting (JB2) occurred across most of the sample in the DDT-Free (ACT = 55%, control = 68.3%), which caused the distribution of DDT-Free AUCs to be so skewed they were unable to be transformed to normality; because of the high number of non-discounters (> 50% of the entire sample) removal of these data was not a viable alternative. It was expected that little to no discounting would occur in this condition because of the short maximum delay (24 hours) and the ability to move about freely during the hypothetical delay; variability was so low the data were unanalyzable for changes in discounting.

Only the JB1 criterion was used to determine systematic data in the DDT-Wait, because removal of non-discounting (JB2) data would have noticeably reduced the sample size (ACT = 12.5%, control = 9.4%). For the DDT-Wait, one measurement incident was removed for meeting

both the JB1 criterion and for having an inverse curve and one measurement incident was removed for having an inverse curve alone. Each of those measurements were at Time 1 in the control condition.

The AUC was calculated for all systematic discounting data. Each discounting task produces a series of indifference points, which represent the value at which the participant is indifferent about the choice for larger later rewards vs. smaller sooner rewards (Myerson, Green, & Warusawitharana, 2001). The indifference point was defined as the point at which the participant shifts from smaller sooner to larger later. AUC values represent the area under the curve that is formed by adjacent indifference points and reflects steepness of the discounting curve. The area of each trapezoid (formed between subjective amounts and the specified delays) was calculated, summed, and divided by the total area for a standardized AUC value (Myerson et al., 2001). The range of potential values is 0 - 1, with 0 being extreme discounting and 1 being no discounting. AUC was chosen over, for example, discounting rates derived via nonlinear curve fitting (e.g., Mazur, 1987) because after conducting these curve fitting analyses, the distributions of discounting rates from all discounting tasks violated assumptions of normality. AUC was used as the dependent measure for all analyses pertaining to delay discounting because AUC better met normality assumptions even after transformation of discounting rates and *k*-values significantly correlated with AUC for all tasks at all time points[1].

Missing data. Missing data analysis that the data of the study variables were missing completely at random (MCAR) according to Little's MCAR test ($\chi^2(52) = 51.55$, $p = .492$). Per the measure scoring protocol for the OQ-45.2 (Lambert et al., 1996) and imputed the

[1] Spearman's *rho*s within-discounting task and within time-points for AUC and *k* were > .91 and *p*s < .0001 in all but one instance (*rho* = .81, *p* < .0001) after the removal of three off-line outliers (correlations conducted prior to exclusions based on JB criteria).

individual mean of the subscale into the missing item (Time 3 = 11% for one participant; 0.3% of all OQ-45.2 data). For the remaining amount of missing data (6 items; each from a different participant and item), individual mean imputation was used because of the extremely small percentage of missing data (0.07% of all data; Cheema, 2014). To determine any potential differences between those that completed the study and those that did not, independent samples *t*-tests were conducted for the outcome variables. The comparison of completer status (Table 1) showed a significant difference at Time 1 on the DDT-Wait (AUC), t (38) = 2.32, p = .01, the VQ-P, t (20.97) = -2.65, p = .02, and the VQ-O, t (38) = 2.26, p = .03. These values suggest that those that did not complete the study had lower delay discounting on the DDT-Wait and were less likely to live a valued life at Time 1.

Primary Analyses. The treatment effect on the primary variables of interest (AAQ-II, DDT, DDT-Wait, DTS, OQ-45.2, and VQ) were determined using growth curve modeling (Singer & Willett, 2003) within Multilevel Modeling (MLM) using an intent to treat analysis. Both fixed and random effects were estimated for the intercept and the slope; each individual was allowed to begin at different values (random intercepts) and were allowed to vary in their trajectory over time (random slopes).

For each outcome, a series of models were estimated differing in the variance-covariance structure. The most appropriate model was chosen based on the Bayesian Information Criteria (BIC) model fit indices. An unstructured covariance structure (no expectation of consistency in the covariance structure) was selected for each of the variables. The data were visually examined for normality using scatterplots of the overall residuals by predicted values and deemed to be normal.

Within and between group effect size values were calculated using Cohen's *d*. Within group effect sizes were calculated separately for each condition between Time 1 and Time 3 using Cohen's *d* for nonindependent data. Between group effect sizes were calculated by computing a pooled standard deviation. To compare rates of behavior change, a proportion of baseline was calculated by dividing later behavior by baseline behavior. These proportions of baseline behavior were compared using nonparametric Mann-Whitney *U* tests after removing outliers.

A power analysis was conducted using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007), an alpha level of 0.05, a power of 0.80, and for a Cohen's *d* of 0.65. This effect size was based on findings from Morrison et al. (2014) yielding a Cohen's *d* for high delay discounting of 0.57 and was increased by 15% because the magnitude of the intervention was increased in the current study. This analysis revealed that 31 participants were necessary to detect a large effect of 0.65 in a mixed between-within participants repeated measures Multivariate Analysis of Variance (MANOVA). As mentioned previously, MLM growth curve modeling was used instead to test the hypotheses, because MLM can deal with missing data and allows the testing of a wide range of different variance-covariance structures for the residuals.

Results

Sample Description

Forty participants were eligible and randomized into a condition. Thirty-three (ACT = 16, control = 17) completed all three time points (see participant flow chart, Figure 1, for more detail). The majority of participants (80%) were White (7.5 % Latinx, 5% Asian/Asian American, 5% mixed race, 2.5% other), 67.5% male, with a mean age of 26.8 (*SD* = 8.4). Twenty percent of the sample reported current use of psychotropic medication. Participants

reported the history of target behaviors at less than 12 months (5%), 13 months-5 years (22.5%), 6-10 years (27.5%), and over 10 years (45%). There were no differences between conditions at Time 1 on demographic or outcome variables, suggesting randomization was effective. The most frequent types of problem behaviors participants requested to target at Time 1 included procrastination (40%), problematic pornography/media use (30%), eating habits (25%), overall poor self-control (10%), and ineffective interaction styles (e.g., yelling, over-dependency; 10%); with the remaining less frequent behaviors (3-8%) being risky sexual behavior, poor sleeping habits, substance use, poor financial management, self-harm, and inactivity. Twenty-two participants (55%) requested help for one behavior (ACT = 14; control = 8), 14 participants (35%) for two behaviors (ACT = 3; control = 11), and 4 participants (10%) for three or more behaviors (ACT = 3; control = 1).

Impulsive Behavior Frequency

Four outliers in the ACT condition were excluded from the analyses of problem behavior frequency, one at Time 2 and three at Time 3. At Time 2 (midtreatment), there was no significant difference between the control (*Mdn* = 0.71, IQR = 0.36 - 1.36) and ACT (*Mdn* = 1.00, IQR = 0.25 - 1.75) conditions on reported occurrences of problem behavior ($U = 145$, $n_{control} = 18$, $n_{ACT} = 17$, $p = .81$). At Time 3 (posttreatment), the ACT condition (*Mdn* = 0.10, *IQR* = -0.15 - 0.35) had significantly lower proportions of their baseline behavior ($U = 48.5$, $n_{control} = 17$, $n_{ACT} = 12$, $p = .02$) in comparison to the control condition (*Mdn* = 0.71, *IQR* = 0.24 - 0.57). See Figure 2 for a visual depiction of the results.

Clinical Outcomes

There was a significant interaction effect of time and condition on AAQ-II, DTS, OQ-45.2, and VQ-O. Those who participated in ACT had significantly lower psychological

inflexibility (AAQ-II), higher distress tolerance (DTS), lower psychological symptoms (higher well-being; OQ-45.2), and were impacted less by obstacles to valued living (increased VQ-O). The magnitude of these effects was large (Table 2). There was no significant interaction effect on the progress subscale of valued living (VQ-P), but there was a significant effect of time, suggesting both conditions increased progress toward valued living.

Delay Discounting Outcomes

Table 2 shows the MLM growth curve models. As can be seen, AUC values of the DDT decreased significantly over time in both conditions. Yet, the control and ACT conditions did not significantly differ at baseline or in their slope, indicating that participating in ACT did not impact delay discounting beyond an inactive control. No statistically significant effects were found for condition, time, or the interaction of condition and time for the DDT-Wait (AUC). Results suggest that the intervention did not have a statistically significant effect on delay discounting.

Treatment Adherence

Twenty percent (n = 15) of the total number of sessions (randomly selected; balanced for session, participant, therapist) were rated for therapist competence and adherence to the treatment model by two graduate research assistants (Plumb & Vilardaga, 2010) after interrater agreement between each of the two coders and a base coder (Coder 1 ICCs =.98 and .97, Coder 2 ICCs = .99 and .92). ACT processes were covered with moderate frequency and depth (1: the variable was never explicitly covered to 5: the variable occurred with high frequency and was covered in a very in-depth manner): acceptance (M = 2.7, SD = 1.29), defusion (M = 2.5, SD = 1.2), self-as-context (M = 1.33, SD = 0.79), present moment (M = 1.93, SD = 1.2), values (M = 2.43, SD = 0.85), and committed action (M = 2.77, SD = 0.77). No ACT-inconsistent processes

were identified during coding. Competency (M = 4.67, SD = 0.48) and adherence to the ACT therapeutic stance (M = 4.67, SD = .48) were high (1: not at all competent/adherent to 5: extremely competent/adherent). No statistically significant differences were found on any of the outcome variables between therapists (therapist 1, n = 24; therapist 2, n = 6; all ps > .05). These results suggest consistency across therapists and ACT-consistent treatment.

Treatment Satisfaction

Those in the ACT condition who completed Time 3 reported levels of treatment satisfaction. The data were negatively skewed and peaked (leptokurtic) due to two outliers. The analyses with outliers (n = 16, Mdn = 30.5, IQR = 28-31) did not differ in a meaningful way from results without outliers (n = 14, M = 30.14, SD = 1.46; Mdn = 31, IQR = 30-31). Both sets of results suggest a high level of satisfaction with treatment.

Discussion

This study examined the effect of eight individual sessions of ACT, compared to an inactive control, on the rate of problematic impulsive behaviors, delay discounting, psychological flexibility, distress tolerance, psychological symptoms/well-being, and valued living, in a sample of adults with problematic impulsive behaviors and high delay discounting. Although ACT originated within the behavior analytic tradition and is a functional treatment, much of the applied ACT research has focused on categorical diagnoses. This study was an attempt to apply ACT in a transdiagnostic, functional manner across broad symptomology. The sample self-referred to the study to change at least one behavior related to "self-control." We predicted that the intervention would decrease problematic behaviors and delay discounting as well as increase psychological flexibility, distress tolerance, well-being, and valued living more

so than the inactive control. All predictions were supported except changes in delay discounting and the progress subscale of valued living.

The primary outcome of interest, frequency of problem behavior, significantly decreased at posttreatment, suggesting that different forms of behavior can be targeted with ACT by focusing on the underlying function of behavior rather than its topography. Furthermore, the magnitude of the treatment effect on psychological flexibility, distress tolerance, well-being, and obstacles to valued living was large. These results are encouraging given the range of target behaviors reported in our sample, including procrastination, problematic pornography viewing, and poor financial management. The success of using ACT to decrease problem behaviors associated with impulsive decision making supports the use of similar functional approaches (e.g., process-based therapies; S. C. Hayes & Hofmann, 2017) to address topographically diverse maladaptive behaviors. Ultimately, streamlining treatment by distilling presentations to a few underlying core processes may lead to more efficient interventions, reducing both clinician and client burden.

Contrary to the prediction, the DDT and DDT-Wait showed no significant effect of treatment over the three assessments. The lack of significant difference in either of the analyzed delay discounting tasks was surprising because previous research has shown that a much shorter ACT intervention (one 90-minute session) significantly decreased delay discounting (Morrison et al., 2014). The discrepancy could be due to additional criteria in the current study that increased the clinical severity of the sample. The majority of the sample in the current study had struggled with one or more target behaviors for 6 or more years (73%) and almost half of the sample struggled with them for more than 10 years (45%). While the intervention changed most

clinically relevant outcomes, delay discounting may be more resistant to change when clinical severity is higher.

At the same time, observed changes in behavior and constructs tied to behavior change may suggest that the intervention could be effective in changing delay discounting in a real-world context—even without a corresponding shift in the DDT. The ostensible incongruence raises questions about the validity of using the DDT as a proxy of impulsive decision making in real-world contexts where options from which to choose are much more varied (e.g., selecting between spending time with family or working) and many more factors are likely to influence decision making. Unfortunately, there is not currently a measure of delay discounting that maps exactly onto real-world decision making. The tasks that are available and were used in this study are certainly valuable at identifying individuals that are more likely to have problem behaviors. Yet, they may be capturing a construct that is not necessarily causally related to real-world behavior change.

Conversely, psychological inflexibility decreased significantly in the ACT group, indicating that it may be a more ecologically valid process underlying real-world impulsive decision making. After all, internal experiences may not guide decision making as strongly when completing the delay discounting tasks, whereas they are a critical component of psychological flexibility and real-world behavior when our values are at stake. For example, choosing among differing amounts of money can elicit some anxiety, uncertainty, or fear of making a mistake. However, when a subgroup of our options includes things that deeply matter to us, such as family, friends, self-care, and spirituality, we may experience stronger physiological responses and concomitant thoughts that differentially affect our decision making. More experimental research is needed to test if there are qualitative differences in the relationship between real-

world behavior and psychological inflexibility and that between real-world behavior and delay discounting.

Due to the small sample size used in this study, conducting analyses to understand variables that influenced change would have exhausted the models being used (e.g., mediation, moderation). Thus, it is unclear if psychological inflexibility is a more statistically important process than delay discounting in terms of shifting problem behavior. Another limitation is that the treatment manual designed for this study was not tested previously. The main distinctions between this manual and other ACT manuals were the early focus on values (session 3), no session was devoted to the process of present moment awareness (rather, it was dispersed throughout treatment), and no specific population was targeted. Adding a session devoted to present moment awareness would have allowed for more depth in targeting this process and should be considered for future manuals. Additionally, eight sessions of therapy may not have been sufficient for this heterogeneous population. Highly entrenched decision-making processes and valued living may take longer than eight weeks to alter. Finally, the durability of the changes observed is unknown without follow-up assessments.

The findings are somewhat tempered by the use of a non-treatment control comparison and self-reported behavior severity. The primary concern of an inactive control is that there is no comparison intervention to determine if the effects are due to ACT or if there are non-specific treatment factors (e.g., attention, validation, weekly accountability) that are influencing the outcomes. Additionally, problem behavior severity was reported at the time of the assessment, which was retrospective. This procedure was used to reduce the burden on participants, but retrospective reports can lead to less accurate data. It is recommended future studies compare

ACT to active control conditions and that behavior tracking is completed immediately after the occurrence of the behavior in all conditions.

As for delay discounting in treatment research, developing reliable, precise, and ecologically valid assessments is an important focus for future research. The commodity used in the discounting tasks (e.g., money, food, cigarettes) may impact results when studying more severe populations. To examine this hypothesis, one could use commodity-specific tasks for those with specific struggles and use more general tasks for those with general struggles. Unfortunately, changing the commodity for each person would reduce the transdiagnostic application of such a measure. Alternatively, finding a way to measure delay discounting while it is being influenced by real-world contingencies would make it more applicable to clinical settings and interventions. Involving technology and situationally appropriate prompts may allow for assessment in the actual decision-making context. Ideally, measures would combine aspects of psychological flexibility, distress tolerance (self-report or behavioral), values identification, valued living, quality of life/well-being, and delay discounting in order to account for all of the proposed components of decision making.

Based on current data, it appears that ACT is an effective intervention for impulsive decision making (operationalized as impulsive problem behavior) and a functional application of therapy shows promise for treating topographically diverse presentations. However, the effect of ACT on delay discounting is unknown. Furthermore, the clinical relevance of delay discounting as measured by the DDT is unclear, given that there was improvement in clinical outcomes without a corresponding change in performance in the DDT. It is possible that psychological inflexibility as measured by the AAQ-II provides a more clinically useful means of measuring the process underlying problem behavior. Further research is needed to test this hypothesis.

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Table 1

Descriptive statistics of outcome variables at Time 1 by completer status

	Completer (n = 33)		Non-Completer (n = 7)		
Variable	*M*	*SD*	*M*	*SD*	*p*
AAQ-II	29.91	7.43	32.71	5.09	0.35
DTS	2.68	0.81	2.43	0.52	0.44
DDT (AUC)	0.23	0.15	0.23	0.16	0.99
DDT-Wait (AUC)	0.41	0.24	0.68	0.25	0.01**
OQ-45.2	80.42	15.27	85.43	24.21	0.48
VQ-P	11.97	5.29	8.57	2.37	0.02*
VQ-O	14.67	3.51	17.86	2.73	0.03*

Note. *$p < .05$, **$p < .01$. AAQ-II=Acceptance and Action Questionnaire-II; DTS=Distress Tolerance Scale; DDT = Delay Discounting Task; AUC = area under the curve; OQ-45.2 = Outcome Questionnaire-45.2; VQ-P = Valuing Questionnaire-Progress; VQ-O = Valuing Questionnaire-Obstruction.