Applying Behavioral Theories of Choice to Substance Use in a Sample of Psychiatric Outpatients

Christopher J. Correia and Kate B. Carey
Syracuse University

The current study tests the utility of the contextual view of reinforcement in predicting substance use among a sample of 34 psychiatric outpatients enrolled at a public psychiatric facility. Participants reported substance use, as well as the frequency and enjoyability of a variety of potential reinforcers, for the previous 30 days. A series of regression analyses revealed that a ratio of reinforcement from substance use relative to total reinforcement was more predictive of substance use days than was reinforcement for substance use taken alone. The results demonstrate the importance of viewing behaviors within their broader environmental context and support predictions derived from the behavioral choice perspective.

According to behavioral theories of choice, a preference for a given reinforcer arises within the context of other available reinforcers (Vuchinich & Tucker, 1996). Herrnstein's (1970) matching law, a mathematical account of choice behavior, provides foundation for the behavioral choice perspective by empirically documenting the importance of context. The theory and accompanying equations specify that a person's behavior is distributed across concurrently available options in proportion to the amount of reinforcement received for engaging in each behavior. Within this framework, the amount of reinforcement received for a behavior relative to other options is viewed as more predictive of choice behavior than the absolute amount of reinforcement received (McDowell, 1988). McDowell's review of the literature suggests the matching law can adequately describe human choice behavior in both controlled and natural environments.

Vuchinich (1995) proposed that empirical research derived from behavioral theories, such as the matching law, could lead to important theoretical and clinical advances in the addictions fields, including the empirical investigation of complex person–environment interactions. The current study sought to demonstrate the utility of contextual variables in accounting for naturally occurring substance use among a sample of psychiatric outpatients. We conducted regression analyses to test the relative contributions of various measure of reinforcement in the prediction of substance use. We hypothesized that a proportional variable accounting for reinforcement derived from substance use relative to total reinforcement, when compared with reinforcement from substance use taken alone, would yield a stronger prediction of the frequency of substance use. Thus, the current study was designed to test hypotheses derived from the behavioral theories of choice.

Method

Participants

Participants were 34 psychiatric outpatients recruited from clinics associated with a public psychiatric facility. Participants in the current study were a subset of a larger sample (N = 80) of outpatients; 46 outpatients who reported no substance use during the previous 30 days were not included in the current analyses. The mean age of the sample was 38.41 years (SD = 6.91); 71% were men and 29% were women; 62% were White, 23% were African American, 6% were Native American, 3% were Hispanic, and 6%
were of other ethnic minority groups. Fifty-three percent of the sample had obtained the equivalent of a high school education or more (M = 12.26 years, SD = 2.97); most had not been in the workforce during the previous 12 months (65%), had a yearly income between $5,000 and $10,000 (69%), and had never been married (68%).

Diagnostic status was established from a chart review. Forty-five percent of the participants had a primary diagnosis of schizophrenia, 24% schizoaffective disorder, 18% a mood disorder, and 9% were in other diagnostic categories. Mean global assessment of functioning was 50 (SD = 7.48), indicative of serious symptoms or any serious impairment in social, occupational, or school functioning. The mean number of psychiatric hospitalizations was 11.88 (SD = 18.84), with the mean age of first treatment at 20.91 years (SD = 5.47). Fifty-three percent of this sample had received alcohol-related treatment at some time in their life, and 24% had received treatment for other psychoactive drugs.

**Measures**

The Pleasant Events Schedule. The Pleasant Events Schedule (PES; MacPhillamy & Lewinsohn, 1982) is a 320-item instrument designed to measure the frequency and subjective pleasure of potentially reinforcing events or activities over the previous 30-day period. Frequency and enjoyability scores range from 0 to 2 for each item, producing a cross product ranging from 0 to 4. A higher cross product score indicates that the activity was engaged in with a high amount of reinforcement potential, a useful approximation of obtained positive reinforcement. Averaging across items produces a summary index for each of the three scores. In previous studies, the PES has demonstrated adequate reliability and validity across a variety of samples (MacPhillamy & Lewinsohn, 1982).

Two modifications were made to the PES for the current study. First, in the interest of reducing participant burden, enjoyability ratings were obtained only for those events or activities in which participants actually engaged in during the previous 30 days. This modification eliminated the original enjoyability score but still allowed for the calculation of the frequency score and the cross product. Second, to sample potential reinforcement from substance use more broadly, a number of substance-related items were added (see Appendix). Some items refer to related events (e.g., “Drinking beer” and “Social drinking”), but items were worded to distinguish between social reinforcement and the reinforcing effects of intoxication. Similar patterns of repetition can be found on the original PES as well, as in the items “Driving long distances,” “Driving skillfully,” and “Driving fast.” A substance-related cross product (the average cross product across the substance-related items) was created for use in the current study; the substance-related cross product displayed adequate internal consistency (coefficient alphas = .76) in the current sample.

We devised a reinforcement ratio, based on Herrnstein’s (1970) matching law, to represent the proportion of reinforcement received from substance-related activities and experiences relative to total reinforcement received over the 30-day period. We calculated the reinforcement ratio for each participant by dividing the average substance-related cross product by the average total cross product score across all of the items. The ratio ranges from 0 to 4.83, with higher scores indicating that the average cross product from substance-related activities is higher relative to the average total cross products (scores greater than 1 indicate that substance-related activities are reported to be more reinforcing than the average activity). The modifications to the PES allow for distinctions between explicitly substance-related reinforcement and overall reinforcement and result in the following summary scores: total cross product, substance-related cross product, and the reinforcement ratio.

Timeline Followback. The format used for reporting substance use was the Timeline Followback Interview (TLFB; Sobell & Sobell, 1996) for the previous 30 days. The TLFB is a semistructured interview designed to obtain retrospective reports of alcohol use over the periods ranging from 1 to 12 months. Extensive evidence attests to the reliability and validity of the alcohol TLFB (Sobell & Sobell, 1996) as well as adaptations for assessing other types of drug use (Ehrman & Robbins, 1994). A 1-month TLFB demonstrated adequate temporal stability and validity in a sample of psychiatric outpatients (Carey, 1997). The frequency of substance use days was the primary variable of interest.

**Procedure**

Participants responded to announcements at psycho-social club community meetings and posters placed in outpatient clinics. After providing informed consent, participants completed assessments in individual sessions lasting approximately 1 hr. Participants received $5 for taking part in the study.

**Results**

A summary of the PES and TLFB data is presented in Table 1. Tests of mean differences revealed no significant gender differences; thus, results are presented for the entire sample.
Table 1

<table>
<thead>
<tr>
<th>Index</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total cross product</td>
<td>0.79</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2. Substance-related cross product</td>
<td>0.52</td>
<td>0.35</td>
<td>0.12</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3. Reinforcement ratio</td>
<td>0.84</td>
<td>0.86</td>
<td>—</td>
<td>0.64</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4. Substance use days</td>
<td>7.48</td>
<td>7.63</td>
<td>—</td>
<td>0.50</td>
<td>0.63</td>
<td>—</td>
</tr>
</tbody>
</table>

Note. N = 34.
*p < .05. **p < .01. ***p < .001.

Correlational data, also in Table 1, reveal that the reinforcement ratio related to the total cross product \((r = -.41)\) and to the substance-related cross product \((r = .55)\) in predicted directions. Substance use days were not related to the total cross product, indicating that the latter represents reinforcement from a variety of sources. In contrast, substance use days were moderately correlated with the substance-related cross product \((r = .50)\) and the reinforcement ratio \((r = .63)\).

Results of the regression analyses are presented in Table 2. We constructed and then compared three separate multiple regression models. In each case, the analysis was restricted to the 33 recent users (1 eligible participant was dropped due to a missing psychiatric diagnosis). Each model used the proportion of substance use days out of the previous 30 days, measured by the TLFB, as the criterion variable. Demographic variables associated with substance use (gender, age, and psychiatric diagnosis) were entered in all models. Model 1, using the substance-related cross product and the demographics as carriers, was able to predict 34% of the variance in substance use days, \(F(4, 28) = 3.62, p < .05\), with substance-related reinforcement emerging as the long significant predictor. In Model 2, the reinforcement ratio and the demographics accounted for 41% of the variance, \(F(4, 28) = 4.82, p < .01\), with the reinforcement ratio contributing significant variance. Model 3, using the demographics and both the substance-related cross product and the reinforcement ratio, accounted for 44% of the variance, \(F(5, 27) = 4.18, p < .01\). In Model 3, only the reinforcement ratio contributed significant variance, even after accounting for the

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>(\beta)</th>
<th>t</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.34*</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.11</td>
<td>0.09</td>
<td>-0.20</td>
<td>-1.26</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>0.01</td>
<td>0.07</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Psychiatric diagnosis</td>
<td>-0.00</td>
<td>0.00</td>
<td>-0.11</td>
<td>-0.72</td>
<td></td>
</tr>
<tr>
<td>Substance-related cross product</td>
<td>0.38</td>
<td>0.12</td>
<td>0.53</td>
<td>3.28**</td>
<td></td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.41**</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.06</td>
<td>0.09</td>
<td>-0.12</td>
<td>-0.75</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.00</td>
<td>0.01</td>
<td>-0.04</td>
<td>-0.26</td>
<td></td>
</tr>
<tr>
<td>Psychiatric diagnosis</td>
<td>-0.00</td>
<td>0.00</td>
<td>-0.07</td>
<td>-0.50</td>
<td></td>
</tr>
<tr>
<td>Reinforcement ratio</td>
<td>0.37</td>
<td>0.04</td>
<td>0.59</td>
<td>3.90**</td>
<td></td>
</tr>
<tr>
<td><strong>Model 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.44**</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.03</td>
<td>0.04</td>
<td>-0.12</td>
<td>-0.80</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Psychiatric diagnosis</td>
<td>-0.00</td>
<td>0.00</td>
<td>-0.10</td>
<td>-0.70</td>
<td></td>
</tr>
<tr>
<td>Substance-related cross product</td>
<td>0.21</td>
<td>0.08</td>
<td>0.24</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>Reinforcement ratio</td>
<td>0.13</td>
<td>0.04</td>
<td>0.43</td>
<td>2.14*</td>
<td></td>
</tr>
</tbody>
</table>

Note. \(N = 33\).
*p < .05. **p < .01.
amount of reinforcement received from substance use.

Discussion

The results of the regression clearly demonstrate that the reinforcement ratio, derived from behavioral theories of choice and designed to view behavior within the broader environmental context, is significantly related to substance use frequency. The regression model with the reinforcement ratio as the final carrier (Model 2) was more predictive of substance use days than the model using reinforcement received from substance use taken alone (Model 1). When both were used as carriers in the same regression equation (Model 3), only the reinforcement ratio contributed significant variance. The enhanced predictions enabled by the reinforcement ratio further emphasize the utility of expanding the study of substance use to include nonsubstance contextual variables. The findings are consistent with results from experimental research (Carroll, 1996) and other survey research (Correia, Simons, Carey, & Borsari, 1998).

Five limitations of this study deserve mention. First, our findings may apply only to individuals with psychiatric disorders. Second, our sample was relatively small, limiting our power to detect relationships. However, one could argue that the large amount of variance accounted for by the reinforcement ratio is notable, given a sample of 33. Third, our substance use variable, number of days on which substances were used, is relatively insensitive to the amount of alcohol or drugs ingested. Nonetheless, predictions derived from the behavioral choice perspective were supported even in the absence of a common metric of quantity of substances consumed. Fourth, although the reinforcement ratio displays some characteristics of ratio measurement, such as a meaningful zero, it is unclear if the scale produces equal intervals between values. These measurement issues do not undermine the correlation analyses presented in this article, but they may need to be resolved to determine the most appropriate empirical and statistical uses of the measure. Finally, note that the reinforcement ratio and the cross product scores were both partially based on frequency scores. Thus, it is not surprising that the reinforcement ratio and the substance-related cross product scores correlate with one another and that both correlate with the frequency of substance use. However, the use of frequency to operationalize reinforcement does not detract from the finding that the addition of a contextual variable enhances prediction of substance use. In future studies, reinforcement or substance use could be operationalized in a way that was not dependent on frequency. For example, using the reinforcement scores to account for the number of standard drinks consumed or the occurrence of substance-related problems might provide an additional test of predictions from behavioral theories of choice.

The behavioral choice perspective has informed a number of substance-related intervention studies. Two recent studies (Higgins et al., 1991; Iguchi, Belding, Moral, Lamb, & Husband, 1997) have demonstrated the effectiveness of contingency management programs in treating cocaine and opiate dependence on an outpatient basis. In both studies, clients were given vouchers for producing clean urine screens or completing portions of their treatment plans. The vouchers could then be exchanged for goods or services; in all cases, purchases were approved only if they facilitated treatment goals or increased participation in substance-free activities. The results of these studies suggest that increasing the reinforcement derived from substance-free sources may be an important component of successful treatment for substance abuse and dependence. However, a limitation of both studies is worth noting: Neither study specifically measured reinforcement received from substance-free sources. Thus, the mechanism thought to be the active treatment ingredient, namely, that increased reinforcement contingent on substance-free activities competes with and devalues reinforcement from substance use, was assumed but not directly measured or formally tested. Future treatment studies could use the reinforcement ratio, or another contextual measure of reinforcement, to determine if clients who reach treatment goals do in fact increase the amount of reinforcement they derive from substance-free sources. Hence, one direction for future research is to determine if the reinforcement ratio is sensitive to changes in behavior or changes in
environmental constraints on access to substances (Vuchinich & Tucker, 1996).

With regard to treatment utility, the reinforcement ratio, and more generally an assessment of reinforcement sources, may prove useful in developing individualized treatment plans. For instance, clients with a high reinforcement ratio may benefit from contextually informed treatments, such as the contingency management programs mentioned above. Therapists may help clients identify activities that are highly pleasurable but engaged in infrequently, and these activities could then be targeted as possible substitutes for substance use. Alternatively, psychiatric outpatients with substance-related problems and very few or no highly pleasurable substance-free activities could benefit from treatment programs that exposed them to novel sources of reinforcement, such as activity-oriented groups (i.e., ceramics or hiking). Thus, the reinforcement ratio may help therapists and case managers develop treatment plans that include the reduction of substance use as well as an increase in substance-free reinforcement. Finally, the reinforcement ratio could be used to empirically demonstrate the relationship between substance use and other sources of reinforcement, such as family relations or occupational success. To achieve this goal, clients could complete one reinforcement survey to document their actual activities and one to document the sources of reinforcement that would be available to them if they reduced or eliminated their substance use (see MacPhillamy & Lewinsohn, 1974, for a similar strategy applied to depression research). This type of information, if presented early in treatment, may help motivate clients who are reluctant to give up the reinforcement derived from substance use by making them more aware of underused substance-free sources.

References


Appendix

Substance-Related Items for the Modified Pleasant Events Schedule (PES)

<table>
<thead>
<tr>
<th>Drinking beer</th>
<th>Using hallucinogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social drinking*</td>
<td>Using cocaine</td>
</tr>
<tr>
<td>Using marijuana</td>
<td>Using drugs by myself</td>
</tr>
<tr>
<td>Getting drunk*</td>
<td>Using drugs in a social situation</td>
</tr>
<tr>
<td>Getting high with drugs</td>
<td>Using methamphetamines</td>
</tr>
<tr>
<td>Using inhalants</td>
<td>Using amphetamines</td>
</tr>
<tr>
<td>Using heroin</td>
<td>Drinking whiskey or liquor</td>
</tr>
<tr>
<td>Having a drink of alcohol by myself</td>
<td></td>
</tr>
</tbody>
</table>

Note. The original item “Taking powerful drugs” was expanded to include a variety of psychoactive substances.

*Items retained from the original PES.  
^Modified version of original item, “Smoking marijuana.”  
^Modified version of original item, “Having a drink by myself.”

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