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Behavioral theory of depression: Reinforcement as a mediating variable between avoidance and depression

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ABSTRACT

Behavioral theory posits that certain environmental changes and avoidant behaviors inhibit individuals from experiencing environmental reward and reinforcement and subsequently leads to the development and maintenance of depressive symptoms. Using self-report and behavioral (daily diary) indices of environmental reward as proxy measures for positive reinforcement, this investigation examined whether environmental reward mediated the relationship between avoidance and depression. When controlling for anxiety, both indices of environmental reward significantly mediated the relationships of depression with cognitive, behavioral and total avoidance. Post-hoc mediation analyses were conducted to examine potential gender differences. Self-reported environmental reward significantly mediated the relationship between avoidance and depression across both genders. Among females, however, daily diary-measured reward only mediated the relation between cognitive avoidance and depression. In males daily diary reward was a mediator with all three forms of avoidance and depression. This investigation provides initial support for reinforcement as a significant mediator between avoidance and depression and further highlights the relevance of avoidance and reinforcement in behavioral conceptualizations of depression.

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Behavioral theories explain the development and persistence of depressive symptoms as the result of decreased environmental reward, associated reductions in positively reinforced healthy behavior, reinforcement of depressive or passive behaviors, and punishment of healthy behaviors (Ferster, 1973; Lewinsohn, 1974; Martell, Addis, & Jacobson, 2001). Cognitions and overt behaviors that serve an avoidant function are thought to be critical precursors to the reductions of reward and positive reinforcement that predispose people to depression (Ferster, 1973; Martell et al., 2001). The construct of avoidance can be defined as attempts to prevent, escape, or reduce contact with subjectively aversive or minimally rewarding internal or external stimuli. These stimuli can come in different forms, including thoughts, behaviors, emotions, memories, and social interactions (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996; Ottenbreit & Dobson, 2004). Excessive avoidance has been implicated in various emotional and behavioral problems, particularly depressive and anxiety disorders (Barlow, 2002; Chawla & Ostafin, 2007; Ottenbreit & Dobson, 2004). In behavioral conceptualizations of depression, behavior aimed at escaping or avoiding stimuli leads to a pattern of passivity and withdrawal that reduces the frequency of positively reinforced behavior, which

in turn produces, sustains, or worsens depressive symptoms. In other words, there is a relationship between avoidance and depression that is largely explained by the mediating role of reduced positive reinforcement (Ferster, 1973; Lewinsohn, 1974; Manos, Kanter, & Busch, 2010; Martell et al., 2001). Although a largely referenced model of depression, to date this theory has received minimal empirical scrutiny. In particular, while significant evidence links depression to avoidance and reduced response-contingent positive reinforcement, no study to date has directly investigated the proposed mediating role of reinforcement. The current study was designed to specifically test this model.

Much of the evidence linking avoidance and depression comes from the coping literature. Avoidance coping consists of focusing attention away from internal or external stimuli to manage, reduce, or eliminate stress, and can be either a cognitive or behavioral process (Cronkite & Moos, 1995). Cognitive avoidance coping involves denying, minimizing, ruminating, or passive decisions that stressful or unpleasant situations are unchangeable. Behavioral avoidance coping occurs when a problem is avoided through participation in alternative activities, engagement in temporarily satisfying albeit maladaptive behaviors such as substance use, gambling, or binge eating, or through overtly displaying behavioral manifestations of unpleasant emotions (e.g., yelling or shouting at others) (Cronkite & Moos, 1995). Individuals with increased depression are more likely to use escape and avoidance coping strategies when stressed

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(Connor-Smith & Compas, 2002; Ingram, Trenary, Odom, Berry, & Nelson, 2007; Kuyken & Brewin, 1994; Penland, Masten, Zelhart, Fournet, & Callahan, 2000; Spangenberg & Campbell, 1999; Spurrell & McFarlane, 1995; Turner, King, & Tremblay, 1992). Longitudinal investigations also causally indicate that avoidance coping directly contributes to the etiology and maintenance of depression symptoms (Cronkite, Moos, Twohey, Cohen, & Swindle, 1998; Holahan & Moos, 1986; Holahan, Moos, Holahan, Brennan, & Schutte, 2005).

The pioneering theoretical work of Ferster (1973) highlighted avoidant behavior as a determinant of depressive behaviors and symptoms, stressing the need to analyze relationships between environmental contexts and behavior to understand and treat depression. While this theory was elaborated by other theorists (Lewinsohn, 1974; Staats & Heiby, 1985), purely behavioral conceptualizations and treatments of depression became overshadowed by more integrative cognitive-behavioral models (Beck, Rush, Shaw, & Emery, 1979). A landmark study revitalized interest in behavioral theory and reaffirmed the importance of targeting avoidance behavior through guided activity scheduling for the purposes of increasing environmental reinforcement and subsequent attenuation of depression symptoms (Jacobson et al., 1996). In this component analysis of cognitive-behavioral therapy (CBT) for depressed outpatients, the behavioral activation (BA) component of CBT was compared to full CBT as well as a condition that incorporated BA and the addressing of automatic thoughts. BA was as effective as both comparison conditions, with treatment gains maintained at 2-year follow-up (Gortner, Gollan, Dobson, & Jacobson, 1998). In later works, the importance of targeting avoidance behavior became more explicitly highlighted in both the conceptualization and treatment of depression (e.g., see TRAP and TRAC models of depression: Addis & Martell, 2001; Martell et al., 2001).

The dismantling study of Jacobson et al. (1996) inspired the development of two behaviorally-focused treatments for depression: *behavioral activation* (BA; Martell et al., 2001) and the *brief behavioral activation treatment for depression* (BATD; Lejuez, Hopko, & Hopko, 2001). Consistent with traditional behavioral models, behavioral activation treatments modify one's environment through behavior change that increases access to positively reinforcing events and activities while limiting reinforcement of depressed behavior. Both BA and BATD incorporate an acceptance-change model that emphasizes action- as opposed to avoidance-based strategies as a means to attenuate depressive symptoms (Hopko, Lejuez, Ruggiero, & Eifert, 2003). BA's model of depression includes a specific emphasis on the role of avoidance that is central to the present investigation. Behavioral and cognitive avoidance of potentially rewarding environmental experiences are thought to be critical in producing and maintaining depressed behavior characterized by passivity, withdrawal, and inactivity. A central goal of treatment is to reduce escape and avoidance behavior and associated passivity through recognition of this avoidance pattern and increased participation in alternative healthy and rewarding behaviors. Importance is placed not only on behavioral avoidance, but also cognitive avoidance strategies such as rumination, which are all hypothesized to interfere with one's ability to elicit reward from the environment (Martell et al., 2001). Importantly, the efficacy of behavioral activation interventions has been well supported and BA is considered an empirically supported intervention (Cuijpers, van Straten, & Warmerdam, 2007; Dimidjian et al., 2006; Ekers, Richards, & Gilbody, 2008; Mazzucchelli, Kane, & Rees, 2009; Sturme, 2009).

In targeting avoidance behavior, the central premise of behavioral theory and behavioral activation treatments is that reducing avoidance and escape behavior will increase exposure to positive reinforcement for healthy behavior (Manos et al., 2010). Lewinsohn et al. highlighted a low rate of response-contingent positive reinforcement (RCPR) as the critical predictor of clinical depression (Lewinsohn,

1974; Lewinsohn & Graf, 1973). RCPR is defined as an increase in the frequency or duration of a behavior as a result of positive or pleasurable outcomes. In addition to potentially pleasurable outcomes, RCPR may involve an increased likelihood of behavior due to the experience of self-mastery or achievement following the emission of a behavior (Beck et al., 1979; Lewinsohn, 1974). Minimal environmental (and social) reinforcement was proposed to result in the extinction of "healthy" adaptive behaviors and consequently the dysphoric mood and passivity that often characterize depression. A low rate of RCPR is a product of: 1) a decreased number of events that are potentially reinforcing for the individual, 2) decreased availability of these potential reinforcers in the environment, 3) inability to experience rewarding contingencies due to inadequate instrumental behaviors such as social skill, and 4) increased exposure to aversive stimuli (e.g., punishment) in the form of distressing, upsetting, or unpleasant events (Lewinsohn, 1974; Lewinsohn, Sullivan, & Grosscup, 1980). Reduced RCPR is thought to be sufficient in producing the dysphoria and related symptoms observed in clinical depression (Lewinsohn, 1974; Lewinsohn et al., 1980). Supporting behavioral theory, several studies demonstrated relationships between pleasant events and mood state, with individuals reporting fewer positive events, decreased environmental reward, and more limited abilities to obtain reinforcement endorsing increased depression severity (Hopko, Armento, Cantu, Chambers, & Lejuez, 2003; Hopko & Mullane, 2008; Lewinsohn & Amenson, 1978; Lewinsohn & Graf, 1973; Lewinsohn & Libet, 1972; MacPhillamy & Lewinsohn, 1974). Depressed individuals also tend to engage in fewer rewarding interpersonal behaviors, suggesting that insufficient social interaction and decreased social reinforcement may predict negative affect (Joiner, Lewinsohn, & Seeley, 2002; Lewinsohn & Shaffer, 1971; Libet & Lewinsohn, 1973).

At this juncture, it is important to note the conceptual relationship between reward and reinforcement. Although positive reinforcers often are experienced as rewarding or pleasurable to an individual and serve to increase the frequency of healthy or adaptive behaviors, it also is true that environmental events may function as positive reinforcers yet be somewhat aversive in their form or presentation. In such cases, unhealthy or maladaptive behaviors actually may increase in frequency. For example, when harsh verbal criticism, or the provision of attention, to a depressed individual's socially withdrawn behavior has the effect of increasing the frequency and duration of social isolation, the behavior of social passivity is positively reinforced. For the purposes of this study, and consistent with the Ferster (1973) and Lewinsohn (1974) formulations, positive reinforcement was conceptualized as increased behavior that generally is a function of rewarding or pleasant responses and freedom from aversive stimuli, a process that has antidepressant effects (Abreu & Santos, 2008). Very nicely described in a recent article reviewing assessment strategies in behavioral activation (Manos et al., 2010), an important issue to consider is that to validly measure positive reinforcement per se, one would need to observe increased behavior over time as a function of specific environmental consequences. This might be possible utilizing a highly complex longitudinal research design, but was beyond the scope of this exploratory investigation. For this reason, RCPR was approximated through use of a validated self-report instrument and daily activity diaries that assessed magnitude of environmental reward as an estimated probability of RCPR. Several studies referenced herein have used self-report questionnaires such as the Pleasant Events Schedule (PES; MacPhillamy & Lewinsohn, 1971) to measure the frequency and intensity of positive events as an approximate, yet valid, method of quantifying RCPR. However, the PES is limited in that it is quite extensive (i.e., 320 items) and prompts for specific events that may be pleasant but not necessarily associated with increased RCPR. Other similarly

focused measures (Armento & Hopko, 2007; Kanter, Mulick, Busch, Berlin, & Martell, 2007) have been more concise, but fail to assess for RCPR as defined by Lewinsohn (1974). Accordingly, the Reward Probability Index (RPI; Carvalho et al., in press) was used as it specifically targets the four dimensions of RCPR as a means of approximating the presence and magnitude of RCPR.

A more ecologically valid method of measuring environmental reward (as a proxy measure of reinforcement) is through use of daily activity diaries (Hopko, Armento, et al., 2003). Studies incorporating daily diaries have found daily ratings of behaviors and depression symptoms to correlate strongly with self-report and clinician-rated measures of depression (Freeman, DeRubeis, & Rickels, 1996; Hopko, Armento, et al., 2003; Hopko & Mullane, 2008; Robbins & Tanck, 1984; Stamenkovic et al., 2001). Similar daily diary designs have demonstrated adequate internal consistency and good convergent and discriminant validity in research on anxiety (Beidel, 1996; Nelson & Clum, 2002) and other symptom presentations (Ely, Dampier, Gilday, O'Neal, & Brodecki, 2002; Grant, Long, & Willms, 2002; Okami, 2002; van den Brink, Bandell, & Huijter, 2001).

Existing avoidance measures have been inconsistent in their definition of the construct and have psychometric properties that may be inadequate for clinical use (Blalock & Joiner, 2000; Ottenbreit & Dobson, 2004). In response to the need for a specific and integrated way to define and measure the construct of avoidance, the Cognitive-Behavioral Avoidance Scale was developed to investigate depression-related avoidance (CBAS; Ottenbreit & Dobson, 2004). The CBAS considers avoidance behavior a response to certain external situations or internal thoughts or emotions. The measure assesses both cognitive and behavioral avoidance strategies and differentiates between avoidance of social and nonsocial events. Studies using the CBAS have demonstrated avoidance and its subtypes are associated with a depression diagnosis and symptom severity (Cribb, Moulds, & Carter, 2006; Moulds, Kandris, Starr, & Wong, 2007; Ottenbreit & Dobson, 2004; Vandromme, Raes, Defranc, & Hermans, 2007).

In systematically assessing behavioral theories of depression, this study aimed to examine whether a multi-method assessment of positive reinforcement (i.e., self-report, daily diary) would reveal that it was a significant mediating variable between avoidance and depression. Avoidance was measured with the CBAS (Ottenbreit & Dobson, 2004), and all analyses examining the relationship between avoidance and depression controlled for anxiety symptoms as measured by the Beck Anxiety Inventory (BAI; Beck & Steer, 1993). This was necessary due to high comorbidity between depression and anxiety symptoms (Kessler et al., 2003) and the well-established association between behavioral avoidance and anxiety (Barlow, 2002). The BAI was used due to its strong discriminate validity in distinguishing anxiety from depressive symptoms (Beck & Steer, 1993). The following hypotheses were tested:

Hypothesis 1a: Each index of avoidance (CBAS Total, CBAS Cognitive Avoidance, CBAS Behavioral Avoidance) would show significant positive relationships with depression symptom severity as measured by the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996).

Hypothesis 1b: The relationship between each avoidance index and depression severity would remain significant when controlling for anxiety symptoms (BAI).

Hypothesis 2: Each avoidance index would significantly and inversely relate to environmental reward, as measured by a self-report questionnaire (RPI) and daily diary.

Hypothesis 3: Reward, as measured by the RPI and daily diary would be significantly inversely related to depression severity.

Hypothesis 4: Reward, as measured by the RPI and daily diaries, would mediate the relationships between total, cognitive, and behavioral avoidance (CBAS) with depression when controlling for anxiety symptoms (BAI).

1. Method

1.1. Participants

The sample included 158 male and female undergraduate psychology students recruited from the University of Tennessee. Students who were at least 18-years-old were eligible to participate to earn credit. There were no exclusion criteria aside from age. The sample consisted of 61 males (38.6%) and 97 females (61.4%), with a mean age of 19.1 years ($SD = 2.0$ years). Ethnic distribution was as follows: 123 Caucasians (77.8%), 18 African Americans (11.4%), 7 Asian Americans/Pacific Islanders (4.4%), 2 Latinos (1.3%), and 8 participants who identified as "Other" (5.1%) (see Table 1).

1.2. Measures

The Cognitive-Behavioral Avoidance Scale (CBAS; Ottenbreit & Dobson, 2004) is a self-report measure that assesses depression-related avoidance. The scale includes 31 items rated on a Likert scale, and includes four subscales: Behavioral Social, Cognitive Social, Behavioral Nonsocial, and Cognitive Nonsocial avoidance. Subscales demonstrate adequate to strong coefficient alphas ($\alpha = .86, .78, .75, .80$, respectively) and test-retest reliability ($r = .86, .58, .88, .94$, respectively). A total avoidance score also is calculated, which has excellent internal consistency ($\alpha = .91$) and test-retest reliability (.92). The CBAS also correlates moderately with other measures of avoidance as well as depression and anxiety scales (Kanter et al., 2007, 2009; Ottenbreit & Dobson, 2004). Sample items include, "I try not to think about problems in my personal relationships" (Cognitive Social) and "I quit activities that challenge me too much" (Behavioral Nonsocial).

Table 1
Descriptive statistics for demographic variables and self-report measures.

	Total Sample (<i>n</i> = 158)			Males (<i>n</i> = 61)			Females (<i>n</i> = 97)		
	Mean	SD	%	Mean	SD	%	Mean	SD	%
Age (years)	19.13	2.05		19.18	1.95		19.09	2.12	
Caucasian			77.8			75.4			79.4
African American			11.4			16.4			8.2
Asian American			4.4			3.3			5.2
Other ethnicity			6.4			4.9			7.2
BDI-II	13.59	9.42		11.25	7.48		15.06	10.22	
BAI	10.37	8.20		8.46	6.61		11.57	8.88	
CBAS T	62.42	20.40		60.38	19.30		63.71	21.06	
CBAS CA	33.90	11.62		33.14	10.40		34.38	12.36	
CBAS BA	28.53	10.47		27.24	10.29		29.34	10.56	
RPI T	57.41	9.38		58.83	9.08		56.52	9.50	
RPI RP	34.28	5.14		34.83	5.34		33.94	5.00	
RPI ES	23.13	5.25		24.00	4.41		23.58	5.66	
Tot diary	2.91	.40		2.79	.44		2.71	.41	

BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; CBAS T = Cognitive-Behavioral Avoidance Scale total; CBAS CA = Cognitive-Behavioral Avoidance Scale – Cognitive avoidance subscale; CBAS BA = Cognitive-Behavioral Avoidance Scale – Behavioral avoidance subscale; RPI T = Reward Probability Index total; RPI RP = Reward Probability Index – Reward Probability subscale; RPI ES = Reward Probability Index – Environmental Suppressors subscale; Tot Diary = Total Daily Diary Reward.

Internal consistency for the total avoidance score in the current sample was excellent ($\alpha = .94, .96$).

Due to the investigation's focus on cognitive and behavioral avoidance and lack of emphasis on social factors, it was decided to collapse the four CBAS subscales into two subscales: Cognitive Avoidance (Cognitive Social + Cognitive Nonsocial) and Behavioral Avoidance (Behavioral Social + Behavioral Nonsocial). Because the authors of the CBAS (Ottenbreit & Dobson, 2004) did not establish psychometric properties for these combined subscales, internal consistency and one-week test–retest reliability were calculated from this study's sample. The Cognitive Avoidance subscale demonstrated excellent internal consistency at Times 1 ($\alpha = .90$) and 2 ($\alpha = .93$), as well as strong test–retest reliability ($r = .87$). Similarly excellent internal consistency (T1 $\alpha = .93$, T2 $\alpha = .91$) and test–retest reliability ($r = .91$) were established with the Behavioral Avoidance subscale. These two subscales were also strongly correlated ($r = .70$, $p < .001$).

The Reward Probability Index (RPI; Carvalho et al., in press) is a 20-item self-report measure designed to measure the magnitude of environmental reward as an approximation of response-contingent positive reinforcement. The scale assesses RCP's four dimensions via two factors: Reward Probability (potentially reinforcing events and instrumental behaviors in obtaining reinforcement) and Environmental Suppressors (availability of reinforcement in the environment and presence of punishing/aversive experiences). Sample items include, "I consider myself to be a person with many skills" (Reward Probability) and "There are a lot of activities I might enjoy, but they just don't seem to happen" (Environmental Suppressors). Participants rate each item on a 4-point Likert scale (1 = *strongly disagree* to 4 = *strongly agree*) for the time period of the "past several months," with higher scores indicating higher levels of reward. Psychometric properties of the RPI were established through three studies. The measure demonstrated strong internal consistency ($\alpha = .88$ to $.92$) and very good two-week test–retest reliability ($r = .69$). Convergent validity was established via strong correlations with measures of activity, avoidance, reward, and depression ($r = .65$ to $.81$). Discriminant validity was supported via smaller correlations with measures of social support and somatic anxiety ($r = -.29$ to $-.40$). Further, the RPI accounted for unique variance in daily diary-reported environmental reward above that accounted for by a pre-existing reward measure (EROS) and self-reported depression (BDI-II). In the present study, internal consistency was strong (total score T1 $\alpha = .89$, T2 $\alpha = .91$).

The Beck Depression Inventory-II (BDI-II; Beck et al., 1996) is a 21-item measure of depression symptom severity, each of which is rated on a 4-point Likert scale (0–3 point anchors), with items summed to form a total score. The instrument has excellent internal consistency ($\alpha = .92$) as well as strong convergent validity with other measures of depression (Beck et al., 1996; Nezu, Ronan, Meadows, & McClure, 2000). Internal consistency in this sample was excellent (T1 $\alpha = .91$, T2 $\alpha = .93$).

The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) is a 21-item questionnaire designed to distinguish cognitive and somatic symptoms of anxiety from those of depression. Participants rate how much they have been bothered by anxiety symptoms over the past week. Good psychometric properties have been demonstrated for the measure among community, medical, and psychiatric outpatient samples (Beck & Steer, 1993; Morin et al., 1999; Osman, Kopper, Barrios, Osman, & Wade, 1997; Wetherell & Areán, 1997). Internal consistency in this study was excellent (T1 $\alpha = .90$, T2 $\alpha = .91$).

1.3. Procedure

Participants met with investigators for two administration sessions. The first lasted approximately 30 min and consisted of

providing informed consent followed by completion of a demographic questionnaire and the self-report questionnaires described above. Following completion of the questionnaires, participants were given seven daily diary activity-monitoring forms (Hopko, Armento, et al., 2003) with the following instructions:

I'd like you to keep this record for one week, making an effort to behave in as "normal" a manner as possible. What I'd like you to do is to record your behaviors during these half hour intervals – you don't have to put everything you did in each half hour, only how MOST of your time during that half hour was spent. Remember to record only your behaviors, that is, what you do and how you spend your time. It is not necessary to write down specific thoughts or feelings that you might be having. Also, don't worry about having to write down everything as it happens – that might be much too overwhelming. Instead, try to keep track of your behaviors every 3–4 h, remembering how you spent your time. When you write down your behaviors, rate each of them using this scale, from 1 (least rewarding or pleasurable) to 4 (most rewarding or pleasurable). Of course you also may rate behaviors as having a reward value of "2" or "3." You have one form for each day of the week till we next meet. Try to be as accurate and as thorough as you can.

Participants were scheduled to return to the laboratory one week from their initial session. At this second administration, they returned their seven completed diary forms and completed self-report questionnaires a second time. Mean elapsed time between administrations was 7.71 days (SD = 2.44 days).

Daily diaries were quantified by totaling the number of hours in each level of reward activity [1 (lowest) through 4 (highest)]. To assess reward value of behaviors as a continuous variable, each participant received a total daily diary reward score based on the following formula: Total Daily Diary Reward = Time in Level 1 behaviors (*1) + Time in Level 2 behaviors (*2) + Time in Level 3 behaviors (*3) + Time in Level 4 behaviors (*4)/Total number of recorded hours. The equation is in the form of a ratio to account for possible differences between participants in the total number of recorded hours. The decision was made to factor out time spent in sleep-related behavior, based on the concern that time spent sleeping did not fit the criteria for potentially reinforcing behavior that the diaries were meant to assess (i.e., response-contingent positive reinforcement). In other words, sleep behavior was conceptualized as a negatively reinforced behavior in that depressed individuals might increase sleep behavior to avoid aversive emotions. As such, inclusion of sleep behaviors (and their reward value) might artificially increase overall reward for individuals with increased depression. Accordingly, Daily Diary Reward was calculated using the above formula, with the exception that all sleep-related behaviors were removed from the hour total. It was theorized that this variable would provide a more valid measure of daily diary-reported activities and associated reward values.

Final CBAS, RPI, BDI-II, and BAI scores were calculated by averaging the totals (and subscale totals) from the first and second administrations of the measures. This procedure was done to obtain a more complete and accurate index of participant psychological and behavioral functioning during the one-week period, as opposed to using only time 1 or time 2 scores. This methodology was used to maintain consistency with other daily diary studies exploring relations between negative affect and overt behaviors (Hopko, Armento, et al., 2003; Hopko & Mullane, 2008). This strategy was viewed as more optimal than examining the relation of time 1 avoidance with time 2 depression, for example, because the concept of avoidance was conceptualized contextually as a state (rather than trait) phenomenon. Accordingly, averaging scores was

deemed to more accurately depict avoidance behavior within the context of the week long experimental interval.

1.4. Data analysis

Mediation analyses (e.g., tests of indirect effects) were conducted using a bootstrapping method (Preacher & Hayes, 2008), which has a lower Type II error rate and greater statistical power than the traditionally used causal steps approach advocated by Baron and Kenny (1986) (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher & Hayes, 2004, 2008; Shrout & Bolger, 2002). Bootstrapping techniques were performed in line with recommendations by Preacher and Hayes (2008), with $k = 5000$ re-samples and 95% bias-corrected and accelerated (BCa) confidence intervals (CI) used to evaluate indirect effects. BCa confidence intervals include corrections for median bias and skew (Efron & Tibshirani, 1993). The use of 95% confidence intervals is equivalent to testing for significance at the .05 level.

2. Results

2.1. Descriptive statistics

Descriptive statistics are presented in Table 1. One-way ANOVAs indicated no significant differences between males and females in age [$F(1, 157) = .07, p = .80, \eta^2 = .00$], CBAS Total Avoidance [$F(1, 157) = 1.00, p = .32, \eta^2 = .01$], CBAS Cognitive Avoidance [$F(1, 157) = .42, p = .52, \eta^2 = .00$], CBAS Behavioral Avoidance [$F(1, 157) = 1.51, p = .22, \eta^2 = .01$], RPI Total [$F(1, 157) = 2.29, p = .13, \eta^2 = .01$], RPI Reward Probability [$F(1, 157) = 1.11, p = .29, \eta^2 = .01$], RPI Environmental Suppressors [$F(1, 157) = 2.79, p = .10, \eta^2 = .02$], Total Daily Diary Reward [$F(1, 157) = 1.24, p = .27, \eta^2 = .01$], or days elapsed between the first and second assessments [$F(1, 157) = .08, p = .78, \eta^2 = .00$]. Males and females did differ in depression symptom severity [BDI-II; $F(1, 157) = 6.31, p = .01, \eta^2 = .04$] and somatic anxiety [BAI; $F(1, 157) = 5.54, p = .02, \eta^2 = .03$], with females scoring higher on both measures. A Chi-square analysis yielded no significant gender differences in ethnic background ($\chi^2(4) = 8.04, p = .09$).

2.2. Bivariate correlations

Bivariate correlations among self-report measures and daily diary totals are presented in Table 2. As predicted by Hypothesis 1, depression symptom severity (BDI-II) was significantly associated with CBAS-measured Cognitive ($r = .68, p < .001$), Behavioral ($r = .71, p < .001$), and Total Avoidance ($r = .75, p < .001$), indicating a strong positive relationship between avoidance and depression. Interestingly, while each of these indices of avoidance correlated significantly with somatic anxiety (BAI), a series of Pearson's tests of dependent r 's demonstrated that the magnitude of the correlation was significantly smaller in each case when compared to the BDI-II results. In other words, cognitive, behavioral, and total avoidance were significantly more associated with depression relative to anxiety.

Supporting Hypothesis 2, Cognitive, Behavioral, and total Avoidance all correlated inversely with all measures of environmental reward (RPI Total, RPI Reward Probability, RPI Environmental Suppressors, and Total Daily Diary Reward; all $p < .001$). These relationships supported the prediction that high avoidance would be associated with decreased environmental reward.

Consistent with Hypothesis 3 and supporting behavioral theories of depression, depression severity (BDI-II) was inversely related to environmental reward, as measured by RPI Total ($r = -.79, p < .001$), RPI Reward Probability ($r = -.65, p < .001$), RPI Environmental Suppressors ($r = -.78, p < .001$), and Total Daily Diary Reward ($r = -.32, p < .001$).

Table 2

Bivariate correlations among self-report measures ($n = 158$).

	1	2	3	4	5	6	7	8	9
1. BDI-II	1	.68**	.75**	.68**	.71**	-.79**	-.65**	-.78**	-.32**
2. BAI 1		1	.45**	.38**	.46**	-.54**	-.39**	-.57**	-.11
3. CBAS T			1	.93**	.91**	-.78**	-.71**	-.69**	-.33**
4. CBAS CA				1	.70**	-.66**	-.60**	-.63**	-.29
5. CBAS BA					1	-.78**	-.76**	-.65**	-.32**
6. RPI T						1	.90**	.91**	.41**
7. RPI RP							1	.63**	.43**
8. RPI ES								1	.31**
9. Tot Diary									1

* $p < .05$ ** $p < .01$.

BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; CBAS T = Cognitive-Behavioral Avoidance Scale total; CBAS CA = Cognitive-Behavioral Avoidance Scale – Cognitive avoidance subscale; CBAS BA = Cognitive-Behavioral Avoidance Scale – Behavioral avoidance subscale; RPI T = Reward Probability Index total; RPI RP = Reward Probability Index – Reward Probability subscale; RPI ES = Reward Probability Index – Environmental Suppressors subscale; Tot Diary = Total Daily Diary Reward.

A series of Pearson's tests of independent r 's was conducted to test for significant differences in correlation values between males and females. Males and females statistically differed on only one correlation value. Compared to females, male RPI Environmental Suppressors ratings correlated more strongly with Total Daily Diary Reward ($Z = 1.98, p < .05$).

2.3. Partial correlations

To examine the relationship between avoidance and depression independent of the effect of anxiety, a series of partial correlations between depression and measures of avoidance were conducted while controlling for anxiety (Table 3). When controlling for somatic anxiety (BAI), depression severity maintained significant positive relationships with Total Avoidance ($r = .68, p < .001$), Cognitive Avoidance ($r = .62, p < .001$), and Behavioral Avoidance ($r = .61, p < .001$). These significant relationships were robust across males and females, and Pearson's tests of independent r 's yielded no significant gender differences on any correlation values.

2.4. Mediation

Mediation analyses were conducted using the bootstrapping technique described above. Mediation was considered to have occurred if the 95% BCa confidence intervals generated by the

Table 3

Partial correlations between depression and avoidance, controlling for anxiety (BAI).

	BDI	CBAS T	CBAS CA	CBAS BA
Total sample ($n = 158$)				
BDI-II	1	.68*	.62*	.61*
CBAS T		1	.92*	.89*
CBAS CA			1	.65*
CBAS BA				1
Males ($n = 61$)				
BDI	1	.58*	.51*	.54*
CBAS T		1	.92*	.91*
CBAS CA			1	.67*
CBAS BA				1
Females ($n = 97$)				
BDI	1	.74*	.68*	.66*
CBAS T		1	.92*	.88*
CBAS CA			1	.64*
CBAS BA				1

* $p < .001$.

BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; CBAS T = Cognitive-Behavioral Avoidance Scale total; CBAS CA = Cognitive-Behavioral Avoidance Scale – Cognitive avoidance subscale; CBAS BA = Cognitive-Behavioral Avoidance Scale – Behavioral avoidance subscale.

bootstrapping method did not contain zero. Depression severity (BDI-II) was the dependent variable in each analysis. The first set of analyses tested total avoidance, cognitive avoidance, and behavioral avoidance separately as independent variables with the RPI total score as the mediating variable. In each case, with somatic anxiety (BAI) as a covariate to control for potential confounding effects of anxiety, the RPI significantly mediated the relationship between all three forms of avoidance and depression (see Table 4).¹ A second set of mediation analyses was performed with Daily Diary Reward as the mediating variable, with the independent and dependent variables identical to the first analysis. Controlling for anxiety, diary-measured reward also significantly mediated the relationship between total, cognitive, and behavioral avoidance with depression (see Table 5).² Subsequent mediation analyses were completed separately for males and females to examine potential gender differences. For males, the RPI was a significant mediator with total, cognitive, and behavioral avoidance as predictor variables. Similar results were observed with Daily Diary Reward as the mediator. So in males, reward as indexed by both the RPI and daily diaries significantly mediated the relationship between avoidance and depression as predicted. Among females, the RPI also significantly mediated the links between each of the three avoidance measures and depression. Different from males, however, when daily diary reward was used as the mediator, only the relationship between cognitive avoidance and depression was significant. The relationships between behavioral avoidance ($\beta = 2.277, p = .12$) and total avoidance ($\beta = -1.576, p = .23$) with depression were not significantly mediated by diary-measured reward.

3. Discussion

According to behavioral conceptualizations of depression, depressive symptoms arise when positive reinforcement (RCPR) for healthy behaviors decreases (Lewinsohn, 1974; Manos et al., 2010; Martell et al., 2001). Some theorists propose that limiting contact with external or internal sources of distress through avoidant behavioral and cognitive coping strategies removes individuals from rewarding reinforcement contingencies, thus increasing the likelihood that depressive symptoms may develop and persist (Ferster, 1973; Martell et al., 2001; Watkins & Moulds, 2007). This is a central tenet of Behavioral Activation theory (Hopko, Lejuez, et al., 2003; Martell et al., 2001). While an abundance of evidence links depression to increased avoidance and diminished RCPR, to date, no study has directly investigated this proposed mediating role of reinforcement. The primary aim of this investigation was to examine the potential mediating role of positive reinforcement in between avoidance and depression. Using daily activity diaries and a self-report index of environmental reward as proxy measures of positive reinforcement, results supported the hypothesis that increased cognitive and behavioral avoidance increased risk for depression through decreases in reinforcement. In doing, some

¹ For this set of analyses, the more traditional Sobel test (Baron & Kenny, 1986) also was conducted using the CBAS (mean total avoidance) as the independent variable, the RPI (mean total environmental reward score) as the mediator, and BDI-II (mean depression score) as the dependent variable. Consistent with the initial analysis, environmental reward significantly mediated the relationship between avoidance and depression severity ($z = 6.98, p < .001$).

² For this set of analyses, the Sobel test also was conducted using the CBAS (mean total avoidance score) as the independent variable, daily diary reward as the mediator, and BDI-II (mean depression score) as the dependent variable. Consistent with the initial analysis, environmental reward assessed via daily diaries significantly mediated the relationship between avoidance and depression severity ($z = 4.37, p < .001$).

Table 4

Indirect effects of avoidance on depression through RPI total using bootstrapping technique ($n = 158$; 5000 bootstrap samples).

	Point estimate	BCa 95% CI	
		Lower	Upper
<i>Simple mediation</i>			
Total avoidance	.1901	.1428	.2478
Cognitive avoidance	.3271	.2536	.4127
Behavioral avoidance	.4927	.3306	.5490
<i>Controlling for anxiety</i>			
Total avoidance	.1145	.0766	.1611
cognitive avoidance	.1874	.1279	.2610
Behavioral avoidance	.2775	.2035	.3725

BCa CI = Bias-corrected and accelerated confidence interval. Confidence intervals containing zero (i.e., negative lower bounds) are interpreted as not significant.

insight is shed on the long-standing theoretical dilemma that the relationship between avoidance and depression may largely be due to an unmeasured third variable (Sweeney, Shaeffer, & Golin, 1982), which demonstrated here is conceivably environmental reinforcement.

As predicted, total, cognitive, and behavioral avoidance were positively related to depression severity. Avoidance also was inversely associated with reward as measured via self-report (RPI) and daily activity diaries. All avoidance scales also correlated significantly with somatic anxiety, although with consistently smaller magnitudes than observed with the BDI, suggesting that avoidance in this sample was more strongly related to depression than anxiety. Consistent with behavioral theory, reward indices were also significantly (inversely) related to avoidance and depression. Given well-documented relationships between avoidance and anxiety (Barlow, 2002) and comorbidity between depression and anxiety symptoms (Kessler et al., 2003; Lepine, Wittchen, & Essau, 1993), it was important to establish significant relationships between avoidance and depression when controlling for anxiety. Indeed, when controlling for somatic anxiety, all forms of avoidance maintained significant relationships with depression. Observed relationships therefore were not a function of covariance with anxiety symptoms, and indicate a unique positive relationship between avoidance and depression.

Mediation analyses were conducted using a bootstrapping methodology (Preacher & Hayes, 2008). When controlling for anxiety, reward as measured via both daily activity diaries and self-report mediated the relationships of depression with cognitive, behavioral, and total avoidance. Among females, however, daily diary-measured reward only mediated the relation between cognitive avoidance and depression. In males daily diary reward was a mediator with all three forms of avoidance and depression. In sum, mediation analyses indicated that independent of anxiety, increased cognitive and behavioral avoidance strategies were

Table 5

Indirect effects of avoidance on depression through daily diary reward using bootstrapping technique ($n = 158$; 5000 bootstrap samples).

	Point estimate	BCa 95% CI	
		Lower	Upper
<i>Simple mediation</i>			
Total avoidance	.0129	-.0003	.0342
Cognitive avoidance	.0324	.0062	.0766
Behavioral avoidance	.0306	.0030	.0742
<i>Controlling for anxiety</i>			
Total avoidance	.0165	.0035	.0368
Cognitive avoidance	.0317	.0091	.0672
Behavioral avoidance	.0379	.0115	.0825

BCa CI = Bias-corrected and accelerated confidence intervals. Confidence intervals containing zero (i.e., negative lower bounds) are interpreted as not significant.

associated with decreased environmental reward, which in turn increased depression symptom severity. Somewhat unexpectedly, results from mediation analyses implicated gender as important in the avoidance–reinforcement–depression relationship. This finding was especially interesting given no significant group differences between males and females in the use of cognitive, behavioral, or aggregate avoidance strategies as measured by the CBAS or in reward levels as measured by the RPI or daily diaries.

While previous research has shown some evidence that females with elevated depression may be more likely than males to employ avoidance coping strategies (Hansenne et al., 1999; Hayes et al., 2004; Jylha & Isometsa, 2006; Moulds et al., 2007), gender differences in avoidance strategies largely have been inconclusive (Ben-Zur & Zeidner, 1996; Blalock & Joiner, 2000; Holahan & Moos, 1986; Ingram et al., 2007; Ottenbreit & Dobson, 2004). Similarly, no gender differences have been observed in RCPR or pleasurable events as they relate to depression (Carvalho et al., in press; Lewinsohn & Amenson, 1978; Lewinsohn & Graf, 1973). Two studies that examined relations among avoidance, stressful life events, and depression did identify gender differences. In a 10-year longitudinal investigation, Holahan et al. (2005) examined the mediating effect of stressful life events in the relationship between avoidance and the development of depression. The authors found that stressors were a significant mediating variable for both men and women, although stress fully explained the relationship between avoidance and depression for men, but only provided a partial explanation in females. These results were somewhat similar to those observed in the present study, where diary-measured reward was a stronger and more consistent mediator for men than for women. Blalock and Joiner (2000) found that an interaction between avoidance, life stress, and gender predicted development of depression symptoms. Among women, a greater frequency of stressors interacted with cognitive avoidance to predict depression. There was no such relationship with men or with behavioral avoidance. These gender differences are the inverse of those found in the present investigation. However, the finding that only cognitive avoidance interacted with stressors to predict depression was similar to the finding in the present investigation that, for women, diary-measured reward only mediated the link between cognitive avoidance and depression.

Taken together with previous research, results suggest that avoidant tendencies in men may be more likely to lead to reductions in external sources of reward and associated depression when compared to avoidant women. There is some evidence that men are more physically active than women (Azevedo et al., 2007) and that for men physical activity is more strongly related to self-esteem and self-worth (Hayes, Crocker, & Kowalski, 1999). Therefore, activity level may be more consequential for men, and reductions in activity (and associated decreased reward) may be more influential in predicting depression. The daily diaries, which quantified the cumulative degree of pleasure derived from activities, may have been assessing this phenomenon more validly than the RPI.

Gender discrepancies also suggest that for women, cognitive avoidance strategies may play a more critical role in limiting pleasurable activity and predisposing women to depression than behavioral avoidance. Females are in fact more likely to engage in rumination (a process conceptually related to cognitive avoidance), and in females rumination is more strongly related to depression than in men (Moulds et al., 2007). Perhaps females that were more likely to ruminate were at highest risk for reductions in RCPR and associated depressive symptomatology. This would be consistent with BA's conceptualization of rumination (Martell et al., 2001). Further, since activity is less influential on self-esteem and self-worth in women (Hayes et al., 1999), avoidance strategies that are behavioral in nature may be less tied to reward values and

associated affective change. Alternatively, the gender differences might be related to variables not assessed in this investigation that either strengthened the relationship between diary-measured reward and depression in men or weakened it in women. All speculation aside, the gender differences highlighted in this study should be interpreted with much caution, with a need for replication of findings with larger (clinical and non-clinical) samples that would allow for increased statistical power and assessment of external validity. The importance of such future research rests in the need to more systematically elucidate the role of gender in behavioral models of depression (Manos et al., 2010) as well as any potential implications for behavioral activation interventions.

There are several important study limitations to consider. First, it must be emphasized that reward and reinforcement are not synonymous. This investigation was based on behavioral theory that considers positive reinforcement to occur when pleasurable or rewarding outcomes following a behavior increase the likelihood of the future occurrence of that behavior (Lewinsohn, 1974). In this study, reward was assessed as an approximate strategy to quantify reinforcement. Reinforcement was not directly assessed, and therefore conclusions about reinforcement's role in the avoidance–depression relationship cannot be inferred with complete confidence. However, as an initial investigation of these hypotheses, reward was considered an appropriate proxy measure. Second, because data were cross-sectional, it is not possible to establish a temporal or causal connection between variables. It was hypothesized that in a causal fashion, avoidance leads to reduction in reward, which in turn increases depression. However, given the nature of the design, causation cannot be confirmed. The strong relationships between the three constructs could plausibly indicate that depression precedes both increased avoidance and reduced reward. It is most likely, however, that these relationships are bidirectional in nature. Behavioral theories do in fact postulate that even though this sequence of events begins with avoidant behavior and associated decreases in reinforcement, depressed mood leads to further passivity, avoidance, and decreases in reward, creating a perpetuating cycle of negative symptoms and behaviors (Ferster, 1973; Lewinsohn, 1974). Future longitudinal designs could determine if individuals who tend to utilize avoidant coping strategies experience less positive reinforcement over time, which consequently promotes the onset or maintenance of depressive symptoms. Finally, due to sample characteristics, questions remain about external validity and generalizability of the findings. The sample was predominantly comprised of Caucasian undergraduate students. Additionally, even though the aggregate depression scores were consistent with a rating of mild depression (Beck & Steer, 1987), this was a non-clinical sample that included no formal assessment of depression diagnoses. Future investigations should test for these mediation effects in community and clinical samples to assess external validity.

In summary, findings provide important support for behavioral conceptualizations of depression and thus support the rationale and strategies of BA treatment. BA considers avoidance behaviors instrumental in creating a depression-inducing environment (Manos et al., 2010; Martell et al., 2001). Over-reliance on avoidant coping creates an environment where healthy behaviors are not adequately reinforced and reduce in frequency or are extinguished altogether, being replaced with passive non-rewarding activity (McDowell, 1982). The significant mediational role of environmental reward in the avoidance and depression relationship is consistent with the most recently proposed psychopathology and treatment models of depression (Manos et al., 2010). As highlighted in this model, the changes in reinforcement contingencies that precede and maintain depression symptoms are in large part associated with behavioral and cognitive avoidance. BA assists

depressed individuals in becoming aware of this process and reducing problematic avoidant behaviors. BA patients learn to more actively engage in goal-oriented behaviors that increase the frequency, intensity, and magnitude of environmental reward. These rewarding experiences increase the likelihood of continued behavioral change and corresponding improvements in mood and cognition (Jacobson et al., 1996; Martell et al., 2001). As detailed earlier, there has been substantial support for the efficacy of behavioral activation treatments (Cuijpers et al., 2007; Ekers et al., 2008; Mazzucchelli et al., 2009). Targeting and reducing cognitive and behavioral avoidance strategies through behavioral activation methods can maximize environmental reward and reinforcement, and the current study provides some much needed insights into behavioral theories of depression that implicate reinforcement as central toward understanding the avoidance and depression relationship.

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