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An Idiographic Examination of Day-to-Day Patterns of Substance Use Craving, Negative Affect and Tobacco Use among Young Adults in Recovery

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Abstract

Psychological constructs, such as negative affect and substance use cravings that closely predict relapse, show substantial intra-individual day-to-day variability. This intra-individual variability of relevant psychological states combined with the “one day of a time” nature of sustained abstinence warrant a day-to-day investigation of substance use recovery. This study examines day-to-day associations among substance use cravings, negative affect, and tobacco use among 30 college students in 12-step recovery from drug and alcohol addictions. To account for individual variability in day-to-day process, it applies an idiographic approach. The sample of 20 males and 10 females (mean age = 21) was drawn from members of a collegiate recovery community at a large university. Data were collected with end-of-day data collections taking place over an average of 26.7 days. First-order vector autoregression models were fit to each individual predicting daily levels of substance use cravings, negative affect, and tobacco use from the same three variables one day prior. Individual model results demonstrated substantial inter-individual differences in intra-individual recovery process. Based on estimates from individual models, cluster analyses were used to group individuals into two homogeneous subgroups. Group comparisons demonstrate distinct patterns in the day-to-day associations among substance use cravings, negative affect, and tobacco use, suggesting the importance of idiographic approaches to recovery management and that the potential value of focusing on negative affect or tobacco use as prevention targets depends on idiosyncratic processes.

Keywords

idiographic approach; vector autoregression; cluster analysis; substance use craving; negative affect; tobacco use; recovery

Among all U.S. cohorts, youth aged 18–22 have the highest rates of substance use disorders, with over 20% meeting the diagnostic criteria (SAMHSA, 2009). Rates among college and university students are similar, with 22.9% meeting the criteria versus 8.5% of the general population (CASA, 2007). As 48% of young adults currently attend or have completed college (Kidscount, 2010), the university setting provides an opportunity to reach a large proportion of youth with substance use disorders.

The number of U.S. adolescents and young adults (ages 12–24) treated for addictions rose 32% in the decade ending in 2009, compared with a 9% increase for the rest of the population (SAMHSA, 2009). Leaving substance abuse treatment and trying to live an abstinent life is difficult for anyone, but for those who have not completed their educations, the ubiquity of substance use on college campuses presents an additional barrier. Recognition of this problem has led at least 20 colleges and universities to develop collegiate recovery communities (CRCs) (Smock, Baker, Harris, & D'Sauza, 2011) that provide comprehensive recovery support services. CRCs are largely based on the 12-step program (Harris, Baker, & Cleveland, 2010), which has been shown to be effective in reducing relapse among both adults (Humphreys, Mankowski, Moos, & Finney, 1999) and adolescents (Kelly, Dow, Yeterian, & Kahler, 2010). Only 4% to 8% of CRC members relapse each year (see Smock et al., 2011), providing hope to these vulnerable young adults.

Although the low relapse rates of these members make it difficult to examine relapse itself, CRCs present an excellent opportunity to investigate processes that underlie sustained abstinence. Using data collected from members of a CRC, we focused on two intra-individual constructs linked to relapse: negative affect and craving for drugs and alcohol (Witkiewitz & Bowen, 2010). We linked these two constructs to tobacco use because such use is common among persons in recovery and because many believe it ameliorates the urge to use other substances (Drobes, 2002), but may also be a trigger for, rather than solely a response to, either negative affect or craving. Further, as the nation's leading cause of preventable death (CDC, 2011), tobacco use itself also constitutes a major public health problem, especially among teens (de Bry & Tiffany, 2008), so it is important to examine whether it has any salutary effects on recovery.

Given their nature as states or behaviors rather than traits, each of these variables should exhibit considerable variation both within and between individuals during recovery, ideally captured by daily data collection. Further, as individuals differ in recovery experiences, it makes sense to search for and attempt to systemize these differences rather than to simply adopt a nomothetic approach that aggregates data across individuals in order to describe the "average" individual, who may not represent anyone actually in the sample (Hoeppner, Goodwin, Velicer, Mooney, & Hatsukami, 2008; Molenaar, 2004). To investigate associations among negative affect, craving, and tobacco use consistent with the idiosyncratic nature of how such associations may differ among people in recovery, we

analyzed daily diary data collected over three weeks from members of a large CRC (for a description of this CRC and its members, see Cleveland, Harris, Baker, Herbert, & Dean, 2007). First-order vector autoregression models were fit to each person in the sample. With estimates obtained for each individual's across-day associations, cluster analysis was then employed to determine groups of individuals exhibiting similar patterns of association.

The study has two goals: (1) to substantively add to the literature that examines across-day, within-individual processes underlying recovery that may put successful abstinence at risk or, alternatively, support long term maintenance; and (2) to demonstrate the value of the idiographic approach for exploring the dynamic processes of recovery. Before describing the study and its results, we review research that establishes the relevance of craving as a criterion variable in recovery research, of negative affect as a predictor of craving, and of tobacco use as both an important correlate of substance use and craving and a serious public health risk. We then compare and contrast nomothetic and idiographic approaches and briefly review Granger causality, which allows causal inference within a time series framework.

Craving, Negative Affect, and Substance Use

Researchers generally assume that craving—a strong, subjectively-experienced desire or urge to use drugs or alcohol (Kozlowski & Wilkinson, 1987)—can precede and predict drug use (e.g., Stalcup, Christian, Stalcup, Brown, & Galloway, 2006). Craving has been linked to the use of cigarettes (Catley, O'Connell, & Shiffman, 2000), alcohol (Litt, Cooney, & Morse, 2000), and other drugs (Hopper et al., 2006; Preston et al., 2009), as well as to relapse among persons in recovery from alcohol and other substances (e.g., Drummond, 2001; Witkiewitz & Bowen, 2010). For this reason, many treatment and recovery programs explicitly target craving (e.g., Florsheim, Heavin, Tiffany, Colvin, & Hiraoka, 2008; Stalcup et al., 2006), and many of those programs have shown promise in relapse prevention (Witkiewitz & Bowen, 2010; Witkiewitz, Bowen, & Donovan, 2011).

The association among negative affect, craving, and substance use can be explained through negative reinforcement. In this model, negative affect, stemming in part from the desire to avoid withdrawal symptoms, stimulates drug use, which results in, and is reinforced by, reduced levels of negative affect and other stressors (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Thus, craving can be seen as a cognitive and emotional state that involves the anticipation of negative reinforcement, with the goal of relieving negative affect (see Robinson, Lam, Carter, Wetter, & Cinciripini, 2012). Empirically, negative affect has proven to be a reliable predictor of both substance use (Armeli, Carney, Tennen, Affleck, & O'Neal, 2000) and craving (Mason, Hitch, & Spoth, 2009; Wheeler, Twining, Jones, Slater, Grigson, & Carelli, 2008). Because negative affect can be expected during interpersonal interactions and other social situations, it may be an important predictor of recovery and abstinence maintenance. Further, negative affect may build, or at least endure, over time. Individuals with high levels of negative affect may continue to feel negative affect one or two days later, which could lead to increased craving, threatening their abstinence.

Tobacco Use and Recovery

The higher prevalence of tobacco use among persons in alcohol and drug abuse treatment and recovery than among the general public (Chun, Guydish, & Chan, 2007) has often been interpreted as an indicator of self-medication, either to reduce craving for alcohol and drugs indirectly by catharsis on tobacco use, or to reduce the negative affect that often leads to craving (see review in Eissenberg, 2004). Both suppositions have found research support. While a nicotine patch can reduce cravings for alcohol among abstinent alcoholics who had quit smoking (Cooney, Litt, Cooney, Oncken, Pilkey, & Findley, 2001), smoking can also be used to self-medicate depression and other problems with emotional regulation (Gehricke, Loughlin, Whalen, Potkin, Fallon, Jamner et al., 2007). Therefore, many alcohol and drug abuse programs do not target tobacco use. Not only do they consider tobacco less harmful than other addictive substances, but they often value it as an effective coping tool for dealing with craving, as well as the stress associated with alcohol and/or drug withdrawal or abstinence (Drobes, 2002).

However, the relationship between smoking and craving is not clear-cut. One study found a reversed relationship: Alcohol use moderated the noxious effects of cigarette smoking among smokers in the experimental stage (McKee, O'Malley, Shi, Mase, & Krishnan-Sarin, 2008). Further, not all research has found tobacco to ameliorate negative affect. For example, Chaiton, Cohen, O'Loughlin, and Rehm (2010) found that among adolescents, smoking did not alleviate depression; Dvorak and Simons (2008) found that daily tobacco use predicted emotional instability and liability, as well as decreased positive affect; and Kouri, McCarthy, Faust, and Lukas (2004) found that nicotine *increased* levels of subjective intoxication, alcohol craving, and tobacco craving among heavy-drinking daily-smoking males. Thus, tobacco use may be, at best, a neutral predictor of craving and, at worst, a risk factor for relapse.

As a serious public health concern, whether tobacco has any beneficial effects for persons in recovery is important. Clearly, if tobacco use is a risk factor for substance use relapse, it should be treated along with other substance use issues. If neutral, it should be treated as well, as employing a smoking cessation intervention during treatment for drug and/or alcohol dependence does not adversely affect the success of the drug and alcohol treatment (Cooney, Litt, Cooney, Pilkey, Steinberg, & Oncken, 2007; Reid, Fallon, Sonne, Flammino, Nunes, Jiang et al., 2008). In fact, quitting tobacco may reduce the risk of relapse for recovering alcoholics (Hughes & Callas, 2003), although concurrent, rather than delayed, treatment for tobacco use may make substance abuse relapse more likely (Joseph, Willenbring, Nugent, & Nelson, 2004; NIAAA, 2007). Thus, it is important to investigate the role of tobacco use among a recovery sample. Unless tobacco plays an important role in subsequent attempts to maintain abstinence from alcohol and other non-tobacco substances, it would seem advisable to target tobacco use within this population.

Day-to Day Investigation with Nomothetic and Idiographic Approaches

Although recovery from substance use is a long-term process, it is associated with many risk factors that occur on a daily basis. Many psychological and behavioral constructs that are

closely related to recovery outcomes, such as negative affect, substance use craving and tobacco use, demonstrate considerable day-to-day variation within individuals. Close examination of associations among these risk factors at a daily level could potentially highlight how daily risks accumulate and pose difficulties for abstinence maintenance over time. Therefore, investigating recovery as a daily process could add considerably to the results of conventional longitudinal research by revealing unique information relevant to future lapse and relapse (e.g., Cleveland & Harris, 2010).

Day-to-day examination of recovery patterns also provides a unique opportunity to study recovery with an idiographic approach, in order to fully understand recovery process at the individual level. Empirical findings summarizing the relationship between negative affect and craving, as well as tobacco use in recovery, have already shown substantial individual differences, underscoring the importance of examining data at the individual level. Most previous studies looking at the different processes associated with successful recovery rely on the nomothetic approach, aggregating data across the sample and generalizing the results to the population. Despite their wide use and apparent generalizability, population-level methods have some important limitations. Most importantly, the pooled results may not fit any specific individual in the sample (Hoepfner et al., 2008; Molenaar, 2004). As demonstrated by the classic ergodic theorem, only under rare occasions with strict conditions, the homogeneity of the population and the stationarity of psychological or behavioral processes, can population-based inter-individual analysis yield the same results as in intra-individual analysis (Molenaar, 2004; & Campbell, 2009). In contrast, methods using the idiographic approach, focusing on individual-level data, can capture unique intra-individual processes and may be more appropriate for exploring the dynamic process of recovery. This approach can reveal different patterns within the same sample. For example, Velicer and colleagues (1992) investigated time series tobacco use data from 10 subjects, and found that, among seven, use could be predicted negatively by prior day's use while among two, use related positively to use two days before.

Although their utility may be widely acknowledged, idiographic approaches may be underutilized because their results are difficult to generalize to the population (Molenaar, 2004). However, it may be possible to identify generalizable homogeneous subgroups by capturing *inter*-individual differences in *intra*-individual patterns. For example, using time series and dynamic cluster analysis, Hoepfner et al. (2008) identified three distinct longitudinal patterns of daily smoking in a smoking cessation sample following treatment: decreasing, constant, and increasing. A similar approach could help disentangle various patterns of associations among craving, negative affect and tobacco use.

Once subgroups have been identified, the stage is set for developing tailored treatment. This approach matches treatments to specific risk factors and monitors individual dynamic recovery processes in order to adaptively intervene in negative recovery paths and reinforce positive ones (Collins, Murphy, & Bierman, 2004). A given intervention may not work for everyone, and indeed may have an iatrogenic effect on some participants, but work well for others, which may partly explain the commonly-found minimal, trivial, or short-term effects among many substance abuse interventions (SAMHSA, 2002; cf. Waldron & Turner, 2008).

Granger Causality

The quest to uncover individual across-day patterns among these variables may ultimately prove unsatisfying, however, if it reveals nothing about causation. Interventions can succeed if they explicitly target causes of the condition or behavior they are intended to remedy. Using concepts pioneered by Granger (1969), the current study aims to establish causal relationships among our three variables by using time series data to improve the prediction of outcome variables of interest. Specifically, Granger causality between stochastic variables X and Y is found when adding the history of X to all other available relevant information “significantly reduces the forecast error variance of Y” (Atukeren, 2008, p. 836). X is said to be the Granger cause of Y when the cross-lagged prediction of X on Y is significant but the cross-lagged prediction of Y on X is not significant, while simultaneously controlling for the autoregression of both X and Y. Mutual or reciprocal Granger causality occurs when both cross-lagged predictions are significant (Granger, 1969; 1980). This method is commonly used in economics and neuroimaging studies, where researchers have little control over causal forces but wish to make usable predictions of important outcomes, but is less frequently used in the behavioral sciences given the substantial amount of longitudinal data required.

The Current Study

To facilitate the investigation of intra-individual emotional and behavioral patterns among young adults in recovery, this study used an idiographic approach to investigate across-day associations among daily substance use craving, negative affect and tobacco use among members of a CRC, nearly all of whom have completed substance use treatment (Cleveland, Baker, & Dean, 2010). We used first order vector autoregression (VAR(1)) models to investigate associations among the three variables within each subject searching for individual patterns. Individuals may fit different VAR(1) models, differing in both the direction and magnitude of across-day associations. We then used cluster analysis on the results from individual VAR(1) models to identify homogenous subgroups within the sample. We then examined our data at the cluster level by pooling across participants within the same clusters to examine Granger causality among the variables. Given the exploratory nature of the study, we did not have specific hypotheses regarding the results of cluster analysis, but we did expect that distinct subgroups would demonstrate different processes with explicable meanings. This is especially salient in light of the conflicting research findings regarding the relationship between tobacco use and substance use craving. For some individuals, tobacco use could act as a protective factor from craving, whereas for others it could enhance the risk of craving. In addition, subgroups might also differ on the relationship between negative affect and tobacco use.

In addition to exploring heterogeneity among individual VAR(1) models, we were able to test several hypotheses. First, consistent with previous findings of the risk role of negative affect during recovery, we hypothesized that daily substance use craving could be positively predicted by prior days' negative affect. Next, two competing hypotheses were tested regarding the relationship of tobacco use to negative affect and craving. Consistent with the self-medication hypothesis, tobacco use might increase in response to increased craving and

negative affect, which could predict lower levels of craving and negative affect in the next day. Alternatively, increases in tobacco use might *adversely* affect recovery by leading to increases in cravings and negative affect in the next day.

Method

Sample

The sample comprised young adult addicts, members of a CRC at a Southwestern university who provided diary data at the end of each day. The full sample consisted of 1222 discrete reports from 55 subjects, 39 males and 16 females (Cleveland & Harris, 2010). For the current study, the sample included 30 young adult addicts (10 females) with a mean age of 20.7 years old ($SD = 2.4$). Two of the original 55 were excluded because their levels of craving exhibited no day-to-day variance, while 13 were excluded as nonsmokers. Ten more participants were excluded during model fitting because their data could not be fit satisfactorily to a VAR(1) model. All participants were non-Hispanic white. All had received professional alcohol/drug dependency treatment; all had received inpatient care, most for three months or more. All considered themselves to be 12-step group members and reported that they read 12-step literature and applied the steps to their lives on a daily basis. Participants provided an average of 26.7 days' worth of data each ($SD = 5.3$, ranging from 10 to 43 days), with the average participant missing 2.0 days ($SD = 3.1$, ranging from 0 to 16 days).

Measures

Tobacco use—Daily tobacco use was measured with one item asking “How many cigarettes did you smoke today?” Responses ranged from 0 (no cigarettes), 1 (1 or 2), 2 (2 to 5), 3 (5 to 10), 4 (half pack) to 5 (full pack plus).

Substance use craving—Daily substance use craving was measured with seven items modified from the Desires for Alcohol Scale (Love, James, & Willner, 1998) and the Alcohol Urges Questionnaire (Bohn, Krahn, & Staehler, 1995) to accommodate daily assessment and polydrug use. A sample item reads, “For a moment today I missed the feeling of drinking or drugging.” Responses were 1 (strongly disagree) to 5 (strongly agree). Reliability (Cronbach's Alpha) was calculated both conventionally, without regard to reports being nested within participants, and separately for each analysis day with 10 or more data points (day 1 excluded). Calculated conventionally, α was .95, while within-day α ranged from .88 to .97.

Negative affect—We used the 10-item negative affect scale from the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) to assess daily negative affect. Emotions included “Stressed,” “Upset,” “Scared,” “Hostile,” and “Irritable.” Responses ranged from 1, “very slightly or not at all,” to 5, “very much.” Conventional α was .88, while day-level α ranged from .78 to .93. Table 1 provides descriptive statistics for the three variables and the number of observations of each participant.

Analytic Strategy

Daily craving, negative affect, and tobacco use were first regressed on time individually to detect any potential linear trends for each variable in preliminary analyses. Block Toeplitz covariance matrixes up to two lags from multivariate time series data of each participant were calculated, with missing data pairwise deleted when producing a Block Toeplitz covariance matrix (Molenaar, 1985). Next, a series of VAR(1) models were fit to these covariance matrixes for each subject. In VAR(1), we modeled all across-day associations between each pair of variables, both within variable (autoregression) and across variables (cross-lagged). For example, craving was predicted by prior day's craving (autoregression), and by prior day's tobacco use and negative affect (cross-lagged). Thus, for a VAR(1) model, we estimated three parameters for each of the three variables, representing nine total pairs: three autoregressions and six cross-lagged (see Figure 1). To explore Granger causality, we focused on cross-lagged parameters.

Our goal was to identify the most parsimonious good-fitting model for each subject. A good-fitting model was operationally defined as one that achieved satisfactory model fit as well as satisfactory residual fit, indicated by fit indices. Satisfactory residual fit indicates that residuals conform to white noise. We used LISREL 8.8 (Jöreskog & Sörbom, 2006) with quasi-maximum likelihood estimation, which has been shown to produce the same unbiased estimates as Full Information Maximum Likelihood estimation using Block Toeplitz covariance matrix (Hamaker, Dolan, & Molenaar, 2002; 2005). This model setup in LISREL enabled us to investigate multivariate time series data. To protect the .05 significant level at individual model level and to avoid spurious significance, Bonferroni corrections were used to adjust multiple estimate hypothesis tests (9 tests for each model) within each individual VAR(1) model, producing an adjusted single-parameter significance level of .0056 (.05/9).

After fitting individual VAR(1) models, each model's estimates were used in cluster analyses to identify homogenous subgroups within the sample. Model estimates rather than the measured variables themselves were used because we were interested in differences across individuals of intra-individual patterns, which would manifest in different patterns of associations among craving, negative affect and tobacco use. Given the limited numbers of participants and individual observations, as well as the exploratory nature of the study, we used a two-step auto-cluster analysis in SPSS 17.0, a procedure that works similarly to two-stage clustering methods like BIRCH (SPSS, 2001). Individuals with similar model estimates were first pre-clustered into sub-clusters by constructing a modified cluster feature tree. Next, using the generally sensitive log-likelihood distance measure (the corresponding decrease in log-likelihood from combining two clusters into one) and Akaike's Information Criterion, numbers of clusters were automatically determined and individuals with similar model estimates were grouped into clusters using the agglomerative hierarchical clustering method. In the last step, using multi-group VAR(1) modeling, model estimates were re-estimated using the same specifications and procedures described before, and then pooled across all participants grouped into the same cluster to produce cluster-level estimates. Models estimates in the same cluster were constrained to be equal across all participants, whereas individual contemporaneous correlations of variables and residuals were left to be freely estimated.

Results

Descriptive Examination of Individual Patterns

The majority of participants showed stationary multivariate time series data, with a few participants exhibiting a mild to moderate linear trend (Table 1). Six participants showed significant changes in daily negative affect, with half increasing. Two participants showed significant changes in daily substance use craving. Four showed significant changes in daily tobacco use, with four increasing. As noted in the *Sample* section above, our analyses revealed 30 participants with good-fitting VAR(1) models, who constituted our final sample. Ten participants, whose data fit VAR(2) or higher-order models, were excluded from our sample at this point.

Table 2 contains individual VAR(1) model estimates and fit indices as well as the clusters into which subjects were grouped, as described below. Participants exhibited considerable heterogeneity in their across-day patterns of negative affect, tobacco use, and craving, with both autoregression and cross-lagged patterns varying widely. However, half of these associations were non-significant when a Bonferroni-adjusted significant level was used. The following summary reports only estimates significant at the adjusted level.

Negative affect among four of the 30 subjects fitted to VAR(1) models showed significant positive autoregression, indicating that negative affect could persist to the next day. Three subjects' daily craving could also be significantly predicted by the prior day's negative affect, one negatively and two positively. Three subjects' daily tobacco use could be predicted by prior day's negative affect, with one being positive. Four subjects showed significant autoregression of daily substance use craving, all positive. No subject's daily negative affect could be significantly predicted by prior day's craving. Five subjects' craving could predict next day's tobacco use, three negatively. Seven subjects' daily tobacco use showed significant autoregression, each in a positive direction. Three participants' tobacco use predicted next-day craving, again all positive. Among the four participants whose prior day's tobacco use predicted negative affect, three were negative.

Cluster Patterns

As indicated in Table 2, two distinct clusters among the 30 participants were identified, 5 in the first cluster and 25 in the second. The pooled model estimates across all participants in the same cluster are shown under each cluster. In order to compare idiographic and nomothetic interpretations of these data, we also combined results across all 30 participants. These combined results are shown in the bottom row of Table 2. Table 3 summarizes estimates for each cluster as well as the combined results.

The clusters contain both similarities and differences. First, among both clusters, negative affect demonstrated significant autoregression. However, this relationship was about two times stronger in cluster 1 than in cluster 2 (.23 vs. .11). Neither craving nor tobacco use significantly predicted next-day negative affect in either cluster. Thus, among both clusters, craving and tobacco use appeared to be more like next-day outcomes of negative affect than prior-day Granger causes of negative affect.

Second, craving exhibited significant autoregression in cluster 1 (.32) but not in cluster 2 (.05, *ns*), while tobacco use significantly predicted next-day decreases in substance use craving in cluster 2 (−.03) but not in cluster 1 (−.02, *ns*). Negative affect significantly predicted next-day substance use craving in cluster 1 (.16) but failed to do so in cluster 2 (−.02, *ns*). Thus, negative affect appeared to be a Granger cause of craving in cluster 1 but not in cluster 2.

Third, tobacco use demonstrated significant autoregression only in cluster 2 (.27) and craving predicted next-day tobacco use only in cluster 1 (.07). Negative affect significantly predicted next-day tobacco use in cluster 2 (−.10) but not in cluster 1, suggesting that negative affect was a Granger cause of tobacco use only in cluster 2. This pattern was opposite of that for the prediction of craving by negative affect.

The last column of Table 3 shows combined results. By themselves, the pooled results do not seem unreasonable, but when compared with the results from each cluster, they illustrate how misleading such average patterns can be. Only three of the nine relationships were consistent across the clusters and the pooled sample, and two of these were non-significant across the board: the prediction of negative affect by tobacco use and craving. The third was the autoregression of negative affect, which was significant in both clusters and in the pooled sample (.15). The pooled sample exhibited significant autoregressions of both tobacco use (.23) and craving (.09), but they were not significant in cluster 1 for tobacco and cluster 2 (the majority of the sample) for craving. For the pooled sample, neither prior-day negative affect nor prior-day craving significantly predicted next-day tobacco use, while the former relationship was significant in cluster 2 and the latter in cluster 1. Finally, prior-day negative affect could, but tobacco use could not, significantly predict next-day craving. However, negative affect positively predicted next-day craving only in cluster 1, and tobacco use negatively predicted next-day craving in cluster 2.

T-tests on the cluster means of three variables were conducted, revealing no significant differences between the clusters. For example, for negative affect, cluster 1 ($M = 1.77$, $SD = .60$) did not differ significantly from cluster 2 ($M = 1.62$, $SD = .38$), $t(28) = .73$, $p > .05$. We also found no significant differences in the intra-individual variance of each variable. In sum, despite different patterns of across-day associations, these two clusters did not differ in their mean levels or in across-day intra-individual variations.

Discussion

To explore the processes that link daily levels of substance use craving and negative affect to each other and to tobacco use among young adults in substance abuse recovery, this study modeled across-day associations in a sample of College Recovery Community (CRC) members. To do so without making conventional nomothetic assumptions about average participants, we used an idiographic approach, and were able to fit a first-order vector autoregression (VAR(1)) model, with all variables lagged one day only, to the 30 participants who comprised our final sample. Cluster analysis further grouped participants into two clusters according to their model estimates, which showed distinct across-day associations among the three variables.

Expectations that participants would differ in the patterns of relationships among the variables of interest and that they would fall into distinct clusters were supported by the results. Heterogeneity was first revealed by individual VAR(1) models, where substantial differences existed in the associations of variables in terms of both direction and magnitude. Heterogeneity was further highlighted by cluster analyses, which revealed two distinct clusters of VAR(1) models that exhibited substantial meaningful differences not only from each other but from the pooled overall sample as well. Together, these findings underscore the importance of applying idiographic approach to substance use treatment and recovery (Hoepfner et al., 2008; Molenaar, 2004; & Campbell, 2009; Gehricke et al., 2007).

Our first hypothesis, that negative affect would prove to be a positive Granger cause of craving, was supported among participants in cluster 1 but not cluster 2. In addition, negative affect showed significant positive autoregression in both clusters and in the pooled results, whereas cravings showed significant positive autoregression only in cluster 1 and the pooled results. This finding is interesting, because the literature is virtually unanimous in identifying negative affect as an important predictor of craving (Witkiewitz & Bowen, 2010). Our results demonstrate how the nomothetic methods employed by most previous research could create such misleading clarity. In fact, our pooled results, a proxy for nomothetic findings, found that negative affect could predict craving one day later for the “average” participant, in contrast with our results for cluster 2.

Our second set of hypotheses, that craving and negative affect were positive Granger causes of tobacco use, and that tobacco use, in the role of self-medication, would be a negative Granger cause of both craving and negative affect, were supported in cluster 1 for craving, and partly in cluster 2. In cluster 2, tobacco use was a negative Granger cause of cravings only, while negative affect was a negative Granger cause of tobacco use. Tobacco use showed significant autoregression only in cluster 2 and the pooled results.

Negative Affect and Craving

The finding that negative affect carries over to the next day highlights a potential barrier to abstinence, because, in general, negative affect is associated with increased substance use craving (Cleveland & Harris, 2010), as demonstrated in cluster 1. Similarly, cluster 1 revealed a carryover effect of craving. These positive across-day associations, for cravings especially, demonstrate that recovery risk can cascade across days. Perhaps it is this type of risk, connecting and even building across days, that most threatens recovery.

The findings reveal a potential target for intervention. Craving acted more like an outcome than a cause of negative affect. Therefore, among cluster 1 subjects, a high level of negative affect may persist to the next day (.23), and could potentially lead to more substance use craving the next day (.16), which may also persist in subsequent days (.32). This pattern of across-day transmissions suggests that individuals in cluster 1 may be more vulnerable to negative affect. In contrast, we didn't find this cascade pattern in cluster 2, among whom negative affect was also likely to persist to the next day (.11) but with no significant across-day associations either between negative affect and craving or within craving itself. Thus, negative affect might be a worthy target of recovery support programs, but only among persons exhibiting a pattern similar to cluster 1.

Tobacco Use, Craving, and Negative Affect

Many of the differences between the subgroups pertain to tobacco use and craving. Analyses revealed self-medication effect in cluster 2, where tobacco use predicted reduced craving the next day ($-.03$). A similar association in the same direction existed in cluster 1, but failed to reach significance. This finding, which did not occur within the pooled VAR(1) sample, suggests that tobacco use could act as a protective factor in helping sustain abstinence from substance use, at least among a subgroup of the population, and may validate some practitioners' reluctance to target tobacco use in substance abuse programs (Drobes, 2002). However, contrary to another manifestation of the self-medication hypothesis, tobacco use did not predict negative affect in any part of the sample. Also contrary to a self-medication hypothesis that proposes smoking as a response to negative affect (Gehricke et al., 2007), negative affect predicted less smoking the next day in cluster 2 ($-.10$). In cluster 1, increases in craving, but not negative affect, could predict increase in tobacco use in the next day ($.07$).

What do these differences mean? In cluster 1, tobacco use proved to be the outcome of craving, but could predict neither negative affect nor craving. Further, it showed no autoregression. These results imply two conclusions: first, that tobacco cessation programs might be effective within this cluster; and, second, that because tobacco use was disconnected from negative affect, and could not cause craving or itself, the decision to target tobacco use should be made independently from the decision to target substance use among persons fitting a cluster 1 pattern.

In contrast, within cluster 2, where lower levels of negative affect and higher levels of tobacco use predicted an increase of tobacco use the next day, participants did not use tobacco in response to negative affect, but may have used it to celebrate feeling good, or at least less bad, perhaps as a reward for good behavior. Further, among these participants, increased tobacco use led to decreased craving. Therefore, decreased tobacco use resulting from high levels of negative affect in the previous day—a hard abstinence day—may lead to decreased tobacco use but increased craving in the next day—possibly an even harder abstinence day. In this situation, tobacco use represents an indirect risk factor for relapse. For participants who fit the cluster 2 pattern, which was the largest group in our overall sample and may reflect a majority of young persons in recovery, substance abuse programs should target tobacco simultaneously with other addictive substances to achieve better outcomes. This recommendation is consistent with the increasing concern by researchers with the potential harmfulness, and mainly illusory benefits, of continued tobacco use among people in treatment and recovery (Prochaska, 2010; see also Chambers, 2009).

Implications

The intra-individual day-to-day variability of relevant psychological states that predict relapse, combined with the “one day of a time” nature of sustained abstinence, warrant a day-to-day investigation of substance use recovery. This approach enables researchers to examine recovery as a dynamic process at the daily level, and can provide useful information on the ways recovery risks accumulate over time, possibly leading to relapse. The substantial autocorrelations as well as cross-lagged predictions demonstrated by our

study in both individual and pooled models illustrate the utility of this approach. A conventional longitudinal study could not have produced these results.

Our study extended previous work using daily diary data from the same sample from within- to across-day analyses. In the previous study, Cleveland & Harris (2010) investigated the moderation of different coping strategies (e.g., problem solving) of the influence of negative affect and negative social interactions (e.g., hostility, insensitivity) on same-day cravings. In contrast, the current study focused on the influence of both tobacco use and negative affect on the next day's cravings.

The current study is also idiographic. Illustrating the utility of the idiographic approach and its potential for improving intervention outcomes is one of the current study's most important contributions. Given the common findings of minimal positive effects in substance use prevention and treatment programs, the ability to identify homogeneous subgroups that demonstrate distinct recovery processes, potentially leading to different relapse outcomes, can enhance the ability to implement tailored treatment, with its attention to both differences in patterns of relationships among risk factors and changes in ongoing dynamic processes during recovery (Collins et al., 2004). For example, the roles of negative affect and tobacco use as Granger causes or outcomes of craving differed across clusters of subjects in our study, a result which would have been masked in a purely nomothetic analysis. Given the ubiquitous substance use in college and the growing body of recovering college students who return to education from treatment, findings from this study have implications for practical and clinical work on intensive care and recovery support programs.

Limitations and Future Directions

This study is a first step toward applying an idiographic approach to investigate across-day process among young adults in recovery. Though its results are promising, several shortcomings must be mentioned. The first concerns the limitations of the data, with both limited observations for each participant and a limited number of participants, as well as the lack of actual longitudinal relapse measures. With an average of 26.7 individual observations, the power of any individual VAR(1) model reported in Table 2 is limited. Nevertheless, the power issue became less prominent after pooling estimates across individuals in the same cluster and re-estimated using all observations of all individuals in the same cluster. For example, the five individuals in cluster 1 provided a total of 131 observations with only 4 missing observations, the power of which is analogous to that of a cross-sectional study with 131 participants measured only once with 4 missing values. Thereafter, substantive conclusions made in this study are based on pooled cluster estimates as shown in Table 3.

Although the statistical power of a VAR(1) model depends on the number of observations for each participant rather than the sample size, the results of a cluster analysis partially depend on the number of participants. More clusters could be possibly have been detected in a larger and more heterogeneous sample, which would have captured more inter-individual differences in intra-individual processes. Future research with larger sample is warranted. In addition, one has to be cautious that few participants exhibited a mild linear trend in a

variable or variables of interest, which may inevitably, although slightly, have biased the corresponding individual autoregression estimates and/or, but less likely, the individual cross-lagged estimates. However, this bias should be negligible once pooled across individuals in the same cluster. In addition, during preliminary modeling fitting, 10 participants were excluded from the final sample because they could not fit to a satisfactory VAR(1) model, suggesting that the effects of the three variables of interest could last two days' lag or more, requiring higher order vector VAR models to capture their recovery processes. This falls beyond the scope of the current study and capability of the available data and requires further investigation.

Perhaps the most important, given the lack of data measuring lapse or relapse months or years later, the potential associations between different daily recovery patterns and different longitudinal recovery outcomes are better regarded as a reasonable speculation or educated guess rather than a conclusion. Future research should use the ideographic approach to understand abstinence maintenance and relapse; data should be collected from diverse contexts including supervised care, in-patient and out-patient, to determine if different across-day recovery patterns are related to the timing and severity of relapse. However, this study was able to demonstrate the feasibility of applying an idiographic approach to investigate across-day process among young adults in recovery. Future recovery research should combine diary and conventional longitudinal study designs, which could integrate an understanding of recovery as a micro level daily dynamic process with a macro level focusing on long-term recovery outcomes and changes.

A second major limitation concerns the measures of substance use craving and tobacco use; specifically, the absence of a measure of tobacco-specific craving, clearly not encompassed by our measure that asked subjects about "the feeling of drinking or drugging." However, this lack does not appear to undermine the validity of this study. In the first place, because all subjects actively used tobacco, mostly several times a day, and none were in treatment for tobacco cessation, "craving" for tobacco was less relevant than actual tobacco use to explore patterns that may involve self-medication. In addition, the fact that research has suggested a common neural mechanism for alcohol and nicotine craving (NIAAA, 2007) indicates that the two may not be as far apart as often believed, a worthy question for future studies.

As noted by an anonymous reviewer, the smoking pattern demonstrated in the sample differs from that shown by normal college students, with no obvious weekday-weekend pattern (Colder, Lloyd-Richardson, Flaherty, Hedeker, Segawa, & Flay, 2006). One possible explanation could be that students in our sample, who are currently in substance use recovery, may intentionally avoid weekend parties and other common social gatherings where both alcohol and tobacco are readily available and their use encouraged. It is also possible that our results were due to our measure of tobacco use, a 6-point Likert scale that might better be regarded as ordinal than continuous. This measure, however, demonstrated generally the same within-individual variation as substance use craving and negative affect. As suggested by the reviewer, future research could model tobacco use as a moderator in a situation where it demonstrates low within-individual variation.

A third limitation concerns the analyses. Our cluster analysis was descriptive rather than predictive: We had no *a priori* hypotheses regarding the nature of the clusters. More advanced methods of identifying latent homogenous groups, such as mixture modeling, could provide better prediction of different groups (Collins & Lanza, 2010). However, this would require more participants than clustering and thus awaits future research. Another concern lies with VAR(1) model. We considered only the sequential causal relationships among variables: across-day predictions. An alternative to VAR, unified SEM, posits that both sequential and contemporaneous directed relationships could be considered in an idiographic framework. This recently-developed approach has been used in neuroimaging studies (e.g., Kim, Zhu, Chang, Bentler, & Ernst, 2007), and rarely, if ever, applied to behavioral science data, although Jackson, Sher, and Wood (2000) used SEM in a nomothetic analysis to examine both contemporaneous and lagged correlations in a study of alcohol and tobacco use disorders. In the current study, the associations among variables within the same day could also be considered under this framework, as in most cross-sectional studies. However, because all behaviors were measured at the same time due to the study design (at the end of the day), it would be hard to interpret any contemporaneous directed relationships.

Conclusion

This study revealed substantial person-level heterogeneity in the day-to-day processes that challenge continued abstinence within a college recovery community (CRC), providing a picture of accumulated daily recovery risk that could threaten abstinence over both the short and long term. Methodologically, it highlights the value of idiographic approaches at a time when prevention researchers, though relying mainly on nomothetic methods, are increasingly calling for tailored and adaptive interventions (e.g., Collins et al., 2004). The application of vector autoregression enables examination of across-day associations by modeling time dependency, which commonly exists in time series analysis. Findings could potentially generalize to a larger population—members of CRCs—and have special meaning given the current prevalence of college drinking as well as the rapid growth in the number of CRCs.

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Figure 1.

Conceptual model of First Order Vector Autoregression. N = negative affect; C = craving; T = tobacco use. Regression residuals for day 2 variables omitted from figure.

Table 1
Individual Means (SD) and Linear Trends of Substance Use Craving, Negative Affect, and Tobacco Use

ID	No.	M (SD)			Linear Slope			ID	No.	M (SD)			Linear Slope		
		N	C	T	N	C	T			N	C	T	N	C	T
1	25	1.83(0.76)	1.14(0.26)	0.32(0.56)	-0.00	0.01	-0.01	16	25	1.34(0.39)	1.09(0.31)	4.46(0.51)	0.00	0.01	-0.02
2	24	1.29(0.26)	1.05(0.13)	3.71(1.20)	0.00	0.00	-0.02	17	25	1.30(0.36)	1.13(0.28)	4.04(0.96)	0.00	-0.01	-0.02
3	26	1.64(0.48)	1.10(0.20)	3.19(1.90)	0.02	-0.00	0.04	18	10	1.66(0.80)	2.37(1.47)	2.22(1.79)	0.01	0.12	-0.07
4	26	2.75(0.61)	1.92(1.08)	4.04(0.20)	-0.04*	-0.01	0.00	19	22	1.66(0.82)	1.81(1.21)	4.25(0.55)	0.05	-0.01	-0.00
5	30	1.32(0.19)	1.04(0.14)	4.50(0.81)	-0.00	-0.01	0.03	20	43	2.42(0.33)	2.87(0.75)	0.04(0.19)	-0.00	-0.00	-0.00
6	23	1.44(0.46)	1.08(0.37)	4.36(0.49)	0.01	0.01	-0.01	21	25	1.49(0.27)	1.45(0.22)	3.52(1.37)	0.02	0.01	0.05
7	26	1.63(0.49)	1.16(0.44)	3.58(1.74)	0.02	0.01	-0.02	22	26	1.49(0.26)	1.56(0.67)	2.15(0.54)	0.02*	0.03	0.05*
8	28	1.91(0.39)	1.47(0.84)	4.04(0.19)	0.01	-0.01	-0.01	23	31	1.22(0.34)	1.47(0.89)	3.24(1.77)	-0.01	-0.02	0.02
9	27	1.41(0.54)	2.54(1.12)	0.17(0.48)	-0.04*	-0.10*	0.04*	24	28	2.20(0.86)	2.67(1.64)	3.19(1.08)	0.06*	0.13*	-0.04
10	27	1.65(0.42)	2.35(0.79)	2.96(1.85)	0.03*	0.02	-0.09	25	33	2.73(0.93)	2.81(1.44)	4.13(0.87)	0.03	0.02	-0.01
11	22	1.25(0.40)	1.48(0.88)	2.43(0.51)	0.01	0.02	-0.03	26	28	1.29(0.34)	1.04(0.08)	3.12(1.03)	-0.01	-0.00	0.04
12	25	1.32(0.19)	1.32(0.32)	3.88(1.12)	-0.01*	-0.02	0.10*	27	24	1.26(0.28)	1.82(1.19)	4.21(0.78)	-0.01	0.06	-0.02
13	26	1.77(0.57)	1.37(0.92)	0.92(0.65)	-0.03	-0.01	0.03	28	33	1.60(0.59)	1.47(0.89)	4.59(0.50)	-0.02	-0.01	-0.01
14	24	1.98(0.37)	1.12(0.39)	3.74(1.29)	-0.03	0.01	0.00	29	28	1.34(0.22)	1.12(0.24)	4.22(0.42)	0.00	-0.01	0.04*
15	25	1.39(0.51)	1.32(0.58)	3.00(1.04)	-0.01	-0.01	-0.01	30	35	1.65(0.36)	2.08(0.88)	1.11(1.50)	-0.00	-0.01	0.03

Note. N = negative affect; C = craving; T = tobacco use; No. = number of observations of each participant. ID is randomly assigned to each individual.

* $p < .01$.

Table 2

Model Fit and Parameter Estimates of Individual First Order Vector Autoregression (VAR(1)) by Clusters

ID	VAR(1) Model fit indices				VAR(1) parameters										
	Residual variance			χ^2/df	Negative affect (DV)				Craving (DV)				Tobacco use (DV)		
	N	C	T		N	C	T	N	C	T	N	C	T		
Cluster 1															
1	0.49	0.02	0.23	1.25	0.36 ⁺	-0.28	0.08	0.17 [*]	0.58 [*]	-0.17 [*]	0.05	0.82 ⁺	-0.32 ⁺		
2	0.06	0.01	1.14	0.30	0.23	-0.57	-0.04	0.29 [*]	-0.07	0.01	1.10	-2.40	0.31 ⁺		
3	0.18	0.04	1.97	0.63	0.40 ⁺	-0.62 ⁺	0.03	-0.04	-0.13	0.03	0.66	-5.88 [*]	0.40 [*]		
4	0.26	0.98	0.03	0.41	0.38 [*]	0.05	-1.22 [*]	0.33	-0.07	1.83 ⁺	-0.03	0.08 [*]	0.04		
5	0.03	0.01	0.48	0.59	0.09	-0.17	0.03	0.20 ⁺	0.49 [*]	-0.03	1.62 [*]	-1.53 ⁺	-0.24		
	Pooled cluster 1			0.98	0.23 [*]	0.03	-0.02	0.16 [*]	0.32 [*]	-0.02 ⁺	0.00	0.07 [*]	0.04		
Cluster 2															
6	0.19	0.11	0.13	0.81	0.09	0.23	0.04	-0.12	-0.04	0.23 ⁺	-0.98 [*]	0.59 ⁺	0.05		
7	0.20	0.15	2.48	0.49	-0.40 ⁺	0.10	-0.11 ⁺	-0.53 [*]	0.10	-0.14 [*]	0.02	0.70	0.23		
8	0.15	0.63	0.03	0.68	0.06	0.05	-0.23	-0.54	0.29	-0.22	-0.05	0.10 [*]	0.03		
9	0.08	0.53	0.16	0.11	-0.07	0.19 ⁺	0.07	-0.18	0.79 [*]	0.13	0.02	-0.17 [*]	0.46 [*]		
10	0.11	0.45	1.74	0.81	0.41 [*]	0.00	-0.06	0.67 ⁺	0.03	-0.06	-1.36 ⁺	0.30	0.54 [*]		
11	0.14	0.68	0.19	0.34	-0.21	0.00	0.09	0.41	-0.27	-0.04	0.05	-0.33 [*]	0.33 ⁺		
12	0.03	0.06	0.97	0.96	0.02	-0.21 ⁺	-0.06 ⁺	0.63 ⁺	-0.35 ⁺	0.03	-0.04	0.59	0.42 ⁺		
13	0.25	0.65	0.37	0.30	0.34 ⁺	-0.07	-0.37 [*]	0.57 ⁺	-0.23	-0.47 ⁺	-0.21	-0.04	0.27		
14	0.12	0.14	1.44	0.84	0.31	-0.02	0.00	0.03	-0.07	-0.03	-0.84	0.73	0.09		
15	0.23	0.32	1.06	0.38	-0.11	0.29 ⁺	0.07	-0.06	-0.02	-0.08	-0.09	-0.20	0.01		
16	0.14	0.08	0.22	0.33	0.02	-0.01	0.25 ⁺	0.13	0.02	-0.15	-0.16	0.30	-0.10		
17	0.12	0.07	0.78	0.27	0.06	0.22	-0.04	0.22	-0.15	0.07	-0.09	-1.10 ⁺	-0.04		
18	0.86	2.37	3.32	0.02	-0.31	0.08	0.02	-0.20	0.03	0.28	-0.54	-0.40	-0.04		
19	0.47	1.18	0.24	0.53	0.48 [*]	0.07	0.00	0.61 ⁺	-0.24	-0.06	0.03	-0.03	-0.26		

ID	VAR(1) Model fit indices			VAR(1) parameters											
	Residual variance			χ^2/df			Negative affect (DV)			Craving (DV)			Tobacco use (DV)		
	N	C	T	N	C	T	N	C	T	N	C	T	N	C	T
20	0.07	0.27	0.02	0.88	0.36 [*]	-0.08	-0.42 ⁺	-0.44	-0.05	-0.62	-0.29 [*]	-0.09	-0.05	-0.09	-0.09
21	0.06	0.04	1.01	0.59	0.09	0.14	0.05	-0.04	0.17	-0.03	-0.04	0.00	-0.59	0.00	0.00
22	0.04	0.38	0.23	0.84	-0.03	0.11 ⁺	0.27 [*]	0.58	0.12	0.10	0.23	0.40 ⁺	0.08	0.40 ⁺	0.40 ⁺
23	0.12	0.63	1.42	1.02	0.05	0.02	0.02	0.32	-0.32 ⁺	-0.11	-0.91	0.75 [*]	0.36	0.75 [*]	0.75 [*]
24	0.63	1.16	0.89	0.43	0.25	0.15	0.06	0.22	0.58 [*]	-0.48 [*]	0.01	0.57 [*]	0.07	0.57 [*]	0.57 [*]
25	0.83	1.82	0.70	0.57	0.09	-0.11	-0.01	-0.22	-0.11	0.37	0.12	0.16	0.04	0.16	0.16
26	0.10	0.01	0.55	0.46	0.07	-0.59	-0.04	0.02	-0.19	-0.01	0.39	0.30 ⁺	0.42	0.30 ⁺	0.30 ⁺
27	0.07	1.28	0.47	0.32	-0.11	0.06	0.05	0.25	0.19	-0.39	0.75	0.16	0.12	0.16	0.16
28	0.29	0.74	0.22	0.76	0.34 ⁺	-0.24 ⁺	0.09	-0.01	-0.01	-0.31	0.06	0.25 ⁺	0.04	0.25 ⁺	0.25 ⁺
29	0.03	0.04	0.08	1.29	-0.17	0.34 ⁺	0.01	-0.25	0.00	-0.08	-0.39	0.66 [*]	0.00	0.66 [*]	0.66 [*]
30	0.08	0.52	1.28	1.22	-0.12	-0.07	-0.11 [*]	-0.74 ⁺	0.05	-0.08	-0.94 ⁺	0.47 [*]	0.43 ⁺	0.47 [*]	0.47 [*]
Pooled cluster 2				0.81	0.11 [*]	0.00	-0.01	-0.02	0.05	-0.03	-0.10 [*]	0.27 [*]	-0.03	0.27 [*]	0.27 [*]
Pooled overall				0.87	0.15 [*]	0.01	0.00	0.07 [*]	0.09 [*]	-0.01	-0.07 ⁺	0.23 [*]	0.01	0.23 [*]	0.23 [*]

Note. N = negative affect; C = craving; T = tobacco use; DV = dependant variable. The same ID indicates the same individual as in Table 1. P-value for the VAR(1) models ranges between 0.15 and 1. The CFI of each VAR(1) model ranges between 0.89 and 1. The NNFI of each VAR(1) model ranges between 0.83 and 1. The RMSEA of all VAR(1) models ranges between 0.10 and 0. P-value for the VAR(1) residual models ranges between 0.64 and 1. All the VAR(1) residual models have RMSEA of 0, NNFI of 1, and CFI of 1.

* $p < .0056$.

+ $p < .05$.

Table 3

Patterns of Association in Clusters and Pooled Sample

Time 1	Time 2	Cluster 1 (n = 5)				Cluster 2 (n = 25)				Pooled (n = 30)			
		B	SE	t	β	B	SE	t	β	B	SE	t	β
Negative Affect	Negative Affect	.23	.06	3.86*	.24	.11	.03	4.26*	.11	.15	.02	6.22*	.15
Negative Affect	Craving	.16	.03	6.33*	.14	-.02	.02	-.74	-.01	.07	.02	3.89*	.04
Negative Affect	Tobacco Use	.00	.04	.07	.00	-.10	.03	-3.21*	-.05	-.07	.02	-3.01	-.04
Craving	Negative Affect	.03	.06	.51	.03	.00	.01	.21	.01	.01	.01	.74	.02
Craving	Craving	.32	.05	6.04*	.29	.05	.03	1.83	.05	.09	.02	3.82*	.09
Craving	Tobacco Use	.07	.02	3.24*	.03	-.03	.02	-1.99	-.03	.01	.01	.68	.01
Tobacco Use	Negative Affect	-.02	.02	-1.14	-.05	-.01	.01	-.99	-.02	.00	.01	-.19	.00
Tobacco Use	Craving	-.02	.01	-2.16	-.04	-.03	.01	-3.47*	-.03	-.01	.01	-1.79	-.01
Tobacco Use	Tobacco Use	.04	.06	.71	.04	.27	.03	10.74*	.27	.23	.02	10.19*	.24

* $p < .0056$.