12-2006

The Environmental Reward Observation Scale (EROS): Development, Validity, and Reliability

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To the Graduate Council:

I am submitting herewith a thesis written by Maria Elizabeth Anne Armento entitled "The Environmental Reward Observation Scale (EROS): Development, Validity, and Reliability." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Derek R. Hopko, Major Professor

We have read this thesis and recommend its acceptance:

John C. Malone, Richard A. Saudargas

Accepted for the Council:
<u>Carolyn R. Hodges</u>

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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and recommend its acceptance:

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Accepted for the Council:

Linda Painter
Interim Dean of Graduate Studies

(Original signatures are on file with official student records.)

THE ENVIRONMENTAL REWARD OBSERVATION SCALE (EROS):

DEVELOPMENT, VALIDITY, AND RELIABILITY

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Maria Elizabeth Anne Armento

December 2006

DEDICATION

This thesis is dedicated to my best friend, IHS, who has spent countless sleepless nights

in vigil with me. You remain the inspiration for all that I have and will ever do;

inquietum est cor nostrum, donec requiescat in te.

ACKNOWLEDGMENT

I would like to thank all those who have helped me complete my Master's Degree in Experimental Psychology. To my best friend, IHS who has taught me above all else: l'amour ne se paie due par l'amour. Mon amour vous appartient. Thanks to my Father, William Joseph, who was the first to incite my thirst for knowledge. Who would have ever known that spending all that time reading labels on cans in the grocery store could amount to so much? Thanks to my Mother, Veronica Marie, who with my Father has fashioned me for so much more than a graduate degree. You have taught me what is most important in life; I promise I will never lose my way. Thanks to Mark Edward Schuster, who has had the tenacity to stick with me through thick and thin. Your love and counsel have made me a better student, a better clinician, and a better person. Thanks to Gerald Allen Tuskan, who has often stopped me from giving up at the very last moment. You have given me a desire to seek excellence in myself and to never settle for mediocrity; above all else you have reminded me to believe in myself; without you I would never have been graduate student material. I want to thank Father John Arthur Orr, who has been my good and faithful spiritual director. You have inspired me to pursue a greater good than the world has to offer; all else pales in comparison. And thanks to Delores, without your love and prayers I would be no where at all. You will always be remembered.

I would like to thank my thesis committee for their support and guidance. Most especially I would like to thank Dr. Derek R. Hopko, my mentor. It is your love of research and true clinical insight that has inspired me to pursue the work I now call my

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own. Your patience and guidance has brought this wonderful self-report measure to life in my work; I don't think Skinner could have come up with a better name for it. To Dr. Richard A. Saudargas, who has kindly served on my thesis committee. You have taught me everything I know about teaching and UT football; thanks for giving me the opportunity to find out that I love both. To Dr. John C. Malone, who has kindly served on my thesis committee. We have been through many years together and you continue to inspire my love of learning. Thank you for not letting me give-up five years ago. To Dr. Don Windham, from whom I gained my first love of psychology. It was your inspiration as a clinician and a teacher that gave me the first glimmer of hope to follow this path. To Melissa K. Hunt, my colleague and my friend, who continues to mentor me through graduate school. If it weren't for the million times you have sat listening to me, or the other million times we have randomly burst out laughing at nothing at all, I might never have survived.

Finally, To the University of Tennessee Department of Psychology faculty, staff and students. Success comes from the help of many; thanks to you all.

ABSTRACT

Researchers have established a strong association between the frequency and duration of environmental reward and affective mood states, particularly in relation to the etiology, assessment and treatment of depression. Given behavioral theories that outline environmental reward as a strong mediator of affect and the unavailability of an efficient, reliable and valid self-report measure of environmental reward, we developed the *Environmental Reward Observation Scale* (EROS) and examined its psychometric properties. In Experiment one, an exploratory factor analysis supported a unidimensional 10-item measure with strong internal consistency and test-retest reliability. When administered to a replication sample, confirmatory factor analysis suggested an excellent fit to the one-factor model and convergent/discriminant validity data were supportive of the construct validity of the measure. In Experiment two, further support for the convergent validity of the EROS was obtained via moderate correlations with the *Pleasant Events Schedule* (PES; MacPhillamy & Lewinsohn, 1976). In Experiment three, hierarchical regression analyses supported the ecological validity of the EROS toward predicting daily diary reports of time spent in highly rewarding behaviors and activities. The EROS may represent a reliable and valid measure of environmental reward that may improve the psychological assessment of negative mood states such as clinical depression.

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CHAPTER I

INTRODUCTION

The frequency, certainty, and magnitude of environmental reward and its impact on emotional affect has been of great interest in recent research (Correia, Carey, & Borsari, 2002; Hopko, Armento, Cantu, Chambers, & Lejuez, 2003a; Kampe, Frith, Dolan, & Frith, 2001). Researchers of varying disciplines within the biological and social sciences have been investigating the experience of environmental reward to better elucidate the relationship of reward value to the etiology and maintenance of psychiatric disorders that include major depression, bipolar disorder, and substance abuse (Harmon-Jones et al., 2002; McBride, Murphy & Ikemoto, 1999; Naranjo, Tremblay, & Busto, 2001). Given that inadequate environmental reward consistently has been highlighted as a mediator of negative affect (Hopko et al., 2003a; Hopko, Lejuez, Ruggiero, & Eifert, 2003b; Lewinsohn, 1974; Lewinsohn, Gotlib, & Hautzinger, 1998; Lewinsohn & Graf, 1973; Martell, Addis & Jacobson, 2001), continued development and empirical analysis of parsimonious and psychometrically sound assessment strategies are essential toward measuring exposure to rewarding environments.

Researchers have long since established a neurobiological basis of reward (Cooper & Liebman, 1989; Olds & Milner, 1954), with a brain reward system (BRS) considered a mediating factor in affective change (Herink, 2000). Investigations of the relationship between the BRS and major depressive disorder have found an

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identifiable BRS dysfunction that manifests in the form of anhedonia and related depressive symptoms (Gray, 1981; Naranjo, Tremblay, Busto, 2001; Tremblay et al., 2002). Specifically, the prefrontal cortex, anterior cingulated gyrus, and temporal lobe areas seem particularly atypical in individuals with clinical depression (Brody et al., 2001; Drevets, 1998; Kennedy, Javanmard, & Vaccarino, 1997; Ketter, George, Kimbrell, Benson, & Post, 1996).

Psychosocial research generally has supported neurophysiological models in that psychotherapy may normalize brain functioning in these regions (Brody et al., 2001) and increased behavioral activation and exposure to environmental reward appear to increase positive affect (Carver, 2004; Carver & White, 1994; Hollon, 2003; Hopko, Sanchez, Hopko, Dvir, & Lejuez, 2003c; Hopko, Lejuez, LePage, Hopko, & McNeil, 2003d; Jacobson et al., 1996; Jorm et al., 1998). As a basis for psychosocial research on the relationship between environmental reward and affect, behavioral theories of depression posit that decreased response-contingent positive reinforcement or punishment of non-depressive behaviors and/or reinforcement of depressive behaviors result in increased depressive affect (Dowd, 2002; Ferster, 1973; Lewinsohn, 1974, Skinner, 1953). Based on this framework, several behavioral treatments for depression initially were developed to facilitate increased access to reward while decreasing the intensity and frequency of punishing events (Lewinsohn & Graf, 1973; Lewinsohn, Sullivan, & Grosscup, 1980; Sanchez, Lewinsohn, & Larson, 1980). A recent revivification of behavioral interventions for depression (Lejuez, Hopko, & Hopko, 2001, 2002; Lewinsohn & Clarke, 1999; Martell et al., 2001) has involved behavioral activation approaches that show promise in effectively

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treating depression through increases in goal (and value) based activity levels that elicit increased response-contingent reinforcement (Hollon, 2001, 2003; Hopko et al., 2003c, 2003d; Jacobson et al., 1996; Lejuez, Hopko, LePage, Hopko, & McNeil, 2001).

In view of convincing support from behavioral and neurobiological research programs that highlight the association between increased environmental reward and positive affect, it is necessary to evaluate the utility of existing psychological assessment measures toward assessing levels of environmental reward. At present, the most commonly used self-report measures of depression include the Beck Depression Inventories (BDI; Beck & Steer, 1987; BDI-II; Beck, Steer, & Brown, 1996), the Center for Epidemiological Studies on Depression Scale (CES-D; Radloff, 1977), Zung SDS (Zung, 1965), Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS; Baer et al., 2000), Reynolds Depression Screening Inventory (RDSI; Reynolds & Kobak, 1998), Hamilton Depression Inventory (HDI; Reynolds & Kobak, 1995), the Pleasant Events Schedule (PES; MacPhillamy & Lewinsohn, 1976), the depression scales of the Minnesota Multiphasic Personality Inventory (MMPI-D; Butcher et al., 1989), and the Personality Assessment Inventory (PAI; Morey, 1991). Although these instruments measure the presence and severity of affective, cognitive, behavioral, and physiological aspects of depression and generally have strong psychometric properties (Hopko, Lejuez, Armento, & Bare, 2004; Nezu et al. 2000), only the PES specifically focuses on the frequency and subjective reward value of environmental experiences and activities. This measure may be of limited practical utility, however,

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given that it consists of 320 items (rated twice) and requires approximately one hour to complete.

Considering strong research support for behavioral theories of depression and the efficacy and effectiveness of behavioral therapy for individuals who are clinically depressed (DeRubeis, & Crits-Christoph, 1998), development of an efficient yet valid and reliable self-report measure of environmental reward could be of great utility in facilitating behavioral assessment in general, and more specifically psychopathology research and treatment outcome studies evaluating the efficacy and effectiveness of interventions for depression. Accordingly, we designed a psychometric study to develop and validate a brief self-report measure of environmental reward, the Environmental Reward Observation Scale (EROS). Experiment one had two primary objectives. Following the initial development of the EROS and subsequent exploration of its factor structure, the EROS was validated on an independent replication sample via confirmatory factor analysis and an assessment of reliability (internal consistency, test-retest) as well as convergent and discriminant validity. Experiment two utilized a third sample of participants to further explore the relation of the EROS with alternative measures of depressive affect, including the 320-item PES (MacPhillamy & Lewinsohn, 1976). Experiment three utilized daily diary procedures (Hopko et al., 2003a) to directly assess experiences of environmental reward, and then involved an evaluation of the predictive (and ecological) validity of the EROS insofar as predicting the duration of time spent in low versus highly rewarding daily activities.

Hypotheses

Hypotheses were as follows: (a) the EROS would represent a unidimensional construct that would be validated through confirmatory factor analysis, (b) the EROS would correlate inversely with measures of depression and anxiety and positively with behavior activation subscales of the Behavioral Inhibition Scale/ Behavioral Activation Scale (BIS/BAS; Carver & White, 1994), (c) the EROS would correlate strongly and positively with the frequency and pleasure experienced in behaviors measured by the PES, and (d) controlling for variance accounted for a common measure of depression (the BDI-II), the EROS would account for unique variance in predicting the duration of time spent in rewarding experiences as measured via daily diaries.

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EXPERIMENT 1

Method

Participants

Participants for experiment one (developmental sample) included 202 undergraduate students (females: n = 141; males; n = 61). The sample consisted of 183 Caucasians (90%), 11 African Americans (5%), 7 Asian Americans (3%), and 1 Native American (0.5%). The mean age of participants was 19.6 years (SD = 2.7 years). Participants for the experiment one (replication sample) included 178 undergraduate students (females: n = 89; males: n = 89). The sample consisted of 155 Caucasians (87%), 14 African Americans (8%), 1 Hispanic (0.6%), 7 African Americans (4%), and 1 Native American (0.5%). The mean age of participants was 19.6 years (SD = 2.4 years). Independent sample t-tests for age and chi-square analysis for ethnicity revealed no significant differences across samples. A significant difference was found for gender (X^2 (2) = 16.2, p < .001); in the developmental sample there was a disproportionately larger number of females than males whereas the gender distribution was equivalent in the replication sample.

Assessment Measures

The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown 1996) consists of 21 items, each of which is rated on a 4-point Likert scale. There is strong

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empirical support for the reliability and validity of the measure with depressed and non-depressed younger adults (Arnou, Meagher, Norris, & Branson, 2001; Carmody, 2005; Dozois, Dobson, & Ahnberg, 1998; cf. Nezu, Ronan, Meadows, & McClure, 2000).

The CES-D is a 20-item self-report questionnaire of depressive symptoms that has adequate psychometric properties (Radloff, 1977). The instrument has been shown to modestly relate to a diagnosis of clinical depression (Myers & Weissman, 1980) and has been recommended as an initial screening measure to assess for this condition (Roberts & Vernon, 1983).

The Zung Self-Rating Depression Scale (Zung SDS; Zung, 1965) is a 20-item self-report measure of depression. All items are rated on a 4-point scale with anchor points referring to the amount of time specific symptoms are experienced, ranging from "a little of the time" to "most of the time". Spilt-half reliability was high (r = .94) among depressed and nondepressed samples with considerable age variability (Gabrys & Peters, 1985). Internal consistency also was high (coefficient alpha = 0.88-0.93). The Zung SDS has high clinical utility, and is efficiently used as an initial screening measure for depression (Nezu et al., 2000).

The Behavioral Inhibition Scale/ Behavioral Activation Scale (BIS/BAS; Carver & White, 1994) is a 24-item self-report measure of dispositional BIS and BAS sensitivities. Items are rated on a 4-point scale with anchor points ranging from "very true for me" to "very false for me". Internal consistency for the BIS (α = .74-.83) and the three BAS subscales was adequate (Reward Responsiveness; .65-.73; Drive .76-.80; and Fun Seeking .66-.70) (Carver & White, 1994; Jorm et al., 1999). Convergent

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validity was demonstrated via moderate associations of the BIS with anxiety (r = .58; Manifest anxiety Scale; Bendig, 1956) and negative affect (r = .42, PANAS; Watson, Clark, & Tellegen, 1988), as well as positive relations (r = .20-59) between the BAS scales and measures of positive affect (PANAS) and extraversion (Eysenck & Eysenck, 1985).

The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) is a 21-item questionnaire designed specifically to distinguish cognitive and somatic symptoms of anxiety from those of depression. Good psychometric properties have been demonstrated for the measure among community, medical, and psychiatric outpatient samples (Beck & Steer, 1993; Morin et al., 1999; Osman et al., 1997; Wetherell & Areán, 1997).

The State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983) is a 40-item scale used to measure state and trait anxiety. Good to excellent internal consistency has been reported for both scales (α's between .86 and .95) across adult, college, high school, and military recruit samples (Spielberger et al., 1983). Adequate 30-day test-retest reliability with high school students [r = .71 (State); r = .75 (Trait)] and 20-day test-retest reliability with college students has been reported [r = .76 (State); r = .86 (Trait)] (Spielberger et al., 1983). Convergent validity of the STAI and other measures of anxiety are evident among both normal and anxiety disorder samples (Beiling, Antony, & Swinson, 1998; Creamer, Foran, & Bell, 1995; Hopko, 2003).

The EROS is a 10-item measure (responses based on a 1 to 4 point Likert Scale) that was developed using procedures commonly implemented in establishing

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valid self-report assessment measures (Hayes, Richard, & Kubany, 1995).

Specifically, the construct of interest was response-contingent positive reinforcement (RCPR), and items were chosen that measured increased behavior and positive affect as a consequence of rewarding environmental experiences (Lewinsohn, 1974). In terms of construct dimensions, the objective was to measure the magnitude of RCPR over an extended duration of time, and to include items that would assess the three aspects of RCPR (Lewinsohn, 1974): (a) the number of events that are potentially reinforcing; (b) the availability of reinforcement in the environment; and (c) the instrumental behavior (or skill) of an individual in eliciting reinforcement. The function of the instrument was to be a brief screening tool.

Procedure and Data Analyses

The developmental sample completed the EROS (n = 202) in the context of a classroom setting. An exploratory factor analysis was conducted on these data using a principal components extraction and a varimax rotation, with the number of factors unspecified. The factor loadings and related interpretability (i.e., face validity of items), scree-plot analysis, and parallel analysis procedures were used to determine the optimal factor structure of the environmental reward observation scale (EROS). An independent replication sample (n = 178) then completed the EROS as part of a comprehensive assessment battery in which the EROS was administered along with all assessment instruments outlined earlier. For the replication sample, test-retest of the EROS occurred at an interval of 7-10 days (M = 8.8 days, SD = 1.5) from the administration of the assessment battery. A confirmatory factor analysis was

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conducted to determine the adequacy of the factor structure established with the developmental sample. Fit indices were derived using SAS CALIS (Hatcher, 1994). As per recommendations in reporting results of confirmatory procedures (Hu & Bentler, 1999; Thompson & Daniel, 1996), the Root Mean Square Error of Approximation (RMSEA), chi-square, goodness-of-fit index (GFI), adjusted goodness of fit index (AGFI), Bentler's comparative fit index (BCFI), as well as Bentler and Bonett's non-normed (NNFI) and normed (NFI) fit indices are presented. Contemporary goodness-of-fit criteria were used whereby an RMSEA of less than .08 and a value 0.90 or greater on other indices are required before concluding that there is a good fit between the hypothesized model and observed data (Hu & Bentler, 1998).

Results

Development Sample

Normative Data. Prior to conducting confirmatory factor analytic procedures, EROS data were subjected to tests of multivariate normality (Hair, Anderson, Tatham, & Black, 1995). Both the symmetry (skewnesss = -.70, SE = .17) and the "flatness" (kurtosis = .47, SE = .34) of the distribution were within acceptable limits (Hair et al., 1995), and a visual analysis of observed values revealed a normal Q-Q plot with a uniform distribution. Based on independent sample t-tests, neither an ethnicity effect nor a gender effect was identified in the developmental sample [females: M = 29.62, SD = 4.87; Males: M = 29.61, SD = 4.20].

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Reliability Analyses. Internal consistency of the EROS was strong (α = .85). As presented in Table A-1, corrected item-total correlations all were statistically significant (p < .01) and ranged from .29 to .66.

Exploratory Factor Analysis. An exploratory factor analysis was conducted on the 10-item EROS. Items on the EROS were responded to using a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree), with the total score representing a summation of the ten items. The optimal factor solution was determined based on an examination of the scree plot (Cattell, 1966), factor interpretability, and factor eigenvalues as assessed via parallel analysis (Glorfeld, 1995; Hair et al., 1995; Watkins, 2000). Based on the parallel analysis procedure (variables = 10, participants = 203, replications = 100), only one generated eigenvalue from the exploratory factor analysis (4.35) was greater than the associated critical eigenvalues established via parallel analysis (1.35 for factor 1), justifying examination of a unifactorial factor solution. For an item to be included on this factor, only factor loadings with a value of .40 or higher were considered salient (Floyd & Widaman, 1995). All ten items met this criterion and the one-factor solution accounted for 43% of the variance. EROS items and their factor loadings also are presented in Table A-1.

Replication Sample

Normative Data. For the replication sample, self-reported environmental reward on the EROS was as follows: Administration 1 (M = 29.46, SD = 4.86), Administration 2 (M = 30.33, SD = 4.86). Based on a repeated measure ANOVA,

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there was a significant difference on the EROS score as a function of administration in the replication sample (F (1,159) = 14.10, p < .001), with the scores on the second administration slightly higher than those on the initial administration. For both administration 1 (skewnesss = -.31, SE = .18; kurtosis = -.13, SE = .36) and administration 2 (skewnesss = -.29, SE = .19; kurtosis = .05, SE = .38), the symmetry of the distribution was within normal limits. There was no significant difference between the developmental and replication samples on the EROS total score (compared with the first administration for the replication sample; t (379) = .37, p = .71; second; t (361) = 1.38, p = .17). No gender effect or ethnicity effects were identified on either EROS administration in the replication sample.

Reliability Analyses. Internal consistency of the EROS was strong for the first (α = .86) and second administrations (α = .88). Across both administrations, corrected item-total correlations all were statistically significant (p < 0.01) and ranged from .47 to .71. Seven-to-ten day test-retest reliability was excellent on the EROS (r = .85, p = 0.01).

Convergent-Discriminant Validity. Having established strong support for the reliability of the 10-item EROS, zero-order correlations were conducted to examine its relation to other commonly administered measures of depression and anxiety (Table A-2). In general, supporting the convergent validity of the measure, moderate-strong correlations were obtained between the EROS and other measures of depression (BDI-II = -.69; CES-D = -.65; Zung = -.54, and the question "how depressed are you?" = -.63). Given the strong conceptual (Barlow, 2002; Barlow, Allen, & Choate, 2004) and empirical relation (Antony, Orsillo, & Roemer, 2001;

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Nezu et al., 2000; Bieling, Antony, & Swinson, 1998) between depression and anxiety, it was unsurprising that EROS scores also were moderately and inversely related to self-reported anxiety (STAI-S = -.63; STAI-T = -.71; BAI = -.48). Importantly, consistent with conceptual distinctions outlined in the Carver and White (1994) study, EROS scores also were positively related to the behavior activation subscales (BAS-FS = .19; BAS-DR = .40; BAS-RR = .40) and negatively associated with the behavior inhibition subscales (BIS = -.25) of the BAS/BIS.

<u>Confirmatory Factor Analysis</u>. Confirmatory factor analytic procedures were used to assess the adequacy of the previously established one-factor model of the EROS. Fit indices were derived from the SAS CALIS procedure (Hatcher, 1994). The maximum likelihood method of parameter estimation was used in the analysis and was performed on the variance-covariance matrix. As per the fit indices outlined as preferential in the reporting of confirmatory procedures (Thompson & Daniel, 1996), the Root Mean Square Error of Approximation (RMSEA), chi-square (and associated degrees of freedom), Bentler's comparative fit index (BCFI), goodness-of-fit (GFI), and adjusted goodness of fit (AGFI) indexes were as follows: chi-square = 64.84 (35 df), RMSEA = .06; GFI = .92; AGFI = .88; BCFI = .94; NNFI = .93, NFI = .90. Standardized path coefficients for the model ranged from .52 (item 6) to .75 (item 3) and are presented in Table A-3.

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EXPERIMENT 2

Method

Participants

Participants for experiment two included 61 undergraduate students (females: $n = 41$; males; $n = 20$). The sample consisted of 59 Caucasians (97%) and 2 African Americans (3%). The mean age of participants was 22.0 years ($SD = 4.4$ years).

Assessment Measures and Procedure

In the context of a single assessment session, all participants completed the EROS, BDI-II, and CES-D as described previously. Participants also completed the Pleasant Events Schedule (PES; MacPhillamy & Lewinsohn, 1976), a 320-item measure assessing the frequency and subjective pleasure of potentially reinforcing events or activities. Each item has a frequency and enjoyability score, each of which is rated on a 0 ("not happened in last 30 days"; "not pleasant") to 2 ("happened often"; "very pleasant") Likert-type scale. Average frequency and pleasure ratings are multiplied to form a cross-product score, with higher cross-product scores indicating that activities were engaged in with a higher amount of reinforcement potential, considered a useful index of experienced positive reinforcement (Correia et al., 2002). The PES has strong psychometric properties across multiple studies (MacPhillamy & Lewinsohn, 1976; Nezu et al., 2000).

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Results

Normative Data. EROS data were again subjected to tests of multivariate normality, with both the symmetry (skewnesss = -.18, SE = .31) and the "flatness" (kurtosis = -.69, SE = .60) of the distribution within acceptable limits (Hair et al., 1995), and a visual analysis of observed values revealed a normal Q-Q plot with a uniform distribution. As with Experiment one, a gender effect was not identified in the sample [females: M = 28.4, SD = 5.4; Males: M = 27.5, SD = 5.7].

Reliability Analysis. Internal consistency of the EROS was again strong (α = .90). As with Experiment one, corrected item-total correlations all were statistically significant ($p < .01$) and ranged from .55 to .80.

Convergent-Discriminant Validity. As presented in Table A-4, zero-order correlations were conducted to examine the relation of the EROS to other commonly administered measures of depression. In further support of the convergent validity of the measure and consistent with the results of experiment one, strong correlations were obtained between the EROS and other measures of depression (BDI-II = -.78; CES-D = -.79; and the question "how depressed are you?" = -.75), indicating that increased exposure to rewarding activities and events as measured by the EROS was associated with decreased self-reported depression. The more novel finding of experiment two was the moderate correlation of the EROS with the PES (r = .43 - .51), supporting some degree of overlap between the measures. Importantly, as indicated using a t-score comparison of dependent correlations procedure (Bruning & Kintz, 1997), relative to the PES (composite score), the EROS measure correlated

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more strongly (and inversely) with the BDI-II (t (58) = 4.91, p < .01), CES-D (t (58) = 5.01, p < .01), and the question of "how depressed are you" (t (58) = 2.57, p < .05).

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EXPERIMENT 3

Method

Participants

Participants included 30 undergraduate students (females: n = 26; males: n = 4). The sample consisted of 24 Caucasians (80%) and 4 African Americans (13%), and 2 Asian Americans (7%). The mean age of participants was 21.6 years (SD = 2.1 years).

Assessment Measures and Procedure

Each participant met individually with an experimenter on two occasions. During the first meeting, participants completed a demographic form, the EROS, and the BDI-II. Included on a demographic form, participants were asked two questions: (a) "In general, how active are you?" and (b) "In general, how rewarding are the activities you engage in?" Participants responded to these questions using a 5-point Likert scale ranging from 1 ("not at all") to 5 ("extremely"). Following the questionnaires, participants were given seven daily diary activity-monitoring forms (Hopko et al., 2003a). The following instructions were provided: "Please take this packet and record all your behaviors and activities for the next week. Your packet contains seven daily monitoring forms (one for each day) that contain spaces to record behaviors from 8 A.M. to 2 A.M. (half-hour intervals). Please take the time to

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record your behaviors every couple hours to ensure accuracy in remembering your behaviors. Please try to be as honest and thorough as you can in recording your behaviors and only write down those behaviors that constitute how you spent the majority of that half-hour interval. Also, try to engage in your normal routine. Following the recording of each behavior, you should ask yourself one question: 'How rewarding or pleasurable was this activity?' In the space provided, indicate your response using the scale ranging from 1 ("minimally rewarding") to 4 ("extremely rewarding"). Participants also were provided with an explanation as to what constituted overt behavior and were asked not to record specific thoughts, physiological responses, and/or feelings and emotional experiences. Participants returned aproximately1 week later and completed the post-assessment BDI-II and EROS. Throughout the assessment process, experimenters were blind to assessment results.

For purposes of data analyses, given our objective of assessing the predictive validity of the EROS as it pertained to daily activities and associated reward, the pre and post EROS scores were used to formulate a mean score (M = 30.0, SD = 5.0) that would best represent self-assessed environmental reward during the week long daily diary procedure (i.e., as opposed to using only the pre- or post-assessment score). This same procedure was used for the BDI-II (M = 10.1, SD = 10.4). For the daily diaries, the total duration of time spent in low reward value (rated 1 or 2) and high reward value (rated 3 or 4) was calculated for each participant.

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Results

Normative Data. EROS data (both administrations) were again subjected to tests of multivariate normality, with both the symmetry (skewnesss = -.67 and -.87) and the "flatness" (kurtosis = .91 and .93) of the distribution within acceptable limits (Hair et al., 1995). As with Experiments one and two, a gender effect was not identified in the sample [first administration: (females: M = 29.8, SD = 5.3; Males: M = 29.3, SD = 1.7); second administration: (females: M = 30.2, SD = 5.9; Males: M = 30.5, SD = 1.0)].

Reliability Analysis. Internal consistency of the EROS was again strong (α = .87 - .88). As with Experiments one and two, corrected item-total correlations for both administrations all were statistically significant (p < .01) and ranged from .43 to .83. Consistent with Experiment one, seven-day test-retest reliability was excellent on the EROS (r = .84, p = 0.01).

Convergent-Discriminant Validity. In further support of the convergent validity of the EROS and consistent with the results of both previous experiments, moderate to strong correlations were obtained between the EROS (pre-post mean score) and depression [BDI-II (pre-post mean score) = -.80), as well as self-reported activity (r = .34, p < .05) and reward (r = .51, p < .01) as reported on the demographic form.

Regression Analyses. Hierarchical multiple regression analyses were conducted to determine the relative value of self-reported environmental reward (EROS) and depressive symptoms and behaviors (BDI-II) in predicting the duration of time spent in Low versus High reward value activities and behaviors. Given study

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hypotheses and the finding of high bivariate relationships between the EROS and the BDI-II, we assessed the incremental value of the EROS in predicting duration of time spent in daily behaviors (Low and High reward), above that accounted for by the BDI-II. For both regression analyses in which time spent in Low and High reward value behaviors were independently analyzed as criterion variables, the first step of the model included BDI-II assessed depressive behaviors and symptoms. In step 2 of regression models, we assessed the potential incremental value of the EROS, anticipating that response-contingent positive reinforcement (RCPR) as measured by daily diaries would be better accounted for by a direct (EROS) measure of reward as opposed to a more nebulous and less functional measure of depressive behaviors (BDI-II). Specifically, although we postulated that (BDI-II) depressive behaviors would be highly related to decreased RCPR (Ferster, 1973; Hopko et al., 2003a; Lewinsohn, 1974), decreased environmental reward as assessed by the EROS was hypothesized to be more convergent with daily diary ratings.

For both regression analyses, collinearity statistics were within the acceptable range [tolerance value = .36, variable inflation factor (VIF) = 2.74; Hair, Anderson, Tatham, & Black, 1995]. Results of the regression analyses are presented in Tables A- 5 and A-6. For time spent in Low Reward Value behaviors, the BDI-II accounted for 1% of the variance, with increased depression positively (but non-significantly) associated with more time engaged in less rewarding behaviors. When the EROS was added in the second step, the amount of variance increased to 19% (overall regression model: $F_{(2, 27)} = 3.44$, $p < .05$), with higher EROS scores significantly and negatively related to time in less rewarding behaviors. Change statistics indicated that

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the addition of the EROS toward predicting time spent in Low Reward Behaviors was statistically significant (F change $(1, 27) = 6.08$, $p = .02$]. Also presented in Table A-6, for time spent in High Reward Value behaviors, the BDI-II accounted for 1% of the variance, with increased depression negatively (but non-significantly) associated with more time engaged in highly rewarding behaviors. When the EROS was added in the second step, the amount of variance increased to 20% (overall regression model: F $(2, 27) = 3.43$, $p < .05$), with higher EROS scores significantly and positively related to increased time in highly rewarding behaviors. Change statistics indicated that the addition of the EROS toward predicting time spent in High Reward Behaviors was statistically significant (F change $(1, 27) = 6.55$, $p = .02$].

DISCUSSION

Using several non-clinical undergraduate student samples, these studies were designed to develop and establish the psychometric properties of the Environmental Reward Observation Scale (EROS). In Experiment one, statistical analyses on the developmental sample data yielded strong internal consistency for EROS items and a unifactorial solution. Internal consistency also was strong for both administrations completed by the replication sample, and test-retest reliability for the EROS was excellent. Confirmatory factor analyses on the replication sample provided strong support for the unidimensional structure of the EROS, as indicated via excellent goodness-of-fit values across multiple indices. Convergent validity also was supported given the strong associations between the EROS and other commonly administered and psychometrically sound self-report measures of depression and anxiety (BDI-II, CES-D, Zung SDS, STAI-S, STAI-T, BAI). Adequate discriminant validity also was observed given the inverse relation between the EROS and BIS subscale and the positive relations between the EROS and three behavior activation subscales (BAS-FS, BAS-SR, BAS-RR). Further support for the convergent validity of the EROS was demonstrated in Experiment two, where the EROS correlated moderately with the Pleasant Events Schedule (PES). This finding was significant in that unlike other depression measures administered in Experiment one, this instrument is the only available measure specifically designed to assess

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environmental reward and exposure to pleasant events. Finally, Experiment three provided support for the ecological validity of the EROS, in that after controlling for variance associated with depressive symptoms and behaviors (BDI-II), the EROS accounted for significant incremental validity in predicting how much time individuals spend in low and high reward behaviors.

The strong negative relationship of EROS scores with those on the BDI-II, CES-D, and Zung SDS and moderate positive relationship with the PES support behavioral theories in which depressive symptoms strongly are associated with diminished availability of environmental reward and decreased response-contingent positive reinforcement (Ferster, 1973; Lewinsohn, 1974). Also relevant to behavioral theory, it is noteworthy that the EROS was more strongly associated with the BDI-II than the PES. This is a provocative finding in that the EROS may more precisely assess for decreased response contingent reinforcement that is hypothesized as etiologically related to depression. The strong relation between self-reported environmental reward on the EROS and direct behavior and reward monitoring on the daily diaries further supports this hypothesis, in addition to the construct validity of the self-report measure. Finally, also supportive of a more advanced theoretical association with depressive affect, whereas the EROS correlated strongly with measures of depression ($r = -.54$ to $-.69$) in this series of studies, established behavior activation scales have been demonstrated as only weakly related to negative affect ($r = -.07$ to $.05$; Carver & White, 1994).[1]

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[1] Note that a pure measure of depression (e.g., BDI, CES-D) was not incorporated in the Carver and White (1994) study.

In addition to measures of depressive affect, the EROS demonstrated moderate-strong inverse relationships with anxiety scales (STAI-T, STAI-S, BAI). This finding was logical given escape and avoidance behaviors associated with anxiety, subsequently reduced exposure to sources of environmental reward, and the coexistence of anxiety and depressive symptoms and disorders (Barlow, 2002; Lang, 1968; Mineka, Watson, & Clark, 1998). Although the EROS shared significant associations with all self-report depression and anxiety measures, it was least strongly related to the BAS and BIS subscales. Specific to the behavior activation subscales, the EROS shared the weakest correlation with the BAS-Fun Seeking subscale, possibly reflective of the BAS-FS focus on novel rewards and willingness to spontaneously approach potentially rewarding events (Carver & White, 1994), making it less a measure of reward and potentially more a measure of adventure-seeking and impulsivity. The second weakest association was found between the EROS and BIS, which is considered the subscale most strongly related to negative affect, with heightened BIS sensitivity hypothesized to increase susceptibility to anxiety or depression (Carver & White, 1994; McNaughton & Gray, 2001). Speculating on this apparent incongruity, the minimal association between these two measures could be due to the qualitative nature of BIS items, assessing sensitivity to cues of punishment and impending punishment rather than exposure to environmental rewards. As a measure of the latter, the EROS understandably is more related to the BAS Drive and Reward Responsiveness subscales that are more sensitive to signals of reward and nonpunishment (Carver & White, 1994). Taken together, the EROS therefore extends upon BIS/BAS scale research (Carver & White, 1994) in that the

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EROS more specifically measures frequency of exposure to environmental rewards. In contrast, the BIS scale assesses inhibitory and anxious behavior while the BAS-RR, BAS-D, and BAS-FS scales measure emotional consequences of experiencing reward, motivation to pursue environmental reward, and desire for enjoyment, respectively.

Following this series of studies, several future research directions are indicated. First, to assess external validity, further psychometric work on the EROS should include more heterogeneous clinical and non-clinical samples in that the current samples primarily involved younger, educated Caucasian cohorts. Second, behavioral theory suggests that depressive symptom patterns may be a combination of inadequate environmental reward, reinforcement of depressed behaviors, and punishment of healthy alternative behaviors (Ferster, 1973; Kazdin, 1977). As the EROS specifically was designed to assess the former of these etiological factors, continued research is necessary to explore whether an expanded or alternative measure may be used to better evaluate the latter two components. Third, another potential limitation is that the EROS measures environmental reward at a more global level, with items such as "a lot of activities in my life are pleasurable" or "I am satisfied with my accomplishments." Although it may be argued that a more content-specific assessment of reward domains in a person's life (e.g., recreation, relationships, spirituality) such as that provided via the PES might provide more pertinent data insofar as psychological assessment and treatment is concerned, it also should be noted that there are data to support increased predictive utility and

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treatment sensitivity using content non-specific measures of affect (Hopko et al., 2000; Stanley et al., 2003).

Conclusion

The EROS may represent a valid, reliable, and parsimonious measure of environmental reward that is congruent with behavioral theories of depression and may facilitate behavioral and neurobiological research programs highlighting the association between increased environmental reward and positive affect (Harmon-Jones et al., 2002; Hopko et al., 2003b; Jacobson et al., 1996; Lewinsohn & Graf, 1973; McBride, Murphy & Ikemoto, 1999; Naranjo, Tremblay, & Busto, 2001). Findings are particularly timely considering the paucity of self-report measures that specifically focus on the frequency and subjective reward value of environmental experiences and activities and the recent revitalization of research into behavioral theories of depression and the efficacy and effectiveness of "pure" behavior activation interventions to treat this condition (DeRubeis, & Crits-Christoph, 1998; Hopko et al., 2003a, 2003b; Martell, Addis & Jacobson, 2001). As such, although future research directions are indicated, the EROS shows potential in improving the psychological assessment of negative mood states such as clinical depression. In representing a more valid measure of environmental reward, the EROS may serve to better assess etiological factors implicated in behavioral theories of clinical depression and thereby fill a void insofar as current psychological assessment resources are concerned. Given its brevity, the EROS also may be more useful from a practical standpoint relative to the lengthy PES (MacPhillamy & Lewinsohn, 1976)

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and may be more functional in the context of primary care environments where the

need to focus on accountability as well as cost and time-effectiveness has been

highlighted (Shoenbaum, Unutzer, Sherbourne, & Duan, 2001; Wells et al., 1999).

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APPENDICES

Table A-1

**EROS Developmental Sample: Corrected Item-total Correlations
and EFA Structure Coefficients**

	R Value	Factor Loading
1. A lot of activities in my life are pleasurable.	.52	.62
2. Lately I have found that many experiences make me unhappy.*	.62	.72
3. In general I am very satisfied with the way I spend my time.	.66	.76
4. It is easy for me to find enjoyment in my life.	.61	.71
5. Other people seem to have more fulfilling lives.*	.57	.68
6. Activities that used to be pleasurable no longer are gratifying.*	.56	.67
7. I wish that I could find more hobbies that would bring me a sense of pleasure.*	.49	.59
8. I am satisfied with my accomplishments.	.58	.68
9. My life is boring.*	.58	.69
10. The activities I engage in usually have positive consequences.	.29	.41

Note: * signifies reverse-scored items

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Table A-2
Replication Sample: Correlations Among Self-Report Assessment Instruments

Instrument	1	2	3	4	5	6	7	8	9	10	11	12
1. EROS	--	-.69**	-.65**	-.63**	-.71**	-.48**	-.54**	.40**	.19*	.40**	-.25**	-.63**
2. BDI-II		--	.84**	.71**	.81**	.73**	.76**	-.33**	-.14**	-.29**	.30**	.68**
3. CESD			--	.72**	.83**	.70**	.73**	-.33**	-.16*	-.38**	.29**	.67**
4. STAI-S				--	.82**	.56**	.63**	-.31**	-.14**	-.29**	.31**	.55**
5. STAI-T					--	.68**	.72**	-.31**	-.16*	-.27**	.37**	.70**
6. BAI						--	.70**	-.25**	-.12	-.19*	.33**	.51**
7. ZUNG							--	-.30**	-.10	-.19*	.23**	.56**
8. BAS-DR								--	.44**	.53**	-.06	-.38**
9. BAS-FS									--	.36**	-.15*	-.16*
10. BAS-RR										--	.09	-.30**
11. BIS											--	.23**
12. DEPRESS												--

Note. EROS = Environmental Reward Observation Scale, BDI-II = Beck Depression Inventory-II, CESD = Center for Epidemiologic Studies Depression Scale, STAI-S = State Trait Anxiety Inventory- State, STAI-T = State Trait Anxiety Inventory- Trait, BAI = Beck Anxiety Inventory, ZUNG = Zung Self-Rating Depression Scale and Depression Status Inventory, BAS-DR = Behavioral Activation System Drive Subscale, BAS-FS = Behavioral Activation System Fun Seeking Subscale, BAS-RR = Behavioral Activation System Reward Responsiveness Subscale, BIS = Behavioral Inhibition Scale, DEPRESS = "How depressed are you?".
** Signifies correlation is significant at the 0.01 level;   * Signifies correlation is significant at the 0.05 level

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Table A-3

Replication Sample: Standardized Path Coefficients for EROS Items

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	Path Coefficients
1. A lot of activities in my life are pleasurable.	0.58
2. Lately I have found that many experiences make me unhappy.	0.61
3. In general I am very satisfied with the way I spend my time.	0.75
4. It is easy for me to find enjoyment in my life.	0.72
5. Other people seem to have more fulfilling lives.	0.55
6. Activities that used to be pleasurable no longer are gratifying.	0.52
7. I wish that I could find more hobbies that would bring me a sense of pleasure.	0.60
8. I am satisfied with my accomplishments.	0.63
9. My life is boring.	0.68
10. The activities I engage in usually have positive consequences.	0.52

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Table A-4

Experiment Two: Correlations Among Self-Report Assessment Instruments

Instrument	1	2	3	4	5	6	7
1. EROS	--	-.78**	-.79**	.43**	.51**	.48**	-.75**
2. BDI-II		--	.88**	-.34**	-.36**	-.36**	.75**
3. CESD			--	-.33**	-.41**	-.37**	.78**
4. PES-F				--	.67**	.90**	-.50**
5. PES-R					--	.91**	-.50**
6. PES-COMP						--	-.51**
7. DEPRESS							--

Note. EROS = Environmental Reward Observation Scale, BDI-II = Beck Depression Inventory-II, CESD = Center for Epidemiologic Studies Depression Scale, PES-F = Pleasant Events Schedule (frequency of pleasant events), PES-R = Pleasant Events Schedule (pleasure experienced during events), PES-COMP = Pleasant Events Composite Score, DEPRESS = "How depressed are you?"

** Signifies correlation is significant at the 0.01 level

Table A-5

Low Reward Value Behaviors as a Function of EROS and BDI-II Self-Report

Independent Variable	β	SE	sr	t	p
STEP 1					
BDI-II	.11	.4	.11	.58	= .57
$R^2 = .01$					
STEP II					
BDI-II	-.45	.6	-.29	-1.60	= .13
EROS	-.71	1.3	-.43	-2.47	= .02
$R^2 = .19$					
$\Delta R^2 = .18$					

Note. BDI-II = Beck Depression Inventory II, EROS = Environmental Reward Observation Scale.

Table A-6

High Reward Value Behaviors as a Function of EROS and BDI-II Self-Report

Independent Variable	β	SE	sr	t	p
STEP 1					
BDI-II	-.10	.4	-.10	-.51	= .62
$R^2 = .01$					
STEP II					
BDI-II	.49	.6	.31	1.71	= .10
EROS	.73	1.3	.44	2.56	= .02
$R^2 = .20$					
$\Delta R^2 = .19$					

Note. BDI-II = Beck Depression Inventory II, EROS = Environmental Reward Observation Scale.

VITA

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