



Full length article

Emotion differentiation predicts likelihood of initial lapse following substance use treatment



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ARTICLE INFO

Keywords:

Substance use
Relapse
Abstinence
Emotion differentiation
Negative affect

ABSTRACT

Background: An estimated 40% to 70% of individuals treated for a substance use disorder relapse within one year following treatment (Walitzer and Dearing, 2006). Relapse is often driven by the need to cope with intense negative affect (Koob, 2013). Emotion differentiation, defined as the ability to distinguish among various emotion states, has been linked to better behavioral control in the face of negative affect (Kashdan et al., 2015). The aim of the current study was to determine if higher levels of emotion differentiation are associated with the risk of experiencing an initial lapse following entry into residential substance use treatment.

Methods: A total of 213 substance users (69.5% male, 94.4% African American, M age = 43.01 ± 11.35 years) entering residential treatment were assessed on study variables at pre- and post-treatment, and at 1-, 3-, 6- and 12-month post-treatment. Emotion differentiation was calculated using ratings on five negative affect items derived from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) at five assessment points.

Results: A Cox proportional-hazards regression model adjusting for age and negative affect intensity demonstrates that for every unit increase in emotion differentiation, there is a 27% reduction in the likelihood of initial lapse on any given day (OR = 0.73; 95% CIs [0.56, 0.95]).

Conclusions: The ability to differentiate among negative emotion states protects against initial lapse following treatment.

1. Introduction

A predominant motivational force thought to drive substance use is its negative reinforcement via the relief of negative affect (Baker et al., 2004; Koob, 2013). This is especially true when individuals cease prolonged use of a substance, and therefore experience heightened negative affect due to psychological withdrawal (Baker et al., 2004). Consequently, when faced with increased negative affect following abstinence, individuals resort to the prepotent coping technique (i.e., substance use). It follows that among individuals who are recently abstinent, those who are better able to cope with negative affect would be less likely to experience an initial lapse. Indeed, evidence suggests that individuals who are able to tolerate negative affect stay abstinent for longer periods of time (Daughters et al., 2005; Strong et al., 2012). However, the specific mechanisms contributing to one's ability to cope with negative affect remains undetermined.

Emotion differentiation may be one mechanism contributing to an individual's ability to cope with negative affect states (Barrett et al., 2001; Kashdan et al., 2015). Individuals who are high in emotion differentiation are able to distinguish among negative affect states and

represent their feelings using specific emotion adjectives (e.g., experience their negative affect as anger v. shame v. anxiety). Although previous research has linked constructs such as “emotional clarity” to drug use (Boden et al., 2013), emotion differentiation differs from emotional clarity in important ways. Whereas emotional clarity refers to an individual's self-reported meta-knowledge about their emotional experiences (e.g., Boden et al., 2012), emotion differentiation is typically represented by an *objective*, behavioral measure using repeated measurements of affect (e.g., Kashdan et al., 2014; Pond Jr et al., 2012). In such studies, individuals with high emotion differentiation have smaller correlations over time among negative affect states. In contrast, individuals who are low in emotion differentiation tend to exhibit higher correlations over time, leading to an undifferentiated and general experience of negative affect (e.g., experience their negative affect as just feeling bad). For such individuals, negative affect states are more highly correlated over time.

It is thought that emotion differentiation helps individuals cope with negative affect because individuals high in emotion differentiation perceive more nuanced information about the context of their emotional experience, and therefore engage in purposeful behavior directed

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<http://dx.doi.org/10.1016/j.drugalcdep.2017.09.007>

Received 27 May 2017; Received in revised form 3 August 2017; Accepted 7 September 2017

Available online 29 September 2017

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at regulating their negative affect (e.g., “I feel guilty, so I should apologize”) (Barrett et al., 2001; Kashdan et al., 2015). On the other hand, individuals with lower emotion differentiation may be less able to regulate negative affect using adaptive strategies and thus feel more overwhelmed by it, leading them to use maladaptive behaviors to alleviate their affect (e.g., “I’m upset, so I need a drink”).

Consistent with the idea that emotion differentiation helps individuals regulate negative affect and abstain from maladaptive substance use behaviors, evidence finds that underage social drinkers showing greater emotion differentiation among negative affect states are less likely to drink alcohol in response to negative affect (Kashdan et al., 2010). Differentiation of negative affect states is also protective against retaliating with aggression when feeling angry or engaging in non-suicidal self-injury when ruminating among individuals with borderline personality disorder (Zaki et al., 2013). Additionally, individuals with major depressive disorder (Demiralp et al., 2012) and social anxiety disorder (Kashdan and Farmer, 2014) have lower emotion differentiation ability compared to healthy controls.

Taken together, greater emotion differentiation appears to protect against maladaptive behaviors, including alcohol use. However, no study to date has examined whether this construct is associated with a greater likelihood of staying abstinent among treatment seeking substance users. Given that early abstinence from substance use is characterized by intensified negative affect and emotional vulnerability (e.g., Fox et al., 2007) emotion differentiation may prevent an individual from experiencing an initial lapse during this phase. Therefore, the current study aimed to examine whether greater emotion differentiation is associated with a lower probability of initial lapse following admission to substance use treatment.

2. Methods

2.1. Participants

Participants were current substance users, recruited upon admission from a 136-bed residential substance use treatment center in Northeast Washington, DC. Exclusion criteria for the study were < 5th grade English reading level, current psychotic symptoms, and initiation of psychotropic medication within the past three months.

Two additional exclusion criteria were used for the current study: (1) participants with less than three time points of valid affect data due to attrition ($n = 30$), and (2) participants who dropped out of the study prior to report of their initial lapse ($n = 13$). Participants with less than three time points of valid affect data were not included in analyses because having data at only one assessment point would lead to undefined correlations among affect items, and correlations for those with 2 assessment points would have to equal 1 or -1 , regardless of an individual’s true level of emotion differentiation. Individuals who dropped out of the study before their initial lapse were not included in the analyses because the statistical technique of survival analysis assumes that attrition is not related to the outcome measure of the study (Singer and Willett, 2003), yet studies indicate that attrition is positively related to substance use disorders (Graaf et al., 2000). The final sample included 213 participants.

2.2. Procedure

Potential participants participated in an intake interview within one week of admission, at which point they were assessed for eligibility and provided informed consent. All participants received treatment as usual (TAU), and were randomized to one of two additional treatment conditions, an experimental behavioral treatment or a contact time matched control condition (for detailed information regarding the parent trial and treatment conditions, see Daughters et al. (2017)). Participants from both conditions were combined for the following analyses, as treatment condition was not a variable of interest in this study. Study

assessments occurred pre-treatment, post-treatment (3 weeks following pre-treatment), and at 1-, 3-, 6-, and 12-month post treatment follow-ups. Study measures were administered at all study assessments, except for the momentary affect measure, which was not administered at the 1-month follow-up. Participants were compensated for their participation with gift cards for the pre- and post-treatment assessments, and with cash for the follow-up assessments. All study procedures were approved by the Institutional Review Board.

2.3. Measures

2.3.1. Potential covariates

Participants reported demographic information including race/ethnicity, gender, age, education, employment status and family/household income. Past year substance use diagnoses and current mood and anxiety diagnoses were determined using the substance use module of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First and Gibbon, 2004). Past research has shown that negative affect intensity is associated with increased frequency of use and risk for relapse (e.g., Brandon et al., 2007; Kranzler et al., 2004). Negative affect intensity was therefore included as a covariate, which is in line with previous work examining emotion differentiation (e.g., Demiralp et al., 2012). Negative affect intensity, here on referred to as “affect intensity” was computed using ratings on five negative affect items (i.e., mad, frustrated, upset, embarrassed and nervous) derived from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). The PANAS is a reliable and valid measure of current positive and negative affect (Crawford and Henry, 2004; Watson et al., 1988). The mode of response and scale were different from the original PANAS – participants rated the current intensity of negative affect using a visual rating scale, ranging from 0 (very slightly or not at all) to 100 (extremely). Internal consistency for the negative affect items in this study was strong (Cronbach’s α ranging from 0.81 to 0.85). Affect intensity was computed as negative affect ratings averaged across the five items, and across the five assessment points, consistent with previous literature (Demiralp et al., 2012).

2.3.2. Emotion differentiation

Emotion differentiation was computed from ratings made to the five negative affect items stated above, which were derived from the PANAS (Watson et al., 1988). Emotion differentiation was represented by the average intraclass correlation with absolute agreement across the negative affect items (e.g., Kashdan et al., 2010; Shrout and Fleiss, 1979). This variable was computed using the “ICC” function in the psych package (Revelle, 2014) of the R statistical software (version 3.3.1) (Team, 2014). Some participants ($n = 30$, 11.7%) had ICC values for negative affect that were less than zero. Negative values are outside the theoretical range for an ICC, although such values are mathematically possible. When interpreting negative ICC values in the context of estimating inter-rater reliability, it is advised, “there is no other possible interpretation but poor agreement” across raters (Giraudeau, 1996, p.1). Therefore, in these cases, the value was recoded to equal zero, which is the theoretical lower limit for ICCs. Analyses were also conducted while excluding these participants, which did not change the results reported below. Consistent with previous research, Fisher’s r to z transformation was conducted to fit this variable to a normal probability distribution. Further, to aid interpretation, this variable was recoded by multiplying it with -1 so that larger values would indicate high emotion differentiation (Kashdan et al., 2010).

2.3.3. Post treatment substance use

The Timeline Followback (TLFB; Sobell and Sobell, 1996) was used to assess the occurrence of any substance use following treatment entry. A trained interviewer asks the participants to recall daily substance use in reverse order, starting with the assessment date and ending on the date of the last assessment. This measure demonstrates high test-retest

reliability, convergent and discriminant validity, and agreement with collateral reports of substance use and urinalyses (Hjorthøj et al., 2012). Days to first substance use was calculated as the number of days from the date of pre-treatment assessment until the date participants indicated the first instance of substance use.

2.4. Data analysis

All analyses were conducted using SPSS (version 24). Multiple Logistic Regression analyses were used to test whether the excluded participants ($n = 43$) differed significantly from those included ($n = 213$) in the analyses with respect to demographic variables, past year substance dependence, current anxiety or depression diagnoses or emotion differentiation. Discrete-time survival analyses using Cox proportional hazards regression were used to examine the association between potential covariates (i.e., age, gender, race, household income, past year substance dependence, current anxiety and depression diagnoses, and treatment condition) and risk for initial lapse. Covariates with significant associations with risk for initial lapse were included as covariates in the subsequent analyses. Finally, a Cox proportional hazards survival model was used to determine whether emotion differentiation is associated with an increased risk for initial lapse.

3. Results

3.1. Tests for systematic exclusion and participant characteristics

To test for systematic exclusion, three models, each consisting of a set of predictors were compared to a null intercept model, with the filter variable (identifying individuals excluded based on criteria described above) as the dependent variable. First, the filter variable was regressed on variables representing different past year diagnoses of substance dependence, current anxiety and depression diagnoses (listed in Table 1). No significant difference was observed between this model and the null intercept model ($\chi^2(12) = 15.52, p = n.s.$). Additionally, participants excluded from subsequent analyses did not differ from those who were retained with regard to a set of demographic variables including race/ethnicity, gender, age, or family/household income ($\chi^2(4) = 8.19, p = n.s.$). Finally, participants excluded due to attrition ($n = 13$) did not differ with regard to emotion differentiation ($\chi^2(1)$

Table 1
Participant characteristics.

	Total (n = 213)
Age, mean (SD)	43.01 (11.4)
Gender, n Male (% Male)	148 (69.5)
Race/Ethnicity, n (%)	
African American	197 (92.5)
Caucasian	5 (2.4)
Hispanic/ Latino	2 (0.9)
Other/Multi-racial	9 (4.2)
Household income, median range	\$0–\$9999
DSM-IV Substance Dependence Diagnosis, n (%)	
Cocaine	70 (32.9)
Opioid	24 (11.3)
Marijuana	23 (10.8)
Alcohol	69 (32.4)
Hallucinogen/PCP	31 (14.6)
DSM-IV Mood and Anxiety Disorder Diagnosis, n (%)	
Major Depressive Disorder	42 (19.7)
Bipolar Disorder	9 (4.2)
Panic Disorder	4 (1.9)
Generalized Anxiety Disorder	16 (7.5)
Social Anxiety Disorder	10 (4.7)
Post-Traumatic Stress Disorder	14 (6.6)
Obsessive Compulsive Disorder	1 (0.5)

Note: SD = Standard Deviation, HS = High School, GED = General Educational Development, DSM-IV – Diagnostic and Statistical Manual – IV.

$= 1.8, p = n.s.$; $B = 0.52, SE = 0.37, Wald(1) = 1.99, p = n.s.$). Therefore, no evidence was obtained to suggest systematic exclusion on the basis of demographic variables, past year substance dependence, anxiety, depression diagnoses, or emotion differentiation. Demographic and diagnostic information for the final sample are displayed in Table 1.

3.2. Affect ratings and emotion differentiation

On a scale of 0–100, the average affect intensity for the sample was 21.59 (SD = 20.21). Average intra class correlation (ICC) for negative affect was 0.49 (SD = 0.33), representing adequate variability, and suggesting that individuals differed in the degree of emotion differentiation. Affect intensity was positively skewed (skewness of 1.44 (SE = 0.17) and kurtosis of 1.94 (SE = 0.33)), therefore it was log transformed to fit it to a normal distribution (skewness of -0.59 (SE = 0.17) and kurtosis of -0.24 (SE = 0.33)). Emotion differentiation was not significantly related to affect intensity ($r(213) = -0.10, p = n.s.$).

3.3. Days to initial lapse

Substance use was reported by 76.06% ($n = 162$) of participants, with the majority of lapsers (91.36%, $n = 148$) reporting first substance use (initial lapse) within the first 203 days. The median time to initial lapse was 105 days (SE = 10.47).

3.4. Analysis of potential covariates

Results from Cox proportional hazards regression discrete-time survival analyses examining the association between potential covariates and risk for initial lapse are presented in Table 2. Older participants were significantly less likely to experience an initial lapse. No other significant associations were observed. Age was included as a covariate in subsequent analyses.

3.5. Relationship between emotion differentiation and probability of initial lapse

Results from Cox proportional hazards regression discrete-time survival analyses examining the association between emotion differentiation and probability of initial lapse are presented in Table 3. Age and affect intensity were entered in the first step. Emotion differentiation was entered in the second and final step. The final model was significant ($\chi^2(3) = 14.35, p < 0.01$), with the inclusion of emotion

Table 2
Effect of demographics, past year substance dependence and treatment condition on likelihood of initial lapse.

	χ^2	B	SE	Wald	df	P	OR	95% CI OR
Age		-0.02	0.01	5.48	1	0.02	0.98	[0.97, 1.0]
Gender		0.12	0.17	0.46	1	0.5	1.12	[0.80, 1.57]
Race	7.24				4	0.12		
Household income	8.80				10	0.55		
Alcohol		-0.01	0.17	0.01	1	0.94	0.99	[0.71, 1.37]
Cannabis		0.05	0.26	0.04	1	0.84	1.05	[0.64, 1.74]
Opioid		0.09	0.26	0.13	1	0.72	1.09	[0.66, 1.81]
Cocaine		-0.01	0.17	0.00	1	0.96	0.99	[0.71, 1.38]
Hal PCP		0.05	0.23	0.04	1	0.84	1.05	[0.67, 1.63]
Anxiety		-0.02	0.21	0.01	1	0.91	.98	[.65, 47]
Depression		0.19	0.19	1.02	1	0.31	1.21	[0.83, 1.77]
Treatment Condition		-0.19	0.16	1.48	1	0.22	0.83	[0.61, 1.12]

Note: results significant at $p < 0.05$ are in bold, each substance represents a DSM-IV dependence diagnosis, Anxiety and Depression represent any current DSM-IV diagnosis of an anxiety or depression respectively.

Table 3
Effect of emotion differentiation on likelihood of initial lapse.

	χ^2	B	SE	Wald	df	p	OR	95% CI OR
Step 1	8.43				2	0.02		
Partial effects								
Age		−0.02	0.01	5.78	1	0.02	0.98	[0.97, 1.0]
Affect Intensity	−0.29	0.16	3.15	1	0.08	0.75		[0.55, 1.03]
Step 2 (change from previous step)	5.38				1	0.02		
Partial Effects								
Emotion Differentiation		−0.32	0.13	5.64	1	0.02	0.73	[0.56, 0.95]
Age		−0.02	0.01	5.96	1	0.02	0.99	[0.97, 1.0]
Affect Intensity		−0.38	0.16	5.28	1	0.02	0.69	[0.50, 0.95]

Note: results significant at $p < 0.05$ are in bold.

differentiation significantly improving the model in the second step. On any given day, a one unit increase in emotion differentiation was associated with a 27% decrease in the probability of initial lapse.¹

In order to visualize the relationship between emotion differentiation and days to initial lapse, a median split was conducted to identify individuals with “high” and “low” emotion differentiation (i.e., > -0.62 , < -0.62 respectively). The survival curves for individuals with high vs. low emotion differentiation are illustrated in Fig. 1.

4. Discussion

The present study examined whether emotion differentiation is associated with the likelihood of initial lapse following substance use treatment entry. Consistent with the hypothesis that emotion differentiation is a protective factor against relapse; participants with higher emotion differentiation ability had a lower likelihood of initial lapse after treatment entry over a period of one year. This novel finding suggests that the ability to differentiate among negative affect states may be protective against initial lapse during a vulnerable phase of abstinence.

Approximately 76% of individuals lapsed during this study (i.e., from baseline until 12-month post treatment), consistent with the conceptualization of substance use disorder as a chronic relapsing condition (McLellan et al., 2000), and highlighting the importance of examining risk factors associated with lapse to substance use. Most individuals reported their first use within the first six months (180 days) following treatment. This finding supports previous findings showing that individuals are more vulnerable to the initial lapse during this stage, with risk decreasing over time (e.g., Greenfield et al., 2000). Furthermore, in Fig. 1, the protective effect of high emotion differentiation appears statistically significant through four months (120 days) after treatment suggesting that emotion differentiation may protect against initial lapse when individuals are most vulnerable to experience it. Another possibility is that emotion differentiation would remain a predictor of relapse at later points, but that we did not have the power to detect this effect because only 11 participants in our sample relapsed between the 6- and 12-month follow-ups. This possibility should be assessed in future research.

This study has several important strengths. Emotion differentiation was computed from participants' ratings of affect across five assessment points, yielding a performance-based representation of their emotion differentiation ability. Since emotion differentiation is considered a skill, this technique yields a more valid measure of differentiation

¹ When excluding participants with ICC for negative affect < 0 , emotion differentiation predicted probability of relapse ($B = -0.34$, $SE = 0.16$, $Wald(1) = 4.67$, $p = 0.03$, $OR = 0.72$) after accounting for age, and affect intensity. Similar results were also obtained when including the attrited participants ($n = 13$), and including attrition status as a covariate ($B = -0.30$, $SE = 0.13$, $Wald(1) = 5.5$, $p = 0.02$, $OR = 0.74$). The category of drug used on a weekly basis did not significantly moderate the relationship between emotion differentiation and probability of initial lapse ($B = -0.04$, $SE = 0.08$, $Wald(1) = 0.32$, $p = 0.57$, $OR = 0.96$).

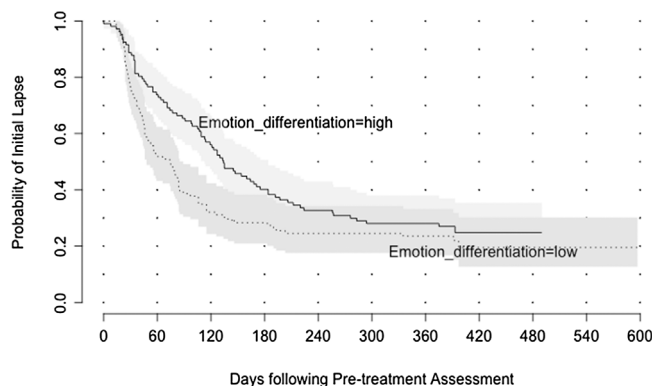


Fig. 1. Survival probability of abstinence on any given day among individuals who are below and above the median in emotion differentiation. Shaded area represents 95% confidence intervals.

compared to participants' subjective perception about their ability to differentiate among affect states (Kashdan et al., 2015). In addition, this study was the first to extend previous research on emotion differentiation by examining its impact within a clinical sample of substance users.

Furthermore, this study represents a novel approach to understanding the link between negative affect and substance use. Most past research on substance use has focused on negative affect intensity, linking high intensity to high levels of substance use (Cheetham et al., 2010; Wills et al., 1999). The present finding demonstrates the importance of looking beyond the level of affect intensity, at the within-person relationship among different negative affect states. Indeed, consistent with previous research (e.g., Demiralp et al., 2012; Pond Jr et al., 2012), no significant association was observed between affect intensity and emotion differentiation in this study. This suggests that emotion differentiation represents a separate construct from affect intensity, and warrants attention as a distinct protective factor against substance use.

Additionally, studies have shown that the ability to regulate and tolerate negative affect predicts lower levels of substance use (e.g., Axelrod et al., 2011; Strong et al., 2012). However, it is unclear what makes some individuals more likely to use adaptive emotion regulation strategies, or to tolerate negative affect (i.e., distress tolerance), compared to others. The current study sheds light on this question by suggesting that one characteristic causing individuals to differ in emotion regulation and distress tolerance may be whether they have highly differentiated emotional experiences. Indeed, using a similar measure of emotion differentiation, Barrett et al. (2001) showed that individuals with high differentiation ability reported using more emotion regulation strategies, such as situation selection, situation modification, attentional deployment, cognitive change, and response modulation. More research is needed to identify the direction of causality (i.e., whether emotion differentiation leads to frequent use of

emotion regulation strategies, or vice versa) but it is typically assumed that emotion differentiation is a form of emotional intelligence (Lindquist and Barrett, 2008) that predicts more adaptive outcomes. Further research should experimentally address whether emotion differentiation enables individuals to tolerate negative affect and thus persist in the face of high stress, without resorting to substance use.

Consistent with the idea that emotion differentiation confers greater emotion regulation, growing neuroscience evidence suggests that emotion differentiation is associated with increased activity in areas involved in cognitive control and self-regulation. For instance, neuroimaging studies show that labeling one's affect states in a discrete and specific way is associated with down-regulation of the amygdala, a brain region associated with representing negative affect (Brooks et al., 2017; Hariri et al., 2000; Lieberman et al., 2007). Another study found lower activation of the dorsal anterior cingulate cortex and anterior insula, two regions involved in representing negative affect, among individuals with greater emotion differentiation (Kashdan et al., 2014). Finally, evidence using electroencephalography suggests that individuals higher in emotion differentiation may more habitually engage neural regions associated with executive control throughout the course of both negative and positive emotion experiences (Lee et al., 2017)

It is important to note that the assessments of affect were spaced further apart in this study (i.e., between 3 weeks to 6 months apart) compared to previous studies on emotion differentiation, which typically assess affect multiple times within a single day across a several week period (e.g., Demiralp et al., 2012; Kashdan et al., 2010). A potential concern is that larger changes in affect may occur over longer periods, although it is unclear how this would in turn influence the inter-relatedness of people's emotion ratings (i.e., the measure of emotion differentiation). In that sense, our measure might be considered a stable individual difference measure as opposed to a contextually-sensitive measure of a person's differentiation at any one period of time. Interestingly, average affect intensity of the sample did not significantly change across time points.² However, the results of this study must be replicated using more closely timed affect ratings to ensure that the spacing of assessments does not influence them.

Additionally, the current study demonstrated cross-sectional associations between emotion differentiation and lapse, limiting the ability to infer a causal relationship. Indeed, for most participants, affect ratings obtained *after* their initial lapse, were also considered when computing emotion differentiation. This was done to ensure an adequate number of data points to compute the ICC. Again, these findings suggest that our measure is a stable individual difference measure such that people who are low in emotion differentiation in general—regardless of where they are in their drug treatment and recovery trajectory—are more likely to relapse. Future research may examine the longitudinal relationship between emotion differentiation and substance use lapse by using more temporally sensitive affect ratings that precede the lapse period. Finally, participants in the current study were predominantly male and African-American. Research using a more race- and gender-balanced sample is needed before these findings can be generalized to the population. Despite these limitations, findings from this study have several important implications. They suggest that emotion differentiation may be a key specific target for intervention. Indeed, several existing treatments that are effective in treating substance use teach individuals to label their emotions accurately (e.g., Axelrod et al., 2011) and increase awareness of their current emotional state (Witkiewitz and Bowen, 2010). More targeted interventions aimed at enhancing emotion differentiation specifically may be effective and efficient ways to prevent lapse.

In conclusion, the present study shows that greater emotion differentiation ability is associated with lower risk for initial lapse following

² Repeated measures ANOVA showed that time did not significantly affect negative affect intensity in this sample ($B = 0.03$, $F(4, 544) = 0.34$, $p = n.s.$)

treatment entry. In doing so, it extends research on substance use by highlighting the role of within-person associations among affect states, beyond the intensity of affect, thus uncovering a potential target for future treatments aimed at reducing lapse.

Conflict of interest

No conflict declared.

Financial disclosure

No financial disclosure to report.

Role of funding source

This research was supported by National Institute on Drug Abuse R01 DA026424 (PI: Daughters). This article is the sole responsibility of the authors and does not reflect the views of the National Institutes of Health.

Contributors

Deepika Anand originated the study concept, conducted the statistical analyses and drafted the manuscript. Yun Chen contributed to manuscript preparation and revisions. Kristen Lindquist advised on the study concept, statistical analysis and reviewed drafts of the manuscript. Stacey Daughters advised on all aspects of the study and provided critical revision of the manuscript for important intellectual content. All authors approved the final version for publication.

Acknowledgements

The authors would like to thank C.J. Seitz-Brown for study oversight and data management, as well as the study participants and staff whose time and effort made this research possible. The authors also thank the funding source that supported this research, i.e. National Institute on Drug Abuse R01 DA026424 (PI: Daughters).

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