University of Nevada, Reno

# Temporal and Contextual Decision Making: Extending Experimental Choice Research to Clinical Psychology

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Clinical Psychology

by

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THE GRADUATE SCHOOL

We recommend that the dissertation
prepared under our supervision by

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## Abstract

The present study investigated the relationship between six discounting assessment tasks using clinically relevant content and measures of social aspects of psychological functioning. The first contextual discounting task assessed discounting involving variables related to the costs and benefits of entering therapy (i.e., increases in social functioning accompanied while experiencing distress) as contrasted with having nothing in life change. The second contextual discounting task assessed discounting involving variables related to the costs and benefits of avoiding distress (i.e., decreases in social functioning while experiencing relief from distress) as contrasted with having nothing in life change. The four clinically relevant variables embedded within the contextual discounting tasks were also assessed using an intertemporal discounting tasks. Study participants also completed measures of social anxiety, general distress, and quality of life. The study used a convenience sample undergraduate students and was administered over the internet. Results focused on characterizing the discounting patterns obtained with these novel assessment tasks and the relationship between discounting and measures of psychological functioning. The novel variables used in the discounting tasks resulted in discounting performances that were consistent with quantitative measures of hyperbolic discounting. Participants scoring high on social anxiety, high on general distress, and low on quality of life reported greater distress tolerance on contextual discounting tasks than comparisons while the opposite mean difference trend was observed for the temporal discounting tasks. The discussion focuses on the relevance of the results to future translational research in clinical psychology.

## Dedication

To Phil Hineline, with deepest gratitude.

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# Introduction

## Background

Broadly speaking, all behavior is choice behavior and all choices are limited by environmental constraints. One particular approach to studying constrained choice involves having people choose between two response alternatives: one involving a relatively small and convenient outcome, and another involving a relatively large outcome that is accompanied by some form of discomforting inconvenience. This type of binary choice dilemma is analogous to common dilemmas of everyday living.

For example, consider a strained social relationship with a significant other. There are many variables that may contribute to the positive value of the relationship (e.g., a history of cooperation, support, and affection); however, engaging with the other person when the relationship is under stress and is in need of repair can be quite uncomfortable. Exerting effort to make amends or engaging in a constructive dialog when you feel hurt is difficult. Alternatively, there are numerous choice options that are less effortful, more certain, and more immediate in comparison that allow a person to avoid working on repairing the relationship. Familiar activities may include watching television, surfing the web, cleaning house, or working on "projects". The value of the relationship is likely to be much greater than the value of watching a particular episode of a television program or the value of completing the day's dishes. The idealized choice in this scenario would involve taking action to repair the relationship. However, most people find themselves making a series of choices involving the lower value but more convenient activities when faced with this dilemma.

The example above illustrates an important psychological process. People routinely make choices that are suboptimal, irrational, shortsighted, or otherwise troublesome. Researchers have methods for characterizing patterns of preferences that involve systematically varying outcome sizes and the sizes of the inconveniences accompanying outcomes in repeated choice procedures. The value of an outcome is said to be discounted when its practical value in a choice dilemma is lower than its value when assessed in the absence of the inconvenience. Thus, discounting illustrates how the relative value of an outcome is degraded when some form of inconvenience accompanies it. This robustness of value (or lack thereof) in the face of adversity captures two clinically meaningful dimensions of behavior patterns: impulsivity and distress tolerance.

Impulsivity in this case characterizes choice patterns where a reversal in preference is observed. All other things being equal, organisms tend to prefer the larger of two desirable outcomes. However, when the larger outcome is accompanied by an inconvenience the smaller unencumbered outcome may become preferred. This preference reversal illustrates how fickle the value of the larger outcome is and captures an important dimension of impulsivity. Choice patterns can also persist for the larger of two outcomes even when the larger outcome is accompanied by distress producing inconveniences. Preference perseverance in the presence of inconveniences illustrates an important dimension of distress tolerance.[1] In this framework impulsivity and distress tolerance are like two sides of the same coin. This paper will use *distress tolerance* to characterize choice patterns illustrating varying degrees of discounting.

[1] In situations involving waiting for a relatively larger and later reward (i.e., delay as an inconvenience), the waiting is often referred to as reflecting self-control (Logue, 1988). However, there are several competing and less technical understandings of self-control that make using this term less desirable.

**Assessing discounting with repeated choice tasks.**

Mazur (1987) developed a repeated choice procedure for assessing the influence of delay and risk on pigeons' choosing between two response keys. The innovative part of Mazur's procedure was that by varying delay and risk he could assess when preference for a larger outcome would be forgone for a smaller outcome. The value of the larger outcome decreased hyperbolically as the delay and risk involved in obtaining the outcome increased.

Rachlin, Raineri, and Cross (1991) developed a procedure for assessing discounting in humans that involved having individuals choose between receiving hypothetical amounts of money at different delays. Delayed choice alternatives involved a relatively large amount of money while immediate choice alternatives involved relatively small amounts of money. As with Mazur (1987), these researchers found that the value of the larger outcome decreased hyperbolically as the delay accompanying that amount of hypothetical money increased.

Rachlin, Raineri, and Cross (1991) also developed a procedure for assessing discounting in humans that involved having individuals choose between receiving hypothetical amounts of money at different levels of risk. Probabilistic choice alternatives involved a relatively large amount of money while certain choice alternatives involved relatively small amounts of money. This procedure also replicated Mazur (1987), finding that the value of the larger outcome decreased hyperbolically as the probability of obtaining that amount of hypothetical money decreased.

**Characterizing discounting.**

Early accounts of discounting have focused on quantitatively characterizing the relationship between the value of an outcome and an accompanying inconvenience. In the idealized case, the effective or practical value of an outcome (*V*) would be equal to its actual value (A). This simple relationship is observed in Equation 1.

$$V = \frac{A}{1} \tag{1}$$

As discussed above, in most choice situations the actual value of an outcome (A) is influenced by how inconvenient it is to obtain that outcome. The most common inconveniences for obtaining an outcome include delay (i.e., you may have to wait), risk (i.e., the outcome may be more or less certain to occur), and cost (i.e., the amount of effort or other resources you have to expend to get the outcome). The impact of these inconveniences (d) is reflected in Equation 2. In Equation 2, the larger the inconvenience, the smaller the discounted value (*V*). In the absence of an inconvenience (i.e., d = 0) the practical value of an outcome (*V*) will remain equal to the outcomes actual value (A).

$$V = \frac{A}{1 + d} \tag{2}$$

Equation 2 suggests that there is no individual variation in how an outcome (A) is degraded or devalued by inconveniences (d). To account for this, an individualized discounting index (k) is calculated that describes how sensitive an individual is to the inconvenience variable (d). This relationship is reflected in Equation 3.

$$V = \frac{A}{1 + kd} \tag{3}$$

When characterizing choice situations where the inconvenience variable involves risk instead of delay, researchers characterize risk by computing the odds against obtaining an outcome (i.e., $\Theta = (1 - p)/p)$) and substitute this for d in Equation 3. It is also conventional to use h for the discounting index instead of k when this type of inconvenience is assessed. Equation 4 illustrates discounting involving risk.

$$V = \frac{A}{1 + h\Theta} \tag{4}$$

The present research seeks to characterize discounting in repeated choice situations where the inconvenience variable involves psychological discomfort ($\Psi$). $\Psi$ can be assessed two ways. When the choice frame involves a scaled negative or aversive event (e.g., 20% increase in anxiety) $\Psi$ equals the scaled value of the negative or aversive event (e.g., $\Psi = 0.2$). When the choice frame involves a scaled positive or hedonic event (e.g., 75% increase in social functioning) $\Psi$ equals the scale maximum minus the particular value of interest (e.g., $\Psi = 1 - 0.75$). To distinguish psychological discounting from discounting involving delay and risk g will be used to characterize individual sensitivity to $\Psi$. This relationship is presented in Equation 5 below.

$$V = \frac{A}{1 + g\Psi} \tag{5}$$

The discounting indexes k, h, and g can magnify or minimize the effect of an inconvenience variable. Relatively large values of k, h, and g amplify the impact of the inconvenience variable (i.e., d, $\Theta$, or $\Psi$) resulting in a lower discounted value ($V$), illustrating poorer distress tolerance. Relatively small values of k and h minimize the impact of the inconvenience variable (i.e., d, $\Theta$, or $\Psi$) resulting in a higher discounted value ($V$), illustrating greater distress tolerance.

Discounting researchers typically look at patterns of choices across varying levels of the inconvenience variable. This involves assessing individuals' preference for one of two hypothetical choices (α or β). Choice α involves some relatively smaller value of the outcome and is available immediately (i.e., without the inconvenience). Choice β involves the relatively larger outcome (A) and some level of inconvenience ($d_{1\text{-}n}$). Participants are given varying levels of Choice α to choose from for each A plus d (or Θ or Ψ) combination. V, for Equations 3, 4, and 5 is calculated by estimating the point of indifference between preferring Choices α and β. Indifference points are estimated in two ways. If A is a hedonic event (e.g., monetary windfall or an improvement in psychosocial functioning) then the indifference point is estimated by identifying the lowest Choice α value selected (i.e., the smallest amount of money the person would rather receive now than wait six months for $1000). If A is an aversive event (e.g., monetary loss or increase in psychosocial distress) then the indifference point is estimated by identifying the highest Choice α value selected (i.e., the largest amount of monetary penalty the person would rather pay now than wait six months to pay $1000). An indifference point is estimated at each level of inconvenience ($d_{1\text{-}n}$, $\Theta_{1\text{-}n}$, $\Psi_{1\text{-}n}$). All discounting parameters (i.e., k, h, and g) are obtained by placing the hyperbolic discounting equations into a nonlinear regression calculator.

Figure 1 will be used to illustrate the relationship between k and indifference points obtained in a prototypical intertemporal monetary discounting procedure. A research participant was presented with a series of hypothetical choices offering $1000 at some delay (Choice β) or a relatively smaller amount of money available immediately (Choice α). Choice β always involves the larger amount of money ($1000) and is

**Figure 1. $1000 Discounted by Delay**

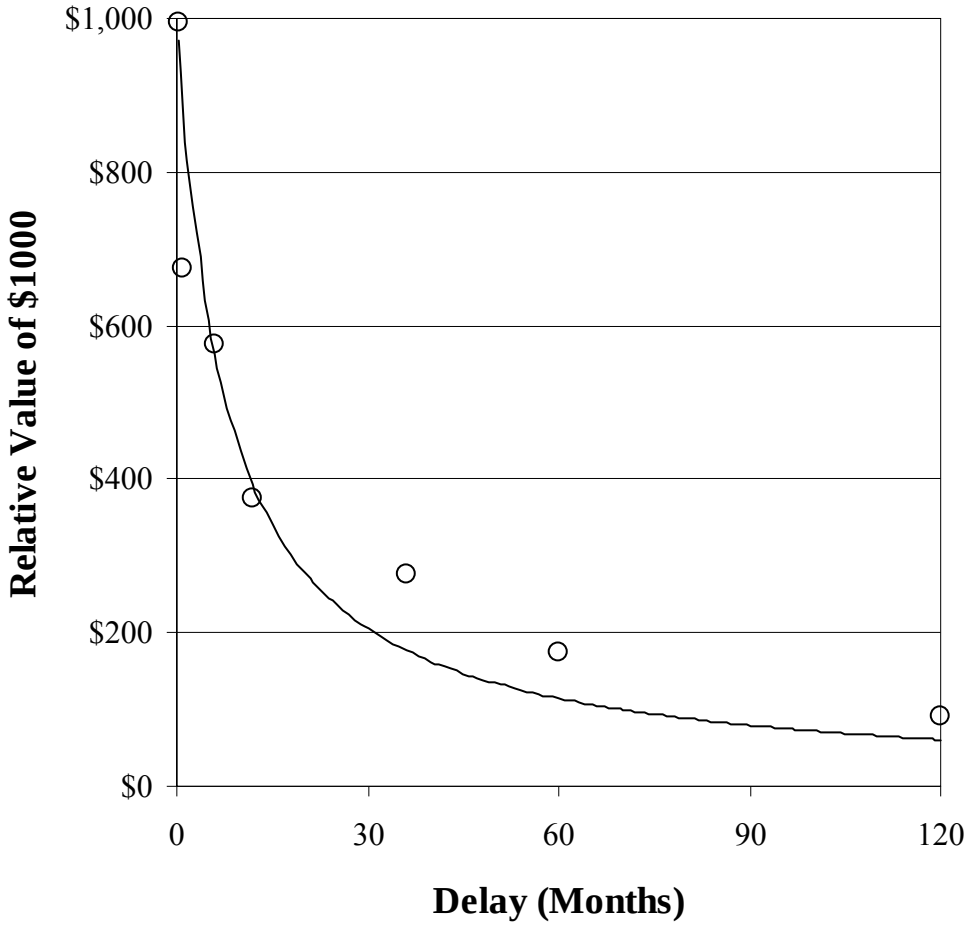


Figure 1. Data from a participant in a previous study involving making choices between receiving $1000 at a delay (Choice β) and a smaller amount of money available now (Choice α). Open circles represent indifference points obtained for seven different delays. The solid line represents the best-fit curve for Equation 3 (k = 0.1290, $R^2$ = 0.90, *SE* = 99.59, and $AIC_C$ = 70.34).

nominally of greater value than the options presented in Choice α, thus failure to choose β indicates that its relative value has decreased when accompanied by delay. The first series of choices holds the delay value in Choice β constant while allowing the amount of money offered immediately to vary in Choice α. Several methods are used to adjust the amount of money offered in Choice α. The method used in the present study starts at a

value 50% of Choice β and adjusts up and down by 50% increments with the 50% increment being restricted by the range of the previous choices.

In Figure 1, the first delay interval assessed was one week. The first choice scenario asked: Would you rather (α) receive $500 now or (β) $1000 one week from now. Our respondent chose Choice β and was then asked: Would you rather (α) receive $750 now or (β) $1000 one week from now. These choices were repeated in attempt to approximate the smallest amount of money that the participant would be willing to accept now instead of waiting one week for $1000. An "indifference point" is calculated by taking the average of the smallest amount of money accepted in Choice α and the largest amount of money forgone in Choice α. The indifference point approximates the subjective value of $1000 when accompanied by delay. The upper leftmost data point in Figure 1 illustrates that the indifference point at one week was $995. Said another way, choice patterns indicated that Choice α values above $995 were preferred to waiting one week for $1000 while Choice α values below $995 were not preferred.

After an indifference point was obtained for one magnitude of delay, others were introduced. The same choice procedure described above was repeated for delays of one month, six months, one year, three years, and ten years. Figure 1 illustrates how as the delay accompanying the $1000 in Choice β increased the value of the lowest amount of money the individual was willing to accept for immediate payment (i.e., the indifference point) decreased. This pattern illustrates how increasing magnitudes of inconvenience (i.e., delay) are poorly tolerated for a monetary outcome. A $1000 windfall is always preferred over an immediate $90 windfall...unless the $1000 windfall will be delivered to you in ten years (see rightmost data point in Figure 1).

It is noteworthy that Equation 3 closely matches the indifference points obtained in discounting assessment tasks. The solid line in Figure 1 illustrates the best-fit curve obtained by varying k to minimize the squared deviations of the data obtained from points derived directly from the model. Discounting parameters (i.e., k, h, and g) characterize the pattern of distress tolerance observed for a particular outcome across a range of inconveniences. Thus, discounting measures serve as a contextualized distress tolerance measure that is concerned with patterns of distress tolerance, rather than instances or traits.

Discounting as a measure of distress tolerance is a substantial departure from the existing trait assessments (e.g., Distress Tolerance Scale, Simons & Gaher, 2005), physical challenges (e.g., cold-pressor task, Hines & Brown, 1932), and cognitive challenges (e.g., PASAT-C, Lejuez, Kahler, & Brown, 2003) currently used in the literature (for a review see Zvolensky, Leyro, Bernstein, & Vujanovic, 2011). Trait assessments aim to characterize a general construct that is stable over time and can be used to differentiate those high on the trait with those low on the trait. Trait measures typically do not have efficient ways of adjusting the contextual sensitivity of the construct of interest. Physical and cognitive challenge measures assess context specific performances that are arguably more state and less trait like. Thus, these unidimensional physical and cognitive challenge tasks are at risk for characterizing distress tolerance specific to the form and magnitude of the variables utilized in the tasks.

Discounting assessments are quite different. The hyperbolic discounting model allows for the characterization of distress tolerance across a range of magnitudes of the inconvenience variable. Furthermore, discounting assessment tasks can entail outcomes

and inconveniences specific to clinical questions of interest (as will be illustrated in the present experiment) and k, h or g is used to characterize the overall pattern of distress tolerance. This pattern, due to the range of inconvenience magnitudes investigated holds the promise of being more contextually sensitive than trait assessments and less dimension specific than challenge tasks that are relatively more state specific.

A significant asset of Equations 3, 4, and 5 is that they are single parameter characterizations of discounting data.[2] This allows k, h and g to characterize content relevant distress tolerance in a way that is easily incorporated into biopsychosocial research. These measures also have good test-retest reliability (for a recent review see Odum, 2011). Other equations have been proposed that add additional free parameters to Equation 3 (for a review see McKerchar et al., 2009), resulting in a slightly better fit to the resulting model. These multiparameter equations have not been demonstrated to covary with other important variables in any way that improves over Equations 3 and 4 and they introduce the problem of determining how to relate these multiple parameters to other events of interest.

**Relationship between discounting and clinical presentations.**

Several researchers have studied whether humans hyperbolically discount hypothetical monetary outcomes similar to actual monetary outcomes. Since discounting assessments involve repeated choice procedures, researchers have emulated actual monetary outcomes by informing research participants that of all the choices they make on the task, one will be randomly selected as an actual outcome (Johnson & Bickel,

[2] Historically, Equation 3 has been compared to the negative exponential discounting model used by economists ($V = Ae^{-kd}$, Samuelson, 1937). A recent meta-analysis highlighted that an overwhelming majority of the discounting studies since 1987 have found Equation 3 to be a better fit of the data obtained from humans, other primates, rodents, and pigeons (MacKillop, 2011).

2002). Thus, depending on the choices the individual made participants would receive at the end of the experimental session either a relatively small but immediate amount of money or be informed of the delay they will experience before receiving the actual larger amount of money ($250 was the highest value studied). The experiment had two phases, one involving hypothetical outcomes only, and one with potentially real outcomes. Order of the phases was counterbalanced across participants. Researchers found no difference in how potentially real outcomes and hypothetical only outcomes were discounted by delay. Recent fMRI research failed to detect any differences in neurological correlates for individuals discounting potentially real and hypothetical outcomes (Bickel, Pitcock, Yi, & Angtuaco, 2009). Overall, the literature suggests that it is reasonable to expect discounting assessments using hypothetical outcomes to influence choice behavior similar to discounting assessments using potentially real outcomes.

Variations of Rachlin, Raineri, and Cross's (1991) hypothetical choice tasks have been used extensively to assess discounting in a variety of populations. Subgroups of clinical populations tend to respond more impulsively than others on these tasks. For example, Vuchinich and Simpson (1998) investigated the relationship between patterns of alcohol consumption and hypothetical monetary outcomes discounted by delay. Study participants were categorized as light social drinkers or heavy social drinkers. They found that the value of money decreased more steeply when accompanied by delay for heavy drinkers as compared to light drinkers. Thus, light drinkers indicated relatively greater distress tolerance for delayed monetary outcomes when compared to heavy drinkers. Similar findings have been found comparing opiate abusers with non-abusers (Madden, Petry, Badger, & Bickel, 1997), cocaine dependent with drug free controls

(Heil, Johnson, Higgins, & Bickel, 2006), smokers with nonsmokers (Baker, Johnson, & Bickel, 1993), substance abusers with and without antisocial personality disorder (Perry, 2002), gamblers with non-gamblers (Holt, Green, & Myerson, 2003), and anxious with nonanxious individuals (Rounds, Beck, & Grant, 2007). All of these studies found that more severe clinical problems are accompanied by lower levels of distress tolerance as measured by discounting tasks.

**Domain specificity.**

Money is not the only hypothetical outcome studied from a discounting framework and not all outcomes are discounted identically. Domain specificity refers to the observation that different outcomes are accompanied by different rates of discounting. For example, Petry (2003) found that when money, health[3], and freedom[4] were discounted by delay, each outcome was discounted at a different rate. Baker, Johnson & Bickel (2003) found different discounting rates for money, cigarettes, and health while holding the monetary equivalencies of these different outcomes constant at $1000.

Other researchers have studied domain specificity by studying outcomes of interest in more naturalistic terms as opposed to monetary equivalencies. A good example of this is Lawyer (2008). Lawyer was interested in studying sexual decision-making and wanted to create a domain specific discounting task. Using duration of watching "one's favorite form of erotic material" as the outcome of interest and delay and probability as inconveniences (in separate tasks) he was able to assess how the value of 10-minutes of pornography access (hypothetical) was discounted. This study had two

[3] Subjects were asked, "I want to know what is the longest period of time you would tolerate feeling the disease's symptoms starting right now, rather than waiting 25 years to feel the symptoms for 1 year."
[4] Subjects were asked, "What is the longest period of time you would tolerate going to jail starting RIGHT NOW, rather than waiting for 25 years to go to jail for 1 year?"

findings of interest to the present discussion. First, individuals who reported being erotica users (i.e., have a history of watching erotica and had high interest in watching erotica if given a chance) produced choice patterns consistent with hyperbolic discounting. Those who reported being non-erotica users (i.e., denied history of watching erotica and had low interest in watching erotica if given a chance) produced inconsistent choice patterns. Second, erotica users with more impulsive discounting curves for erotica also had higher scores on self-ratings of sexual compulsivity. This research illustrated how choice patterns involving clinically relevant outcomes can relate to other clinical measures of sexual impulsivity. Thus, not only do domain specific discounting tasks have greater face validity than monetary discounting tasks, they allow for impulsivity and distress tolerance to be assessed using variables with grater relevance to clinical presenting problems.

A different approach to studying domain specificity involves using theoretically meaningful inconveniences beyond delay and probability to assess discounting. Howard Rachlin has been studying choice and social behavior since the 1960's (see Rachlin, 2002 for a review). He was interested in characterizing altruism within a discounting framework to see how affiliation may serve as in inconvenience variable while choosing whether to keep a resource for your self or sharing it with someone else. It was hypothesized that sharing resources with someone close to you would be relatively less aversive than sharing resources with someone you have a less close relationship. In Jones and Rachlin (2006), subjects were instructed to envision the following:

> The following experiment asks you to imagine that you have made a list of the 100 people closest to you in the world ranging from your dearest friend or relative at position #1 to a mere acquaintance at #100. The person at number one would be

> someone you know well and is your closest friend or relative. The person at #100 might be someone you recognize and encounter but perhaps you may not even know their name. You do not have to physically create the list—just imagine that you have done so. (p. 284)

Subjects then completed a repeated choice procedure with the following response options:

> α. $ _Y_ for you alone.[5]
> β. $75 for you and $75 for the # _X_ person on the list.[6]

The analysis focused on the amount of money subjects were willing to forgo for themselves in order to give $75 to person X. The results showed that subjects were more willing to forgo larger personal gains for person #1 on the list and that the greater the social distance, the less likely the subjects were to forgo personal gain for the comparatively larger joint gain.[7] Thus, this study allowed for a quantitative analysis of altruism by studying how the relative value of mutual gain (as compared to personal gain) could be discounted by relationship closeness. This study also replicated previous discounting research by finding that the choice patterns were consistent with hyperbolic discounting. Jones and Rachlin (2006) extended the field of discounting research by demonstrating that innovative and theoretically meaningful inconveniences can be scaled on a continuum and used to assess how these inconveniences degrade the value of an outcome.

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[5] Y ranged from $155 to $75 in $10 increments
[6] X values studied included 1, 2, 5, 10, 20, 50, and 100
[7] For example if a subject would choose α when Y = $125 but β when Y = $115 when X = #10 then it would be estimated that the subject was willing to forgo about $45 of personal gain to have mutual gains of $75 (each) with person #10 on the list. Thus, the smaller the value of Y when the preference reversal occurs, the less willing the subjects were to forgo personal gain for mutual gain.

**Rationale for the Present Research**

Outside of substance abuse, measures of discounting have not been widely adopted by those conducting psychosocial treatment process and outcome research. One potential obstacle to adoption is that the majority of existing human research has focused on the discounting of monetary outcomes. This emphasis may have made sense in substance abuse research due to the relatively direct relationship between money and access to substances of abuse. However, most psychological interventions do not directly focus on finances, and the relationship between money and presenting problems—such as anxiety and depression—is much less direct than with substance abuse. An important step in translational research in the behavioral sciences involves exporting the analysis of empirically supported functional relationships to new populations and new content domains. The present study aims to highlight the clinical relevance of discounting by investigating more domain-specific outcomes.

Clients can attend therapy and work towards therapeutic goals. However, the modal number of therapy sessions clients attend is one (Talmon, 1990). This can be due to some therapeutic goals being fleeting, but for those with more persistent presenting problems therapy comes with a series of costs: time, money, effort, exposure to undesirable thoughts, feelings, and uncomfortable interactions. All these costs are relatively immediate while therapeutic gains tend to develop slowly over time. For many individuals with histories that do not provide an experiential basis for obtaining therapy relevant goals (e.g., someone with a long history of poor relationships may have had very few positive experiences when trying to build new relationships), they will have

difficulty tolerating many of the costs or inconveniences related to working toward that goal.

To emulate cost-benefit[8] dilemmas relevant to choosing to enter therapy, two repeated choice tasks were designed to assess how therapeutically relevant cost-benefit interactions retain their value. The present research uses college students as a convenience sample. For this reason changes in social functioning and changes in social distress were identified as therapeutically relevant variables that were continuous with every day choice dilemmas, and not particular to the experiences of individuals diagnosed with mental health problems.

Contextual Task 1 focused on how working toward a clinically meaningful gain can also involve working through related discomfort. For simplicity, the choice option involving varying levels of therapeutic gain and discomfort (i.e., benefits and costs) were contrasted with a choice involving "having nothing change." This is not to imply that life remains unchanged if you do not engage in therapy. Rather, it is intended to place the individuals' current life experience as the point of reference for the discounting dilemma. Assuming that improvements in social functioning are preferable to the status quo, then choosing the status quo when improvements are accompanied by costs illustrates a preference reversal. As discussed earlier, reversing a preference to take the path of least resistance is a type of impulsivity. Similarly, choice patterns can be said to illustrate distress tolerance when the prospective improvements in social functioning over the

[8] In this paper cost-benefit refers to the general decision-making practice of subjectively weighing the pros (i.e., benefits) and cons (i.e., costs) accompanying one choice relative to another. In many fields of study cost-benefit analyses require decision makers to place monetary estimates on costs and benefits separately as part of the decision making process. That approach is more specific than the one referred to here.

status quo retain their value even though improvements in social functioning require experiencing distress.

As mentioned above, the choice option of "having nothing change" is intended to frame the dilemma in relation to the individual's current experience. However, it is common for implicit costs to accumulate with the status quo. That is, avoiding costs can also result in decrements in experienced benefits. This therapeutically relevant dimension of choice was not assessed in Contextual Task 1. Active escape and avoidance of this type can become clinically important because successful avoidance is commonly accompanied by clinically relevant costs (Friman, Hayes, & Wilson, 1998; Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Clinically, the costs we are most interested in involve decreases in therapeutically relevant outcomes. For example, avoidance can limit individuals' abilities to access outcomes related to functioning in important appetitive areas such as social relationships, problem solving, accomplishing specific tasks, and actively pursuing goals. Contextual Task 2 asked individuals to choose between "having nothing change" or experience a decrease in social functioning in order to obtain varying levels of relief from emotional distress. This dilemma makes the potential costs of avoidance explicit.

Contextual Task 2 illustrates how discounting assessment tasks can be used to study distress tolerance related to negatively reinforcing events and the possible costs of related escape/avoidance repertoires. Assuming relief from distress is preferred over the status quo even if it comes with costs, then choosing the status quo when relief is available represents a preference reversal. Thus poor tolerance of costs illustrates a form of context specific impulsivity. Similarly, the degree to which relief from distress retains

its value (over the status quo) across varying degrees of loss in social functioning is the degree to which the escape/avoidance pattern illustrates distress tolerance. Clinically, this type of choice task may best be referred to as assessing distress overtolerance. Distress overtolerance refers to "situations in which an individual tolerates a high amount of distress, in a manner that does not fit with his or her long-term values or interests, resulting in adverse long-term consequences" (Lynch & Mizon, 2011, p. 55).

Contextual discounting forces individuals to make choices that consider costs and benefits in tandem. Very often, less comprehensive approaches to choice are taken (Gigerenzer & Todd, 1999). For this reason it was of interest to also study the variables contained in the contextual discounting tasks in isolation. Both of the contextual tasks involve changes in social functioning. Temporal Task 1 assessed improvements in social functioning discounted by delay and Temporal Task 2 assessed decreases in social functioning discounted by delay. Both of the contextual tasks also involved changes in social distress. Temporal Task 3 assessed social distress discounted by delay and Temporal Task 4 assessed relief from social distress discounted by delay. The relationship between discounted choice patterns and distress tolerance will be discussed with the results from these tasks.

# General Method

## Overview

The present study utilized common methods to study the discounting of clinically relevant variables. The general method and non-discounting measures are described in the general method section. The specific procedural details and results will be presented in the three sections that follow.

## Participants

A convenience sample of 419 college students completed online questionnaires for research participation credits. At least one systematic data pattern consistent with the algorithm identified by Johnson and Bickel (2008) was produced by 357 participants. The number of participants meeting inclusion criteria for each particular task will be specified when each task is introduced below. Of all the participants meeting inclusion criteria, 65.83% were female, 28.85% were ethnically diverse, and the mean age was 21.15 (*SD* = 4.96).

## Materials

All study materials were presented to participants online using the www.surveymonkey.com platform. Participants were allowed to participate at their own pace, in a setting of their own choosing, and to discontinue the study at any time. Text from the recruitment materials can be found in Appendix A.

### Measures.

The particular features of the discounting assessment tasks will be described in the sections below. Recall that discounting assessment tasks involve two primary variables of interest: an outcome and an inconvenience. Fixed values of the

inconvenience are presented and participants engage in a series of choices to determine the indifference point for the outcome given each level of inconvenience. All discounting assessment tasks utilized the "skip logic" feature of Survey Monkey to allow for each indifference point to be estimated in five or six questions, instead of using 30 or more questions involving a range of possible values. Figure 2 below illustrates a portion of the choice paths participants could experience through skip logic. Choices always involved whole numbers although calculated points of indifference did use decimals.

**Figure 2. Sample of Possible Choice Paths**

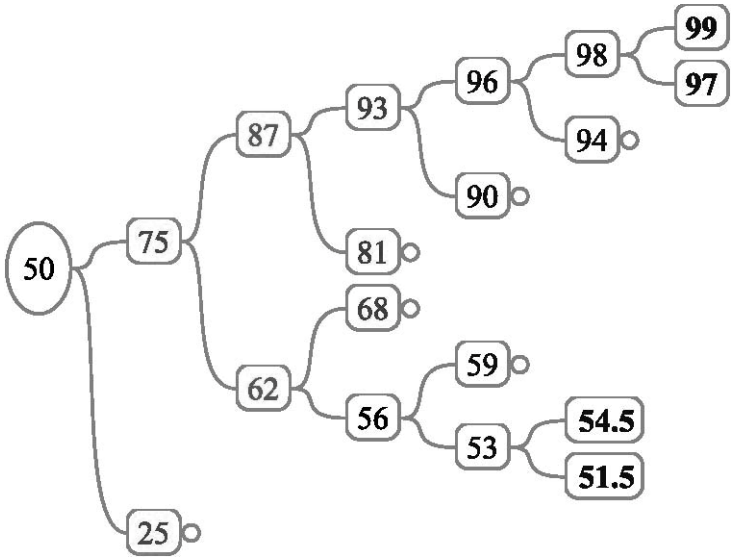


Figure 2. The first question in each series started at a value of 50, and variable values were increased or decreased by 50% of the difference between the current value and the minimum-maximum value possible in the choice path, given the previous responses. For values above 50 the 50% increment was rounded down to the nearest whole number, while for values below 50 the 50% increment was rounded up to the nearest whole number. The bold numbers in the rightmost node represent the indifference points that would be calculated following the response made to the value encountered in previous node of the diagram. Choice options followed by a small circle represent truncated alternative choice paths.

Discounting data were only analyzed for respondents producing grossly systematic response patterns. Johnson and Bickel's (2008) procedure for identifying nonsystematic data was used. A participant's responses were considered nonsystematic if either or both of the following criteria were met:

(1) if any indifference point was greater than the preceding indifference point by a magnitude greater than 20% of the variable's range. Since all outcomes in this study were rated on a 0 to 100 scale, this value was 20.[9]

(2) if the last indifference point fails to be less in value than the first indifference point by a magnitude equal to 10% of the variable's range. Since all outcomes in this study were rated on a 0 to 100 scale, this value was 10.[10]

Each discounting assessment task was assessed for nonsystematic response patterns separately.

Discounting performances were characterized using Microsoft Excel (2003)[11] to calculate k, g, $R^2$, SE, and $AIC_c$ for discounting curves. Although it is conventional to compute $R^2$ when fitting discounting data to the hyperbolic model, $R^2$ can obtain values less than zero in nonlinear regression (Motulsky & Christopoulos, 2004).[12] For the present study $R^2$ values less than zero were converted to zero to prevent these data points from skewing the group means. Akaike's Information Criterion (AIC) has been argued to

[9] This removes responses that indicate that the value of an outcome increased when accompanied by greater levels of inconvenience. This type of responding is not predicted by any behavioral economic models that use this type of choice framework.

[10] This removes "flat" choice patterns. Typically, when a respondent's choices meet criterion (2), indifference points typically produce a flat line across the top of the graph or a flat line across the bottom of the graph. Thus, preference remains unchanged across all levels of the inconvenience variable.

[11] The basic Solver add-in for Microsoft Excel was used to calculate nonlinear regression.

[12] This occurs when the null model (i.e., sum of squares obtained from the mean of the indifference points obtained) is smaller than the sum of squares obtained from comparing the indifference points obtained with reference points fitting exactly to Equation 3. This generally occurs when one or both ends of the distribution of indifference points are less extreme than the points predicted by Equation 3.

be a better way of characterizing model fits (Spiess & Neumeyer, 2010). A second order correction is used to adjust AIC (i.e., $AIC_c$) when only a small number of data points are being fit to a model (Motulsky & Christopoulos, 2004). The current study used nine data points for each discounting task, thus the current study uses $AIC_c$ to characterize model fit. Lower scores on the $AIC_c$ indicate better model fit and can only be interpreted relative to one another (i.e., they are not absolute). Thus, their inclusion in this study functions to facilitate comparisons between the current data and future replications.

SPSS 12 (2003) was used for calculating correlations and mean group comparisons. Due to their skewed distributions, discounting parameters were compared using their natural logs. Since the natural log values are less intuitive to interpret (i.e., 1 = 0, >1= positive numbers, <1 = negative numbers), data tables will provide untransformed values for the means reported, while standard deviations will based on the natural log conversion used in the statistical analysis.

Following each discounting assessment task, participants were asked two comprehension questions. The first asked: Were you able to understand the questions in the previous section? Participants indicated their answer on a one to five scale indicating: (1) not at all, (2) a little bit, (3) somewhat, (4) mostly, or (5) completely. The second comprehension question asked: How much effort was it for you to figure out what the questions were asking? Participants indicated their answer on a one to five scale indicating: (1) not effortful at all, (2) a little effortful, (3) moderately effortful, (4) quite effortful, or (5) extremely effortful. These two comprehension questions will be referred to as Understanding and Effort, respectively, in the subsequent sections.

Two questionnaires were created for this study for the purpose of providing context for the variables used in the discounting assessment tasks. A Social Goals battery (see Appendix B) was created for this study for the purposes of encouraging participants to consider multiple dimensions of their social functioning prior to completing the discounting tasks. A Social Barriers battery (see Appendix C) was also created for this study for the purposes of encouraging participants to consider the multiple sources of distress that may impact their social relationship functioning.

The Liebowitz Social Anxiety Scale (LSAS, Liebowitz, 1987) assesses fear and avoidance of social situations. Originally, the LSAS was intended to be clinician administered, however, subsequent research has demonstrated high correlation ($r = 0.94$) between the clinician and self administered versions of the LSAS (Rytwinski et al., 2009). Individuals scoring 60 or greater on the LSAS were categorized as having high social anxiety (High LSAS) while those scoring 20 or less on the LSAS were categorized as having low social anxiety (Low LSAS). The content of the discounting assessment tasks largely focus on variables related to social functioning. Thus, the LSAS represents the most domain specific clinical measure used in this study. It was hypothesized that individuals scoring high and low on social anxiety will have divergent performances on the temporal discounting tasks with high social anxiety individuals demonstrating less distress tolerance for delay. It was hypothesized that divergent performances for these groups would also be observed for the first contextual discounting task (CT1), replicating previous pilot research where high anxiety individuals would demonstrate greater distress tolerance on this assessment. That is, individuals with high anxiety were more willing to experience the costs and benefits of change while low anxiety individuals were more

content with maintaining the status quo. A directional hypothesis was not made for Contextual discounting Task 2 (CT2). If highly anxious individuals' choice behavior were primarily influenced by obtaining relief from their distress, then performance on CT2 would be expected to be similar to that of CT1. However, if highly anxious individuals were more loss averse than low anxiety peers, then they would demonstrate less distress tolerance on an assessment requiring them to have a decrease in their social functioning.

The target sample size for the present study aimed to ensure sufficient power to detect differences in discounting performance between individuals scoring high and low in social anxiety on the LSAS. Pilot research preceding the current study (Waltz & Follette, 2009) found that, using the high and low LSAS cutoff scores described above, the between group effect size for a contextual discounting task similar to CT1 was medium ($d = 0.44$). The between group effect size for a temporal discounting task similar to Temporal Task 3 was medium to large ($d = 0.74$).

In Waltz and Follette (2009) only 35.9% of the sample had LSAS scores within the high and low social anxiety group ranges. A target sample size of 200 was set for the present study with the expectation that approximately 36 individuals would meet the criteria for membership in each of the groups. With this n, the contextual discounting tasks had an estimated power of 0.6 to detect an effect with $p = .05$ (Cohen, 1988). The temporal discounting task was estimated to have a power of 0.95 to detect an effect with $p = .05$.

The Depression Anxiety and Stress Scales (DASS, Lovibond & Lovibond, 1995) assesses three broad areas of emotional distress. Upper and lower quartiles cutoffs were

used to determine high and low general distress groups. Calculation for the quartiles was based on all respondents providing at least one systematic discounting pattern (one of a possible six). Scores of 28 or greater indicate high general distress (High DASS) while those with scores of 8 or less indicate low general distress (Low DASS). Trends for the analysis of DASS related data are expected to be similar to those found with the LSAS. However, given that the items of the DASS are less specifically related to the content of the discounting tasks, individuals with high and low general distress may have less divergent performances on the discounting tasks.

The World Health Organization Quality of Life Scale-Brief (Bonomi, Patrick, Bushnell, & Martin, 2000) was used to characterize well-being in the present study. The composite score was calculated using all 26 items of this scale. Scores were normalized using a 0 to 100 scale in accordance with the same procedures used to calculate domains scores (Bonomi & Patrick, 1997). Using all respondents providing at least one systematic discounting pattern upper and lower quartiles were identified to determine High and Low quality of life (QOL) groups. Scores of 77 or greater indicate high QOL, while scores of 59 or below indicate low QOL. Those with high QOL are hypothesized to demonstrate greater distress tolerance on the temporal discounting tasks and are expected to be more likely to choose having nothing change (i.e., low distress tolerance) on the contextual discounting tasks.

The Acceptance and Action Questionnaire-II (AAQ-II, Bond et al., in press) is a general measure of psychological inflexibility and experiential avoidance (PIEA). Using all respondents providing at least one systematic discounting pattern upper and lower quartiles were identified to determine High and Low AAQ-II groups. Those with a score

of 25 and above are categorized as High AAQ-II while those with a score of 12 and below are categorized as Low AAQ-II. The higher the AAQ-II score, the greater the PIEA. Pilot research leading up to the present study indicated that those with Low AAQ-II scores indicated greater distress tolerance on temporal discounting tasks (Waltz & Follette, 2009). Conversely, those with High AAQ-II scores indicated relatively greater distress tolerance on contextual discounting tasks. This effect is expected to be observed in the current study for CT1 and the temporal discounting tasks. A directional hypothesis is not being made for CT2 for the same rationale discussed above with the LSAS.

## Contextual Tasks 1 and 2

To emulate cost-benefit dilemmas relevant to choosing to enter therapy, two repeated choice tasks were designed to assess how therapeutically relevant cost-benefit interactions retain their value. Contextual Task 1 (CT1) focused on how working toward a clinically meaningful gain can also involve working through related discomfort. Each indifference point indicates the highest level of social distress the individual was willing to experience for a given level of improvement in social functioning. Lower h values indicate greater distress tolerance for the costs and benefits of treatment relevant variables over the status quo.

Contextual Task 2 (CT2) was designed to make the implicit costs of avoiding emotional discomfort more explicit by allowing for relief from emotional distress at the expense of experiencing decreases in social functioning. Each indifference point indicates amount of decrease in social functioning the individual was willing to trade for a given level of relief from emotional distress. Lower h values indicate greater distress tolerance for the costs and benefits of avoidance over the status quo.

### Method

#### Subjects.

Using Johnson and Bickel's (2008) inclusion criteria 219 and 175 participants provided non-erratic preference patterns in Contextual Tasks 1 and 2, respectively when analyzing all 9 data points ($\Psi_{1\text{-}9}$). When 8 data points were analyzed ($\Psi_{2\text{-}9}$), 196 and 149 participants provided non-erratic preference patterns in Contextual Tasks 1 and 2, respectively.

**Materials.**

All study participants completed the measures discussed in the General Methods section. The choice framing and values used in the discounting assessment tasks are described below.

***Contextual Task 1.***

Study participants were presented with the following instructions:

> Take a moment and consider all of your goals and aspirations involving your relationships with family, friends, colleagues, and romantic partners.
>
> We would like you to envision social success improvements on a scale of 0% to 100%. At 0% your success in pursuing your social goals and aspirations does not change from how you experience it today. At 100% you would consider yourself completely successful in meeting your social goals and aspirations.
>
> We would also like you to envision the barriers to achieving your social goals and aspirations on a scale of 0% to 100%. At 0% you would experience no barrier related distress. At 100% you would experience maximum barrier related distress.
>
> Using these two scales, please indicate your preferences for the choices that follow. There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> α Have nothing in your life change
> β Experience distress related to your social barriers at (Y)% & have a (X)% increase in social success

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 100, 95, 90, 75, 50, 25, 10, 5, and 1.

***Contextual Task 2.***

Study participants were presented with the following instructions:

> Take a moment and consider the various forms of distress you experience because of your social barriers. We would like you to envision RELIEF from this distress on a scale form 0% to 100%. At 0% you would have no relief from this distress. At 100% you would have complete relief from this distress.
>
> We would also like you to envision what it would be like to have a DECREASE in your social success on a scale of 0% to 100%. At 0% there would be no decrease in your social success. At 100% you would experience a maximum decrease in your social success (i.e., you would be completely unsuccessful).
>
> Using these two scales, please indicate your preferences for the choices that follow. The decision-making dilemma concerns how much of your social success you would be willing to give up in order to obtain relief from social barrier related distress.
>
> There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> α Have nothing in your life change
> β Have a (Y)% decrease in your social success & experience (X)% relief from social barrier related distress

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 100, 95, 90, 75, 50, 25, 10, 5, and 1.

**Results and Discussion**

Participants reported fair comprehension of the choice options on CT1 ($n$ = 219, Understanding: $M$ = 3.69, $SD$ 1.01; Effort: $M$ = 2.48, $SD$ = 0.87). Participants reported fair comprehension of the choice options on CT2 ($n$ = 175, Understanding: $M$ = 3.74, $SD$ 1.09; Effort: $M$ = 2.35, $SD$ = 1.01). There were no significant differences in the

comprehension measures for CT1 and CT2 (Understanding: $t(392) = 0.45$, $p = .65$, $d = 0.05$, 95% CI [-.26, .16]; Effort $t(392) = 1.43$, $p = .15$, $d = 0.14$, 95% CI [-.05, .32]).

Figure 3 illustrates how these novel, contextual discounting tasks produce choice patterns consistent with hyperbolic discounting. Table 1 summarizes the variables characterizing how well the choice patterns fit the hyperbolic model. Visual inspection suggests a reasonable fit with Equation 5 while $R^2$ illustrated this measure's sensitivity to deviation from the model's predictions on the left side of the curve. Table 1 has been split to highlight the differences in model fit when all nine data points are included ($\Psi_{1\text{-}9}$) versus the eight points ($\Psi_{2\text{-}9}$) that do not violate the assumptions of the hyperbolic model. The hyperbolic model predicts that the peak of the curve will be equal to the maximum value of the y-axis when the inconvenience variable equals zero. For most participants, their highest preference reversal point did not approach the maximum value of the cost scale, as predicted by the model and this data point represented a disproportional source of standard error in the hyperbolic model. Removing this data point resulted in a substantial decrease in the standard error resulting in a better fit. Prior to removing the 0% Ψ data point 23% of respondents in CT1 and 50% of respondents in CT2 obtained $R^2$ values of zero (values less than zero were converted to zero). After removing this data point and nonsystematic responders[13] 3% of respondents in CT1 and 5% of respondents in CT2 obtained $R^2$ values of zero (values less than zero were converted to zero).

[13] Preference patterns for indifference points obtained for Ψ2-9 were analyzed for nonsystematic responding using Johnson and Bickel (2008) criteria. The individuals eliminated generally had flat preference patterns after the Ψ equals 0% data point.

**Figure 3. CT1 and CT2 Discounting Curves**

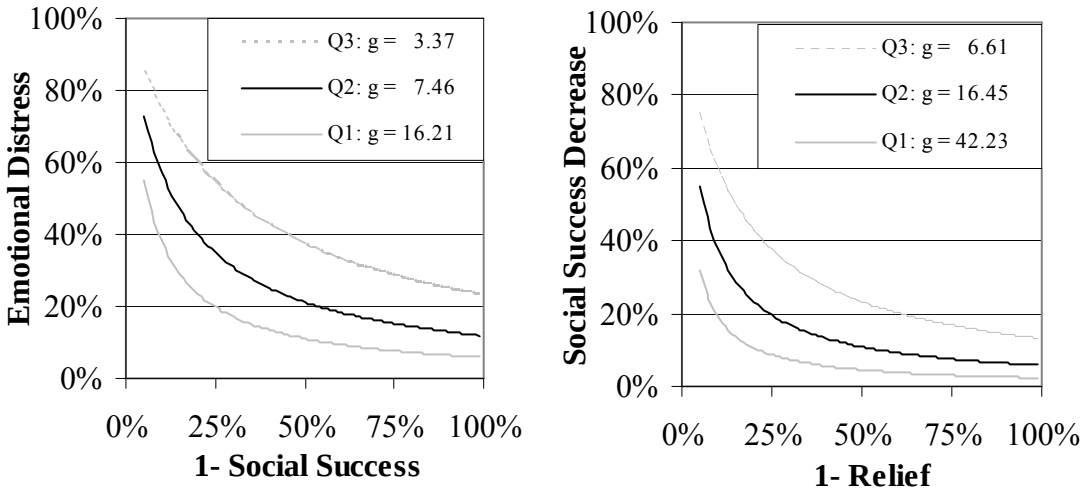


Figure 3. Median and interquartile discounting curves are presented for CT1 (left) and CT2 (right).

**Table 1. Hyperbolic Model Fit for CT1 and CT2**

| Task ($\Psi_{1\text{-}9}$) | $R^2$ | *SE* | $AIC_c$ | Task ($\Psi_{2\text{-}9}$) | $R^2$ | *SE* | $AIC_c$ |
|---|---|---|---|---|---|---|---|
| CT1 | | | | CT1 | | | |
| *M* | 0.19 | 0.1883 | -26.32 | *M* | 0.73 | 0.1314 | -29.95 |
| *Mdn* | 0.78 | 0.1298 | -31.80 | *Mdn* | 0.88 | 0.0935 | -32.59 |
| CT2 | | | | CT2 | | | |
| *M* | 0.31 | 0.2063 | -24.81 | *M* | 0.63 | 0.1093 | -32.90 |
| *Mdn* | 0.01 | 0.1776 | -26.17 | *Mdn* | 0.92 | 0.0529 | -41.70 |

*Note*. The left side of the table represents the Model Fit for CT1 and CT2 when all nine Ψ values were included in the analysis while the right side of the table uses the eight values that did not violate the assumptions of the hyperbolic model. The Mean (*M*) values represent the average $R^2$, *SE* and $AIC_c$ values obtained for all participants' providing systematic data. Median (*Mdn*) values used group median indifference points depicted in Figure 3 for the calculation of $R^2$, *SE* and $AIC_c$.

A summary of the primary findings is presented in Table 2. The high social anxiety group (High LSAS) indicated significantly greater distress tolerance involving increases in emotional distress to obtain improvements in social functioning (CT1) as compared to the Low LSAS group. The high general distress group (High DASS) also

**Table 2. Primary Findings for CT1 and CT2**

| Task | Measure | *n* | *M* | *SD* | *t* | *p* | *d* |
|---|---|---|---|---|---|---|---|
| | LSAS | | | | | | |
| CT1 | Low | 28 | 12.65 | 1.22 | 3.02 | .002 | 0.70 |
| | High | 38 | 5.36 | 1.11 | | | |
| CT2 | Low | 18 | 17.78 | 0.99 | 0.69 | .491 | 0.28 |
| | High | 29 | 12.31 | 1.46 | | | |
| | DASS | | | | | | |
| CT1 | Low | 36 | 8.84 | 1.42 | 2.81 | .003 | 0.50 |
| | High | 55 | 4.39 | 1.32 | | | |
| CT2 | Low | 23 | 14.69 | 1.23 | 1.76 | .084 | 0.48 |
| | High | 47 | 7.81 | 1.34 | | | |
| | QOL | | | | | | |
| CT1 | Low | 53 | 4.67 | 1.32 | -2.32 | .011 | 0.43 |
| | High | 31 | 8.32 | 1.28 | | | |
| CT2 | Low | 43 | 8.20 | 1.30 | -2.58 | .006 | 0.62 |
| | High | 28 | 18.20 | 1.16 | | | |
| | AAQ-II | | | | | | |
| CT1 | Low | 38 | 12.86 | 1.08 | 3.75 | <.000 | 0.75 |
| | High | 56 | 5.17 | 1.19 | | | |
| CT2 | Low | 31 | 13.91 | 1.36 | 1.40 | .166 | 0.25 |
| | High | 46 | 10.06 | 1.25 | | | |

*Note.* Group comparisons were made on the basis of the natural log of participants' discounting parameters (i.e., g). The mean (*M*) value is based on the untransformed g for the group. *SD* values are based on the natural log of the g scores to facilitate future analysis of the statistics presented.

indicated significantly greater distress tolerance with CT1 as compared to the low general distress group. As anticipated, the mean difference scores and the effect size observed for the social anxiety group comparison (LSAS) was larger than that for the general distress group comparison (DASS). This provides preliminary evidence for the relevance of approaching discounting assessments with domain specific variables. Similar mean difference group trends for CT2 were observed for the anxiety and general distress groups; however, these trends did not reach significance. Failure to find a difference for CT2 was likely due to poor power, given that not enough respondents with low LSAS

and DASS scores provided systematic data. This study used university undergraduates as participants and a clinical comparison sample may be required to identify a group with greater distress tolerance for changes detailed in Choice β.

The High QOL group indicated significantly less distress tolerance for having life changes from the status quo for both CT1 and CT2 as compared to the Low QOL group. A similar trend was observed for CT1 but failed to reach significance. This observed difference in CT2 was the only directional hypothesis held for this task. Because the contextual discounting tasks asked participants to choose between (α) having nothing change and (β) experiencing costs and benefits, it was hypothesized that those reporting relatively higher quality of life would have little incentive to tolerate the distress related to the costs in Choice β.

The High AAQ-II groups indicated significantly greater distress tolerance on CT1, replicating the observations of Waltz and Follette (2009). While the same trend was observed for both tasks, the difference was significant only for CT1. AAQ-II scores had a high correlation with QOL scores in this study ($r(261) = -.567$, $p < .001$). This suggests that the Low AAQ-II group had higher quality of life than the High AAQ-II group and thus had less incentive to tolerate the distress related to the costs in Choice β when given the option to have nothing in life change (Choice α).

## Temporal Tasks 1 and 2

Temporal Tasks 1 and 2 (TT1 and TT2) assess how changes in social functioning are discounted by delay. An improvement in social functioning was a variable of interest in CT1, while a decrease in social functioning was a variable of interest in CT2.

TT1 assesses delay relevant distress tolerance for increases in social functioning. Each indifference point indicates the lowest level of improvement the individual was willing to experience immediately, rather than experience maximum improvement at various delays. Greater distress tolerance (i.e., lower k value) is illustrated by forgoing opportunities for relatively small levels of immediate improvement.

TT2 assesses delay relevant distress tolerance for decreases in social functioning. Each indifference point indicates the highest level of decline in social functioning the individual was willing to experience immediately rather than experience maximum decline at various delays. Greater distress tolerance for experiencing high levels of decline across delays is indicated by lower k values.

### Method

#### Subjects.

Using Johnson and Bickel's (2008) inclusion criteria 238 and 134 participants provided non-erratic preference patterns in Temporal Tasks 1 and 2, respectively.

#### Materials.

All study participants completed the measures discussed in the General Methods section. The choice framing and values used in the discounting assessment tasks are described below.

***Temporal Task 1.***

Study participants were presented with the following instructions:

> Take a moment and consider all of your goals and aspirations involving your relationships with family, friends, colleagues, and romantic partners.
>
> We would like you to envision social success improvements on a scale of 0% to 100%. At 0% your success in pursuing your social goals and aspirations does not change from how you experience it today. At 100% you would consider yourself completely successful in meeting your social goals and aspirations.
>
> Using this scale, please indicate your preferences for the choices that follow. There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> Would you rather:
> α Have a (Y)% increase in social success now
> β Have a 100% (maximum) increase in social success (X) from now

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 1 day, 1 week, 1 month, 6 months, 1 year, 2 years, 5 years, 10 years, and 20 years.

***Temporal Task 2.***

Study participants were presented with the following instructions:

> We now would like you to envision what it would be like to have a decrease in your social success on a scale of 0% to 100%. At 0% there would be no decrease in your social success. At 100% you would experience a maximum decrease in your social success (i.e., you would be completely unsuccessful).
>
> Using this scale, please indicate your preferences for the choices that follow. There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> Would you rather:
> α Have a (Y)% decrease in social success now
> β Have a 100% (maximum) decrease in social success (X) from now

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 1 day, 1 week, 1 month, 6 months, 1 year, 2 years, 5 years, 10 years, and 20 years.

**Results and Discussion**

Participants reported good comprehension of the choice options on TT1 ($n$ = 238, Understanding: $M$ = 4.24, $SD$ 0.91; Effort: $M$ = 2.25, $SD$ = 1.14). Participants reported fair comprehension of the choice options on TT2 ($n$ = 134, Understanding: $M$ = 3.90, SD 1.15; Effort: $M$ = 2.35, $SD$ = 1.13). There were no significant differences in comprehension Effort for TT1 and TT2 ($t(370) = -0.81$, $p = .42$, $d = 0.09$, 95% CI [-.34, .14])). There were significant differences in comprehension Understanding for TT1 and TT2 ($t(370) = 3.10$, $p = .002$, $d = 0.24$, 95% CI [.12, .55])). Thus, participants found it easier to understand the delay discounting assessment task when changes in social functioning involved an increase, rather than a decrease.

Figure 4 illustrates how delay discounting of changes in social success produce choice patterns consistent with hyperbolic discounting. Table 3 summarizes the variables characterizing how well the choice patterns fit the hyperbolic model. Visual inspection and quantitative measures indicate good to excellent fit with the model. 9% of

**Figure 4. TT1 and TT2 Discounting Curves**

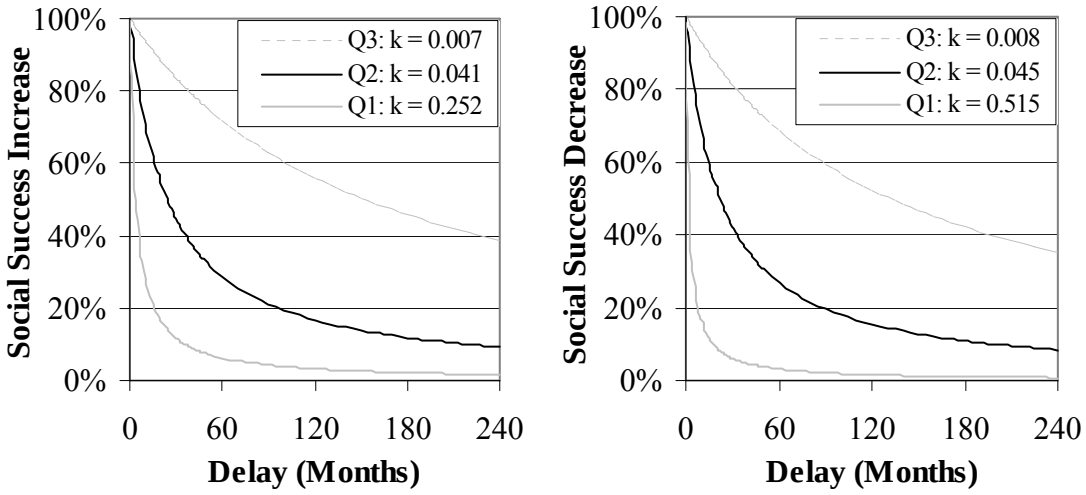


Figure 4. Median and interquartile discounting curves are presented for TT1 (left) and TT2 (right).

**Table 3. Hyperbolic Model Fit for TT1 and TT2**

| Task | $R^2$ | *SE* | $AIC_c$ |
|---|---|---|---|
| TT1 | | | |
| *M* | 0.73 | 0.1133 | -36.51 |
| *Mdn* | 0.95 | 0.0693 | -43.11 |
| TT2 | | | |
| *M* | 0.68 | 0.1294 | -34.78 |
| *Mdn* | 0.97 | 0.0552 | -47.20 |

*Note*. Mean (*M*) values represent the average $R^2$, *SE* and $AIC_c$ values obtained for all participants' providing systematic data. Median (*Mdn*) values used group median indifference points depicted in Figure 3 for the calculation of $R^2$, *SE* and $AIC_c$.

respondents in TT1 and 12% of respondents in TT2 obtained $R^2$ values of zero (values less than zero were converted to zero). These values were obtained when the sum of squares for the mean of the data points was smaller than the sum of squares fitted to the model. This occurs when the tails of the discounting distribution deviate from their expected range or when the overall range of the obtained values is relatively narrow.

A summary of the primary findings is presented in Table 4. Participants scoring

**Table 4. Primary Findings for TT1 and TT2**

| Task | Measure | *n* | *M* | *SD* | *t* | *p* | *d* |
|---|---|---|---|---|---|---|---|
| | LSAS | | | | | | |
| TT1 | Low | 54 | 0.027 | 2.86 | -0.65 | .258 | 0.24 |
| | High | 40 | 0.053 | 2.65 | | | |
| TT2 | Low | 23 | 0.034 | 2.85 | -2.03 | .023 | 0.49 |
| | High | 27 | 0.139 | 2.71 | | | |
| | DASS | | | | | | |
| TT1 | Low | 59 | 0.027 | 2.91 | 0.02 | .492 | 0.18 |
| | High | 62 | 0.042 | 2.34 | | | |
| TT2 | Low | 33 | 0.043 | 3.08 | -0.27 | .394 | 0.10 |
| | High | 33 | 0.057 | 2.64 | | | |
| | QOL | | | | | | |
| TT1 | Low | 59 | 0.040 | 2.37 | 0.69 | .246 | 0.14 |
| | High | 65 | 0.029 | 2.44 | | | |
| TT2 | Low | 35 | 0.080 | 2.82 | 1.20 | .117 | 0.31 |
| | High | 35 | 0.033 | 3.07 | | | |
| | AAQ-II | | | | | | |
| TT1 | Low | 55 | 0.045 | 2.95 | 1.08 | .141 | 0.02 |
| | High | 60 | 0.042 | 1.99 | | | |
| TT2 | Low | 34 | 0.028 | 3.40 | -0.84 | .203 | 0.29 |
| | High | 35 | 0.063 | 2.29 | | | |

*Note.* Group comparisons were made on the basis of the natural log of participants' discounting parameters (i.e., k). The mean (*M*) value is based on the untransformed k for the group. *SD* values are based on the natural log of the k scores to facilitate future analysis of the statistics presented.

high on social anxiety (LSAS) indicated relatively poorer distress tolerance for changes in social functioning. This difference was significant for decreases in social functioning (TT2) but not for increases (TT1). The same trend in mean differences was observed for those scoring low and high on general distress (DASS) and none of these differences reached significance. High quality of life (QOL) individuals indicated relatively greater distress tolerance for changes in social functioning and none of these differences reached significance. Those scoring high on psychological inflexibility and experiential avoidance (AAQ-II) indicated relatively less distress tolerance on TT2. This pattern

indicates High AAQ-II individuals were relatively more likely to choose to experience maximum decreases in social functioning later, in order to minimize the amount of decrease they might experience now. Conversely, the Low AAQ group was willing to experience relatively greater decreases in social functioning now rather than experience maximum decreases later. Although the mean group difference observed for the AAQ-II on TT2 was in the expected direction, the difference was not significant. There was no mean trend for the Low and High AAQ-II groups on TT1. This suggests that the AAQ-II bears a stronger relationship with how aversive events (e.g., decreases in social functioning, TT2) are discounted than how hedonic events (e.g., increases in social functioning, TT1) are discounted. Future research will be needed to determine whether this differential relationship holds for clinical populations as compared to controls.

## Temporal Tasks 3 and 4

Temporal Tasks 3 and 4 (TT3 and TT4) assess how changes in social distress are discounted by delay. Increases in social barrier related distress was a variable of interest in CT1, while relief from social barrier related distress was a variable of interest in CT2.

TT3 assesses delay relevant distress tolerance for social distress. Each indifference point indicates the highest level of social distress the individual was willing to experience now, as opposed to a maximum level at various delays. Greater distress tolerance for experiencing high levels of social distress across delays is indicated by lower k values.

TT4 assesses delay relevant distress tolerance for relief from social distress. Each indifference point indicates the lowest level of relief the individual was willing to experience now, as opposed to a maximum level of relief at various delays. Greater distress tolerance (i.e., lower k value) is illustrated by forgoing opportunities for relatively small levels of immediate relief.

### Method

#### Subjects.

Using Johnson and Bickel's (2008) inclusion criteria 148 and 189 participants provided non-erratic preference patterns in Temporal Tasks 3 and 4, respectively.

#### Materials.

All study participants completed the measures discussed in the General Methods section. The choice framing and values used in the discounting assessment tasks are described below.

***Temporal Task 3.***

Study participants were presented with the following instructions:

> Take a moment and consider the various forms of distress you experience because of your social barriers. Envision the barriers to achieving your social goals and aspirations on a scale of 0% to 100%. At 0% you would experience no social barrier related distress. At 100% you would experience maximum social barrier related distress.
>
> Using this scale, please indicate your preferences for the choices that follow. There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> Would you rather:
> α Experience [Y]% distress related to your social barriers now
> β Experience 100% (maximum) distress related to your social barriers [X] from now

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 1 day, 1 week, 1 month, 6 months, 1 year, 2 years, 5 years, 10 years, and 20 years.

***Temporal Task 4.***

Study participants were presented with the following instructions:

> Take a moment and consider the various forms of distress you experience because of your social barriers. We would like you to envision relief from this distress on a scale form 0% to 100%. At 0% you would have no relief from this type of distress. At 100% you would have complete relief from this type of distress.
>
> Using this scale, please indicate your preferences for the choices that follow. There are no correct or incorrect choices. We are interested in which options you would really prefer.

Study participants were then presented with a repeated series of questions in the following two choice format:

> Would you rather:
> α Experience [Y]% relief from your social barrier related distress now
> β Experience 100% (maximum) relief from your social barrier related distress [X] from now

Y values changed after every choice in the manner described in the General Methods section to obtain an indifference point at each level of the inconvenience (X). The X values were presented in the following order: 1 day, 1 week, 1 month, 6 months, 1 year, 2 years, 5 years, 10 years, and 20 years.

**Results and Discussion**

Participants reported fair comprehension of the choice options on TT3 ($n$ = 148, Understanding: $M$ = 3.89, $SD$ 1.06; Effort: $M$ = 2.32, $SD$ = 1.06). Participants reported good comprehension of the choice options on TT4 ($n$ = 189, Understanding: $M$ = 4.06, SD 1.00; Effort: $M$ = 2.26, $SD$ = 1.06). There were no significant differences in the comprehension measures for TT3 and TT4 (Understanding: $t(335) = -1.52$, $p = .13$, $d = 0.17$, 95% CI [-.39, .05]; Effort: $t(335) = 0.56$, $p = .58$, $d = 0.06$, 95% CI [-.16, .29]). Figure 5 illustrates how delay discounting of changes in barrier related distress produce choice patterns consistent with hyperbolic discounting. Table 5 summarizes the variables characterizing how well the choice patterns fit the hyperbolic model. Visual inspection and quantitative measures indicate good to excellent fit with the model. 28% of respondents in TT3 and 14% of respondents in TT4 obtained $R^2$ values of zero (values less than zero were converted to zero). These values were obtained when the sum of squares for the mean of the data points was smaller than the sum of squares fitted to the

**Figure 5. TT3 and TT4 Discounting Curves**

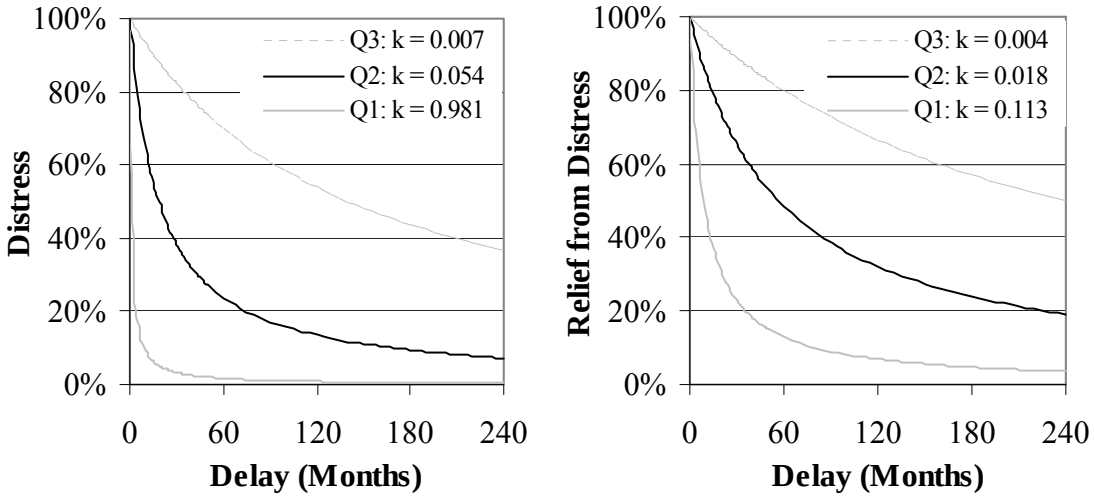


Figure 5. Median and interquartile discounting curves are presented for TT3 (left) and TT4 (right).

**Table 5. Hyperbolic Model Fit for TT3 and TT4**

| Task | $R^2$ | *SE* | $AIC_c$ |
|---|---|---|---|
| TT3 | | | |
| *M* | 0.53 | 0.1532 | -31.44 |
| *Mdn* | 0.74 | 0.1346 | -31.16 |
| TT4 | | | |
| *M* | 0.66 | 0.1135 | -37.03 |
| *Mdn* | 0.81 | 0.1052 | -35.60 |

*Note*. Mean (*M*) values represent the average $R^2$, *SE* and $AIC_c$ values obtained for all participants' providing systematic data. Median (*Mdn*) values used group median indifference points depicted in Figure 3 for the calculation of $R^2$, *SE* and $AIC_c$.

model. This occurs when the tails of the discounting distribution deviate from their expected range or when the overall range of the obtained values is relatively narrow.

A summary of the primary findings is presented in Table 6. There were no significant mean difference trends in distress tolerance for changes in emotional distress for the high and low social anxiety groups (LSAS). For those scoring low and high on general distress (DASS), there were no significant differences in distress tolerance regarding

**Table 6. Primary Findings for TT3 and TT4**

| Task | Measure | *n* | *M* | *SD* | *t* | *p* | *d* |
|---|---|---|---|---|---|---|---|
| | LSAS | | | | | | |
| TT3 | Low | 27 | 0.039 | 3.17 | 0.80 | .327 | 0.05 |
| | High | 24 | 0.046 | 2.49 | | | |
| TT4 | Low | 37 | 0.029 | 2.77 | -0.18 | .474 | 0.02 |
| | High | 35 | 0.027 | 2.90 | | | |
| | DASS | | | | | | |
| TT3 | Low | 37 | 0.012 | 3.20 | 1.69 | .034 | 0.31 |
| | High | 28 | 0.051 | 2.66 | | | |
| TT4 | Low | 45 | 0.030 | 2.91 | 0.23 | .299 | 0.04 |
| | High | 51 | 0.027 | 2.74 | | | |
| | QOL | | | | | | |
| TT3 | Low | 32 | 0.064 | 2.64 | 1.20 | .254 | 0.18 |
| | High | 42 | 0.038 | 3.01 | | | |
| TT4 | Low | 58 | 0.026 | 2.62 | 1.66 | .174 | 0.15 |
| | High | 53 | 0.017 | 2.08 | | | |
| | AAQ-II | | | | | | |
| TT3 | Low | 36 | 0.078 | 3.07 | 0.32 | .306 | 0.06 |
| | High | 25 | 0.066 | 2.51 | | | |
| TT4 | Low | 40 | 0.025 | 2.95 | 0.59 | .181 | 0.03 |
| | High | 36 | 0.023 | 2.62 | | | |

*Note.* Group comparisons were made on the basis of the natural log of participants' discounting parameters (i.e., k). The mean (*M*) value is based on the untransformed k for the group. *SD* values are based on the natural log of the k scores to facilitate future analysis of the statistics presented.

willingness to experience social distress; however there were significant differences in distress tolerance related to obtaining relief from social distress (TT4). Those scoring low on general distress were more willing to wait and receive maximum relief from social distress, while those scoring high on general distress were more willing to settle for lower levels of immediate relief now. High quality of life (QOL) individuals indicated relatively greater distress tolerance for changes in social functioning than their Low QOL peers and none of these differences reached significance. No significant mean

differences were observed for individuals on the basis of psychological inflexibility and experiential avoidance (AAQ-II).

## General Discussion

The present study illustrates how the binary choice procedure for assessing discounting can be extended to include clinically relevant events in clinically relevant frames. CT1 and CT2 represent the first discounting assessments that explicitly frame choice in relation to the status quo and represent novel ways of assessing distress tolerance for experiencing changes from one's current situation. CT1 allowed for the characterization of distress tolerance relevant to experiencing costs and benefits for variables analogous to those involved in therapy. CT2 allowed for the characterization of distress overtolerance that can accompany strong escape/avoidance repertoires that may interfere with therapeutic engagement.

Overall, fewer distress tolerance differences were detected using the temporal discounting framework than the contextual discounting framework. High social anxiety individuals were significantly more willing to experience emotional distress when it was accompanied by an increase in social functioning (CT1). However, this group's distress tolerance for immediate emotional distress (TT3) was indistinguishable from the low social anxiety group and the mean difference trend for delays in improved social functioning (TT1) indicated poorer distress tolerance than the low social anxiety group. Thus, high distress tolerance for change on the contextual discounting tasks was not carried over to the delay discounting tasks that included the same variables. When mean difference trends were observed on the temporal tasks, they were in the opposite direction (i.e., less distress tolerance). These results provide further support for considering the distress tolerance assessed by discounting tasks to be specific to the variables assessed within each task.

The differences in distress tolerance based on the framing of the choice task (i.e., contextual versus delay) may highlight an important feature of the phenomenology of clinical presentations: myopic, temporally focused choices afford less distress tolerance for clinical risk populations than choices including two contextually relevant variables. Cognitive and behavioral therapies often focus on clarifying values, developing self-monitoring or mindfulness skills, and other strategies that may function to broaden the context for clients' decision making. Thus, future studies investigating the ways clients frame their choices, and how choice framing may change over the course of treatment may provide a better understanding of the role context specific distress tolerance plays in the maintenance or remediation of clinical presentations.

Stronger trends in mean differences were observed for delay distress tolerance related to changes in social functioning (i.e., TT1 and TT2) than changes in emotional distress (i.e., TT3 and TT4). This suggests that distress tolerance related to coping with delays to changes in social functioning may have greater relevance to overall functioning than distress tolerance related to changes in emotional distress. Most of the existing discounting literature involves comparisons of clinical with non-clinical groups. Thus, it is encouraging that the mean difference trends observed in the present study could be obtained from a nonclinical convenience population. Future research with clinically relevant discounting tasks looking at differences in discounting between a clinical group and normal controls would be expected to find greater differences than those observed in the present study.

It would be of particular interest to identify whether a clinical population delay discounted changes in emotional distress more than normal controls since few differences

were observed in this study. Many clinical approaches focus on developing skills to better cope with emotional distress; however, discomfort with emotional distress may not be a key variable distinguishing clinical from nonclinical populations considering the overall pattern of results in TT3 and TT4. That is, poor distress tolerance for emotional distress, independent from other contextual variables, may be fairly universal. If the relationships observed in TT3 and TT4 were retained in a clinical versus nonclinical comparison, the result would suggest that clinicians may benefit their clients more by focusing interventions on clinically relevant hedonic variables like improvements in social functioning.

Another implication of the difference in the direction of mean differences observed between the temporal and contextual discounting tasks is that the domain specificity effect is not simply related to the particular events of interest. Previous studies of domain specificity have investigated different outcomes (e.g., money, drugs, food) but have not investigated the role of the type of inconvenience. Although choosing to act with respect to an outcome now versus later is a common choice dilemma, a variety of clinically relevant inconveniences are possible for investigation beyond delay (e.g., physical pain, emotional distress, disturbing cognitions, decrements in social functioning, opportunity costs related to other goals, days of life expectancy lost).

Researchers in substance abuse have started demonstrating the malleability of discounting (Bickel, Yi, Landes, Hill, & Baxter, 2011; Black & Rosen, 2011) over the course of substance abuse treatments. Clinically relevant discounting tasks like the ones in the present study are suitable to be included in psychosocial treatment research that is interested in characterizing changes in distress tolerance over the course of the

intervention. Domain specific discounting assessment tasks are more likely to be sensitive to effects clinical interventions than general assessments such as monetary delay discounting. More importantly, discounting assessments provide a means for describing the behavioral processes that may mediate treatment effects. Client-treatment specific discounting assessments would allow for the investigation of treatment effects on dimensions of distress tolerance specific to a client's presentation.

Clinically relevant discounting assessments could serve several other roles for treatment process and outcome research. Discounting assessments may be useful for identifying individuals at high risk for dropping out of treatment due to poor distress tolerance for variables inherent in a particular therapy (e.g., exposure therapy, self-monitoring, social interaction). If hedonic clinical outcomes are heavily discounted, then early treatment my benefit from focusing on improving the intensity, frequency, duration, and breadth of experiences related to such outcomes to decrease the risk of drop out.

Discounting assessments may be useful for matching individuals to treatments by identifying content domains with relatively more or less distress tolerance. For example, if an individual has good distress tolerance related to aversive events, but poor distress tolerance for hedonic, then an intervention focused on behavioral activation may be a better treatment match than an intervention focusing on emotion regulation skills. Conversely, if an individual has poor distress tolerance related to aversive events, and good distress tolerance for hedonic, then an intervention focused on emotion regulation skills may be a better match than behavioral activation, especially at the initial stages of treatment.

Overall, discounting serves as a promising example of translational research that can provide clinicians with tools for characterizing context specific patterns of distress tolerance. This type of characterization is unique and overdue for being used in clinical research beyond the domain of substance abuse.

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## Appendix A

**Experiment Name**: **Decision-Making in Difficult Situations**

**Short Description**: This study investigates the different variables that influence how people make decisions under difficult circumstances.

**Long Description**: This study involves answering numerous questionnaires online. We want to study the different variables that influence how people make decisions under difficult circumstances. After completing some standard questionnaires, you will be given questions in the form of dilemmas where you will need to indicate your preference of one type of outcome over another. Our goal is to gain a better understanding of how decision making in different types of dilemmas relate to one another. Please make sure you participate in the study during a time when you can be relatively free from distraction for 1 hour. We need you to answer every question. Also, take into consideration the amount of privacy you desire to have while answering questions. You are very likely to want your answers to the survey questions to be private. The researchers will keep your responses to the survey confidential.

**Appendix B**

Social Goals

Take a moment and consider all of your goals and aspirations involving your relationships with family, friends, colleagues, and romantic partners. Using the scale below, indicate the importance of each of the following items.

| Not Important | | A Little Important | | Moderately Important | | Quite Important | | Extremely Important | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

| | **Type of Goal** | **Rating** |
|---|---|---|
| 1. | Making new friends | |
| 2. | Keeping in touch with old friends | |
| 3. | Maintaining or improving current friendships | |
| 4. | Avoiding making friends feel hurt or neglected | |
| 5. | Avoiding people that I do not want to be friends with | |
| 6. | Keeping in touch with family members | |
| 7. | Maintaining or improving current relationships with important family members | |
| 8. | Avoiding making family members feel hurt or neglected | |
| 9. | Having a fulfilling romantic relationship | |
| 10. | Avoiding making romantic partners feel hurt or neglected | |
| 11. | Supporting groups that are important to you (e.g., charities, political, environmental, or religious groups) | |
| 12. | Serving as a leader | |
| 13. | Being a parent or mentoring a child | |
| 14. | Mentoring peers | |
| 15. | Being an effective communicator | |
| 16. | Avoiding sounding foolish while communicating with others | |
| 17. | Being trusted by others | |
| 18. | Avoiding being judged as unreliable | |
| 19. | Supporting others toward their goals | |
| 20. | Being generous toward the emotional needs of others (e.g., listening and being emotionally supportive) | |
| 21. | Being generous toward the practical needs of others (e.g., providing money or other assistance) | |
| 22. | Skillfully apologize to others when I have done something wrong or inconsiderate | |
| 23. | Use my talents to earn the esteem of others | |
| 24. | Use my talents for the benefit of others | |
| 25. | Other social goals and aspirations not listed above | |
| 26. | Considering all your life goals, how important are your social goals | |

## Appendix C

Social Barriers

Everyone experiences barriers that interfere with their ability to pursue their goals. When you think about your social goals and aspirations, what kinds of things get in the way of your ability to pursue these? In the questions below indicate the degree to which each barrier interferes with your ability to pursue your social goals and aspirations.

| No Interference | | A Little Interference | | Moderate Interference | | Quite a Bit of Interference | | Extreme Interference | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

| | Type of Barrier | Rating |
|---|---|---|
| 1. | Physical pain or discomfort | |
| 2. | Low energy or fatigue | |
| 3. | Inadequate sleep or rest | |
| 4. | Lacking the positive feelings you feel you need to take action | |
| 5. | Difficulties thinking, learning new information, remembering, and concentrating | |
| 6. | Struggling with having confidence in yourself or feeling valuable | |
| 7. | Being uncomfortable with your bodily appearance | |
| 8. | Negative feelings like depression, anxiety, worry, sadness, or despair | |
| 9. | Poor physical ability to move about and do things | |
| 10. | Routine everyday living activities such as preparing meals, cleaning your home, getting ready to leave your house | |
| 11. | The medications you take | |
| 12. | Other drugs including alcohol, cigarettes, or prescription medications that were not specifically prescribed to you by your medical doctor | |
| 13. | Work or other employment related responsibilities | |
| 14. | Poor personal relationships with your friends or inadequate support | |
| 15. | Poor personal relationships with your family or inadequate support | |
| 16. | Struggling with feeling unsupported by others | |
| 17. | Problems in your sex life | |
| 18. | Concerns about your safety and security | |
| 19. | Dissatisfaction with your current home environment | |
| 20. | Financial barriers | |
| 21. | Dissatisfaction with your ability to access health care | |
| 22. | Time spent acquiring new information or learning new skills that are important to you | |
| 23. | Participation in recreation, hobbies, or other leisure activities | |
| 24. | Struggling with an unsatisfactory physical environment (e.g., too loud, too hot or to cold, unhealthy or unattractive) | |
| 25. | Inadequate transportation | |
| 26. | Religious activities or beliefs | |
| 27. | Emotional distress (anxiety, worry, fear, dread) | |
| 28. | Social awkwardness due to ineffective or poor social skills | |
| 29. | Educational obligations and workload | |
| 30. | Other (please specify): | |