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Negative Cocaine Effect Expectancies are Associated with Subjective Response to Cocaine Challenge In Recreational Cocaine Users

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Abstract

Although many studies have shown that cognitive effect expectancies are associated with drug use and drug treatment outcomes, few studies have compared effect expectancies with drug response following drug challenge. Healthy male and female volunteers (n=19, ages 21-35) who reported using cocaine 1-4 times per month completed the Cocaine Effect Expectancy Questionnaire (CEEQ; Schafer and Brown, 1991), were challenged with cocaine (0.9 mg/kg, i.n.), then completed a series of visual analog scales (VAS) and the Addiction Research Center Inventory (ARCI) at 15 min intervals for 3 hrs following cocaine administration. Significant positive correlations were found between global negative expectancies and peak responses on the VAS measures "Good," "Happy," "High," "Stimulated," and "Desire to Use Cocaine," and on the LSD subscale of the ARCI post-cocaine administration, and between global positive expectancies and the MBG subscale of the ARCI, and on VAS items "Anxious" and "Good" post-cocaine administration. Global positive expectancies also were positively correlated with peak systolic blood pressure, and global negative expectancies with peak heart rate after cocaine administration. These results suggest that negative and positive effect expectancies both play a complex role in the subjective experience of cocaine effects, and thus likely in the progression of nonuse to recreational use, in the transition to abuse, and in individualized treatment strategies.

Expectancy theory is a memory-based cognitive-learning theory that attempts to explain the acquisition of new behavior (Smith & Goldman, 1994). Used most often in the alcohol literature, this theory describes how early learning experiences relating alcohol consumption to anticipated outcomes are stored in memory and then influence the decision of whether to drink alcohol when faced with a drinking opportunity (Smith & Goldman, 1994).

Drug effect expectancies refer to individuals' specific beliefs about the effects that a particular drug will have on them. Expectancies are the result of an individual's learning history, through both direct and vicarious experiences with the drug in question, and are maintained through memory processes (Goldman, Brown, Christiansen, & Smith, 1991). The role of cognitive effect expectancies in the initiation and maintenance of alcohol

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consumption has been a major focus in studies of etiology and treatment of alcohol abuse (e.g., Brown, Goldman & Christiansen, 1985; Goldman, Brown, & Christiansen, 1987; Sher, 1991). Numerous studies have documented the relations between alcohol expectancies and drinking behavior ranging from occasional social drinking to alcoholism (e.g., Brown, 1985; Mann, Chassin, & Sher, 1987). The expectancy mediation hypothesis has been expanded to account for the use of other drugs of abuse such as marijuana (Schafer & Brown, 1991; Stacy, 1995) and cocaine (Jaffe & Kilbey, 1994; Jaffe, Kilbey, & Rosenbaum, 1989; Schafer & Brown, 1991; Schafer & Fals-Stewart, 1993; Stacy, Newcomb, & Bentler, 1995). Relative to alcohol, however, the corresponding literature on cocaine effect expectancies is relatively sparse. The hope is that the identification of cocaine effect expectancies will help clarify the relations between beliefs about cocaine and the development of cocaine abuse and dependence (Jaffe & Kilbey, 1994), and the role that expectancies may play in cocaine abuse treatment outcome.

In an attempt to clarify the relation between beliefs about cocaine's effects and the etiology and treatment of cocaine abuse and dependence some authors have argued that negative and positive expectancies be considered separately. The extant literature suggests that each may influence initiation and maintenance of cocaine use, as well as treatment outcome. For example, Schafer and Fals-Stewart (1993) suggested that the difference between positive and negative effect expectancies may be the crucial factor that determines whether drug effect expectancies are a risk factor in drug abuse. Although several studies in a variety of populations have found differential relations between positive and negative expectancies and reported use patterns, there is little agreement about the direction of the findings. For example, Schafer and Brown (1991) reported that non-use of cocaine was associated with greater negative expectancies, and the most frequent use of cocaine was associated with greater expectation of positive effects. These findings were interpreted as an indication that expectations of negative consequences of cocaine use may deter some individuals from ever experimenting with cocaine, but once cocaine use is initiated, expected positive consequences attain greater salience, which is thought to maintain cocaine-seeking behavior. If negative expectancies, in fact, prevent the transition from non-use to use, increasing negative expectancies in individuals who have not yet tried cocaine may be helpful in preventing the initiation of cocaine use. Conversely, Jaffe and Kilbey (1994) reported that non-users and experimental users held greater positive expectancies (i.e., grandiosity and euphoria) compared to abusers, and that abusers reported greater negative expectancies (i.e., anxiety) than experimental users and non-users. The authors theorized that negative expectancies likely were due to greater experience with cocaine, both in larger doses and over a longer period of time, and thus with the negative consequences associated with such cocaine use.

Studies of cocaine effect expectancies to date have focused on identifying and quantifying these expectancies, and on their ability to distinguish among participants who report using differing amounts of cocaine. Despite the importance of relating cognitive expectancies to actual drug-taking behavior, to the best of our knowledge, there are no published studies involving a direct examination of expected cocaine effect and actual response to cocaine challenge in the same participants. This study was conducted to assess whether cocaine

effect expectancies were associated with response to cocaine challenge in a group of occasional nondependent cocaine users.

Method

Participants

Participants were healthy male (n=14) and female (n=5) volunteers (ages 21-35 years) who reported using cocaine 1-4 times per month and provided informed consent to participate. The study protocol was reviewed and approved by the McLean Hospital Institutional Review Board. All participants underwent medical and psychiatric evaluation to ensure that inclusionary and exclusionary criteria were met. The Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996) was administered by licensed, doctoral-level clinicians. None of the participants met DSM-IV criteria for any Axis I disorder except for Cocaine Abuse. Participant demographics and drug use histories are presented in Table 1.

Effect Expectancy Measure

The Cocaine Effect Expectancy Questionnaire (CEEQ; Schafer & Brown, 1991) was used to assess cognitive expectancies of cocaine effects. The CEEQ is a 71-item questionnaire that is scored according to 5 area domains: Global Positive Effects (Scale 1), Global Negative Effects (Scale 2), General Arousal (Scale 3), Anxiety (Scale 4), and Relaxation/Tension Reduction (Scale 5). Scale reliabilities (coefficient alpha) are reported to range from .45-.86. The CEEQ was chosen for this study because the CEEQ contains two subscales that yield broad positive effect expectancies (Scale 1: Global, Positive Effects) and broad negative effect expectancies (Scale 2: Global, Negative Effects). Representative scale items are presented in Table 2.

Cocaine Preparation and Administration

Cocaine hydrochloride U.S.P. (Mallinkrodt, St. Louis, MO) was administered at a dose of 0.9 mg/kg, intranasally. A small amount of lactose powder was added to each dose to bring the total weight of powder delivered to 1.0 mg/kg. Cocaine was self-administered intranasally using a modified snort-stick device (Lukas, Mendelson, Amass, & Benedikt, 1990). Subjects snorted one-half of the dose in one nostril and the second half in the other nostril, with dosing complete within 30-60 seconds.

Subjective Measures

The Addiction Research Center Inventory (ARCI; Martin, Sloan, Sapira, & Jasinski, 1971) is a 49-item questionnaire with scales that assess specific drug responses. The scales are: LSD (dysphoria), PCAG (sedation), Amphetamine, BG (stimulant), and MBG (euphoria).

A series of 8 computerized visual analog scales (VAS) were administered using a 100 mm line with the words "none" or "extremely" at either end that represented responses to the following questions: "How good do you feel right now?", "How happy do you feel right now?", "How high do you feel right now?", "How stimulated do you feel right now?", "How anxious do you feel right now?", "How bad do you feel right now?", "How strong is

your desire to use cocaine right now?” and “How strong is your desire to not use cocaine right now?”

The VAS and the ARCI questionnaires were presented on seven occasions during the study: 15 minutes before the cocaine challenge, and at 15-, 30-, 60-, 90-, 120-, and 180-min post-cocaine administration.

Physiologic Variables

As a safety measure, during the conduct of all cocaine challenge experiments two standard electrodes were placed on the subjects' wrists and ribcage (Lead II montage) to provide a continuous record of electrocardiographic (EKG) activity during the entire study. Blood pressure was measured (Hewlett Packard Model 78352A) at baseline and every 30-min post-administration. Skin temperature was monitored continuously over the session and sampled at 1-min intervals. Subjects were not permitted to leave the laboratory until their heart rate and blood pressure returned to baseline levels. All participants were transported to and from the laboratory via taxicab.

Design and Procedure

Participants completed the CEEQ on a screening visit during which they also underwent psychiatric and physical examination. Those who were accepted for participation returned to the laboratory three-to-five days later and received cocaine (0.9 mg/kg). Immediately upon arrival at the laboratory, participants were screened for drug use with a urine screen kit (Triage®, Biosite Diagnostics, San Diego, CA). Any subject who tested positive for phencyclidine, benzodiazepines, cocaine, amphetamines, Δ^9 -tetrahydrocannabinol (Δ^9 THC), opiates or barbiturates was excused from the session, rescheduled, and sent home via taxicab. In addition, participants' breath was tested for the presence of ethanol using an AlcoSensor (Intoximeter Inc, St. Louis, MO). Participants who tested positive for ethanol on their breath similarly were rescheduled. On the screening and study days, female participants were administered a urine pregnancy test, and any female who tested positive was excluded from the study. Participants were required to abstain from over-the-counter drugs, caffeine, nicotine, milk, and egg products from midnight of the night before the study. On the morning of the study, participants were given a light, standardized breakfast.

For the duration of the 3.5-hour challenge study, participants sat in a recliner in a sound-and light-attenuated chamber. The chamber was equipped with a wired intercom and a closed-circuit video camera to provide auditory and visual contact. Verbal instructions during the experiment were given to the participants via intercom. Participants were instructed to relax and keep their eyes closed, but to remain awake. Participants also were fitted with a blood pressure cuff, electrodes, and skin temperature thermistor. Cocaine was administered using the snort-stick device after a 30-minute baseline. Participants used a keypad to respond to computerized questionnaires (VAS and ARCI), which were administered a total of seven times (1 pre- and 6 post-administration) over the course of the 3.5-hour study. Participants were required to remain in the laboratory until all overt signs of intoxication and physiological responses had dissipated.

Data Analysis

Two-tailed, bivariate correlation (Pearson Product-Moment) analyses were used to investigate the degree of intercorrelation among all variables of interest. To control for multiple correlations, only peak subjective and physiological effects were included in analyses. Correlations were considered significant at the $p < .05$ level.

Results

Intercorrelations Among CEEQ Scale Scores

Scale 1 (Global positive expectancies) was positively correlated ($r = .46$, $p = .047$) with Scale 3 (General Arousal). There were no other significant correlations.

Intercorrelations Among CEEQ Scores and Peak Subjective Response to Cocaine

Scores on CEEQ Scale 1 (Global Positive Effects) were positively correlated with peak scores on the MBG ($r = .47$, $p = .044$) subscale of the ARCI, and with peak scores on VAS items "Anxious" ($r = .47$, $p = .042$) and "Good" ($r = .46$, $p = .046$). CEEQ Scale 2 (Global Negative Effects) scores were positively correlated with VAS items "High" ($r = .54$, $p = .016$), "Stimulated" ($r = .69$, $p = .001$), "Desire to Use Cocaine" ($r = .74$, $p < .001$), "Happy" ($r = .70$, $p = .001$), and "Good" ($r = .71$, $p = .001$), and with peak scores on the ARCI subscale LSD ($r = .48$, $p = .040$). Scale 2 scores also were negatively correlated with the VAS item "Desire Not to Use Cocaine" ($r = -.47$, $p = .045$). Representative scatterplots are shown in Figure 1. Significant positive correlations were observed between CEEQ Scale 4 (Anxiety) and peak scores on ARCI subscales LSD ($r = .55$, $p = .015$) and Amphetamine ($r = .48$, $p = .036$). A significant negative correlation was observed between CEEQ Scale 5 (Relaxation and Tension Reduction) scores and peak scores on ARCI subscale MBG ($r = -.50$, $p = .030$). Finally, there were no significant correlations among CEEQ Scale 3 (General Arousal) scores and any of the subjective measures.

Intercorrelations Among CEEQ Scores and Peak Physiologic Response to Cocaine

Significant positive correlations were found between CEEQ Scale 1 (Global Positive Effects) and peak systolic blood pressure ($r = .55$, $p = .014$), between CEEQ Scale 2 (Global Negative Effects) and peak heart rate ($r = .50$, $p = .029$), and between CEEQ Scale 5 (Relaxation and Tension Reduction) and peak heart rate ($r = .49$, $p = .032$). There were no significant correlations between CEEQ Scale 3 (General Arousal) or CEEQ Scale 4 (Anxiety) and any physiologic variables.

Intercorrelations Between Physiologic and Subjective Drug Effects

Significant positive correlations were found between peak heart rate and the MBG ($r = .61$, $p = .006$) and Amphetamine ($r = .54$, $p = .018$) subscales of the ARCI, and VAS items "Good" ($r = .56$, $p = .014$), "Happy" ($r = .54$, $p = .018$), and "Desire to Use Cocaine" ($r = .48$, $p = .038$). Heart rate also was negatively correlated with "Desire not to Use Cocaine" ($r = -.48$, $p = .038$). Finally, peak diastolic blood pressure was negatively correlated with "Desire not to Use Cocaine" ($r = -.48$, $p = .039$).

Intercorrelations Among Cocaine Use and CEEQ Scores

Lifetime use of cocaine (defined as number of episodes of cocaine use) was positively correlated ($r=.67$, $p=.009$) with CEEQ Scale 4 (Anxiety). There were no other significant correlations.

Discussion

The present study was conducted to determine whether cocaine effect expectancies are related to subjective responses to actual cocaine challenge. Results indicate that while belief domains tapped by four of the five CEEQ scales are associated with subjective response to cocaine administration, negative cognitive effect expectancies appear to be more strongly associated with subjective experience of cocaine's effects.

Findings from the present study indicate a strong relation between cocaine negative effect expectancies and subjective response to cocaine administration. Expectancies of global negative effects were positively associated with many more positive subjective effects of cocaine, including increased self-reported feelings of "Good," "Happy," "High," and "Stimulated" following cocaine insufflation. Similarly, expectancies of global negative effects, but not global positive effects, also were significantly associated with a self-reported desire to use cocaine. The only negative subjective effect correlated with global negative expectancies was the LSD scale of the ARCI, which is thought to be a measure of dysphoria. Conversely, global positive expectancies were associated with both negative and positive effects of cocaine: the MBG scale of the ARCI, which purports to measure euphoria following drug administration, and self-reported feeling "Good." In addition, those who reported greater positive expectancies from cocaine also reported feeling "Anxious" following cocaine administration. Thus, for the young recreational cocaine users in this study, negative cocaine effect expectancies were associated primarily with positive subjective cocaine response.

The finding that negative and not positive effect expectancies were associated with positive subjective cocaine response seems counterintuitive. Common sense would posit that individuals would have expectations that mirrored their actual response. It may be that, in this sample, recreational cocaine users who did not expect to have a positive experience with cocaine found the actual experience to be less negative than expected, and thus reported the experience as more positive. Perhaps it is this subpopulation that is most at risk for escalating from use to abuse, as the effects of cocaine are experienced as less aversive than anticipated and thus use continues. It also might be expected that cognitive expectancies would shift over time as a function of experience with cocaine.

Similarly, it might be expected that individuals with positive expectancies would be more likely to seek out this positive effect and in fact robust relations between cocaine effect expectancies and actual use patterns have been reported. For example, Schafer and Brown (1991) found in their study of college-age, recreational cocaine users that positive expectancies were more strongly associated with levels of self-reported drug use than negative effect expectancies. The authors proposed that the initiation of drug use might be deterred by the expectancy of negative consequences, but that positive expectancies take

over a stronger role in maintaining cocaine use once experimentation with cocaine has begun and individuals have experienced the dysphoria-like effects of cocaine. Similarly, Jaffe and Kilbey (1994) reported that greater positive cocaine expectancies were held by their group of experimental cocaine users (defined as those who had used cocaine fewer than 10 times) compared to the non-users (who had never used cocaine) and the abusers (who met DSM-III-R criteria for cocaine abuse) in their sample. Finally, in their study of college students, Schafer and Fals-Stewart (1993) found that both nonusers and experienced users (who had a mean of 16 exposures to cocaine) reported both positive and negative expectancies, but the experienced users reported fewer negative expectancies. In the current study, however, the only significant correlation between cocaine effect expectancies and cocaine use patterns was found between lifetime number of episodes of use and CEEQ Scale 4 (Anxiety). Higher scores on the Anxiety scale were associated with a greater number of episodes of lifetime use. Similar findings have been reported by Jaffe and Kilbey (1994), who found that expectancies of increased anxiety were more often reported by cocaine abusers compared to nonusers, and by Schafer and Brown (1991) who demonstrated that expectancies of anxiety increased in linear fashion with degree of drug experience in their sample of college students with varying cocaine use histories. The lack of association between expectancies and self-reported use patterns in the current study is disconcerting because much of the interest in cognitive effect expectancies lies in their ability to predict future drug use, and several studies have supported their predictive utility (e.g., Jaffe & Kilbey, 1994). However, it is important to note that in the current study the range of cocaine use was restricted, as all participants reported using cocaine only 1-4 times per month. Certainly from a clinical perspective, the understanding of beliefs held about cocaine has important implications not only for understanding the etiology of cocaine abuse and dependence, but also for the treatment of these conditions. As expectancies are potentially modifiable, an individual's drug effect expectancy may have significant influence on his/her substance abuse treatment (Jaffe & Kilbey, 1994). Thus, the assessment of effect expectancies prior to treatment onset may aid in the tailoring of specific treatment approaches that result in a more successful treatment outcome. Particularly in light of the current study, focusing on positive outcomes of cocaine use to the exclusion of negative ones may not be useful for those individuals who expect both positive and negative outcomes, but report positive effects from cocaine use. It may be that for those who hold negative effect expectancies, cocaine use is more reinforcing because the positive effects are unexpected and thus more salient for them. Notable limitations of this study include the small sample size and the correlational nature of the design. Future studies need to be conducted in which participants are classified according to their cocaine expectancies (i.e., high positive, low negative, vs low positive, high negative, etc.) and their responses to cocaine administration compared. Such a design would yield useful information about the relative contribution of positive vs negative expectancies to drug response, and therefore help elucidate the relation between effect expectancies and the development of problematic drug use patterns. It also would be helpful to investigate the stability of cocaine effect expectancies over time and as a function of cocaine intoxication. Such a study would demonstrate whether expectancies of proximal and distal effects parallel differences in actual proximal and distal cocaine response.

To the best of our knowledge, this is the first study to investigate the relation between cognitive cocaine effect expectancies and actual response to cocaine administration. Results indicate that while global positive expectancies were significantly correlated with two indices of positive subjective response as well as with increased anxiety, global negative expectancies were significantly correlated with subjective cocaine effects that are generally interpreted as positive effects. Additionally, for this group of young recreational cocaine users, only self-reported anxiety was correlated with lifetime use of cocaine. These data lend support to the theory that negative and positive effect expectancies each may be associated with risk of developing cocaine abuse/dependence, but that much of the relative risk of these expectancies depends on the current cocaine use of the population under study. Certainly these findings indicate that cognitive effect expectancies play a complex role in the subjective experience of cocaine effects, and thus likely in the progression of nonuse to recreational use, in the transition to abuse, and in individualized treatment strategies.

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Figure 1. Scatterplots of correlations between CEEQ Scales 1 (Global Positive Expectancies) and 2 (Global Negative Expectancies) and peak scores on MBG scale of the ARCI and VAS items “High” “Good” and “Desire to Use Cocaine.”

Table 1
Subject Demographics (n = 19)

Variable	Mean (SD)
Age (years)	25.2 (3.7)
Years Education	14.4 (1.4)
Age at First Cocaine Use (years)	18.9 (1.9)
Years of Cocaine Use	6.5 (4.0)
Lifetime Cocaine Use (# episodes)	29.3 (7.0)
Cocaine Use Past Year (# episodes)	10.0 (6.9)
Cocaine Use Past Month (# episodes)	2.3 (2.1)
Age at First Marijuana Use	15.2 (1.5)
Years of Marijuana Use	10.0 (4.0)
Lifetime Marijuana Use (# episodes)	38.2 (5.0)
Marijuana Use Past Year (# episodes)	22.7 (15.2)
Marijuana Use Past Month (# episodes)	7.3 (10.8)

Table 2
Sample Scale Items for the Cocaine Effect Expectancy Questionnaire

Factor 1: Global Positive Effects

When I am on cocaine I feel as though everything is right in the world.
I am euphoric (strong sense of well-being) when I am on cocaine.
Cocaine makes me feel like I can do anything.

Factor 2: Global Negative Effects

Cocaine makes my judgment worse.
I can get paranoid when I am on cocaine.
After the cocaine "high" is over, I become depressed or "burned out."

Factor 3: Generalized Arousal

Cocaine makes me "hyper" (overactive, overtalkative, etc.).
I become awake and alert when I am on cocaine.
I am more talkative when I am on cocaine.

Factor 4: Anxiety

I grind my teeth when I'm on cocaine.
I'm anxious or tense when I'm on cocaine.
I become numb on cocaine.

Factor 5: Relaxation and Tension Reduction

I do not become impatient and agitated when I'm on cocaine.
I am not easily frustrated when I'm on cocaine.
Cocaine makes me feel dreamy and mellow.