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SUBJECTIVE DIMENSIONS OF HEROIN URGES: INFLUENCE OF HEROIN-RELATED AND AFFECTIVELY NEGATIVE STIMULI[1]

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Abstract — Thirty-five male drug-free heroin addicts rated their affect, craving, and withdrawal in response to boring, anxiety-eliciting, and heroin stimuli. Results revealed that: (a) heroin cues were more effective than boring or anxiety-eliciting cues in prompting self-reports of craving or withdrawal; (b) heroin cues produced an affective state characterized by self-reported low-pleasure and high anxiety/tension; (c) craving was not correlated with any particular affective state, but rather was associated with a variety of negative affects — anxiety, depression, fatigue, anger; (d) the coherence (intercorrelations) of affective, craving, and withdrawal measures was greatest when addicts made their self-ratings immediately after exposure to drug stimuli; and (e) while addicts routinely reported craving without withdrawal sickness, they virtually never reported withdrawal sickness without reporting craving. These results suggested that the potential for negative reinforcement subserved stimulus elicited craving and that craving involved cognitive appraisal processes (attributions, expectations).

Among abstinent drug users, the experience of negative affect increases vulnerability to relapse (cf. Baker, Morse, & Sherman, 1987). In the laboratory, procedures eliciting negative affect increase self-reported drug craving/urges and drug self-administration (cf. Baker et al., 1987; Sherman, Jorenby, & Baker, 1988). Not only do these findings suggest there is sufficient empirical evidence to encourage further work on the relationship between negative affect and drug motivation, but theory also suggests that affective responding is linked to the level and type of activity in motivational systems (Buck, 1985). This suggests that characterizing the affect associated with drug appetitive behavior may provide important clues about the nature and diversity of drug motivation (e.g., Sherman, Morse, & Baker, 1986).

To this end the present study focused on the relationship between drug motivation and the negative affect elicited by two different stressors — one primarily eliciting anxiety/anger and the other boredom. Also, we compared the effects of these two laboratory stressors with the effects of explicit drug-related stimuli; drug-related stimuli have been shown to elicit increased drug motivation and negative affect in a variety of experimental situations (e.g., Childress, McClellan, & O'Brien, 1984; Childress, McClellan, Natale, & O'Brien, 1987; Sideroff & Jarvik, 1980; Teasdale, 1973; cf. Baker et al., 1987; Sherman et al., 1988), thereby providing a meaningful context to contrast the effects of our laboratory stressors. Moreover, because all three situations evoked negative affect, but only one did so in the context of drug-related stimuli, there was the opportunity to determine whether drug cues influenced the *relationship* between negative affect and drug motivation. Finally, we

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gathered information on self-reported withdrawal to evaluate claims that drug craving reflects approximate subclinical withdrawal responses (e.g., Siegel, 1983; Wikler, 1973).

Self-report of craving was used as the sole index of drug motivation. While this means that drug motivation was incompletely assessed, considerable research shows that craving self-report can reliably index motivation to use drug. Self-reported craving predicts subsequent operant responding for drug (Ludwig, Cain, Wikler, Taylor, & Bendfeldt, 1977, Ludwig, Wikler, & Stark, 1974), the choice of drug over alternative rewards (Kaplan, Meyer, & Stroebel, 1983), drug consumption (Rankin, Hodgson, & Stockwell, 1983), and relapse (Brandon, Tiffany, & Baker, 1986; McAuliffe et al., 1986).

METHODS

Subjects

Subjects were 35 male, drug-free heroin addicts recruited from two residential treatment facilities. One facility was the Residential Treatment Community (RTC) of Brentwood Veterans Administration Hospital (Brentwood, CA), a program for male substance abusers that had served in the armed services ($n = 19$). The other facility, CriHelp (CH) (North Hollywood, CA) was a privately run center for both men and women ($n = 16$). The RTC group consisted exclusively of veterans, the majority black, whereas the CH group had only one veteran and one black. In the RTC group, the program director notified patients that, with the consent of their counselor, they could volunteer for a study in which they could earn $5.00/hour. At CH, the program director assigned patients to the study and money for subject time was paid to CriHelp. These two groups did not statistically differ in age. (χs: RTC = 33.7, CH = 33.3 year), education (for both groups combined, 37% were high school graduates, 40% had some college but did not graduate), marital status (married, RTC = 16%, CH = 7%, separated/divorced, RTC = 47%, CH = 47%), years of heroin use (χs: RTC = 12.2, CH = 14.9 year), and number of jail convictions with sentences over 90 days (χs: RTC = 3.6, CH = 3.6). Last use of heroin was more than one month ago for all but one subject; no subject displayed evidence of acute abstinence symptoms.

Facilities, apparatus, and stimulus conditions

RTC subjects were tested at the Brentwood Hospital Psychopharmacology Unit and CH subjects were tested within their residential treatment facility. Because most subjects were tested in groups of 2–4 individuals, efforts were made to ensure privacy by providing either wooden partitions between subjects or spaced seating.

The nominal stimulus conditions were defined as heroin-related (H), anxiety-provoking (A), or boring (B); each consisted of an 8 min video tape followed by a 1 min exposure to a related object or set of objects. The H stimulus was a black and white videotape without sound, depicting addicts preparing, injecting and reacting to the effects of heroin. Immediately after the tape, subjects viewed a display of actual drug paraphernalia consisting of used syringes, a "cooking" spoon, a tourniquet, and small balloons resembling "street-packaged" heroin.

The A stimulus consisted of the Russian roulette segment presented early in the film, *The Deer Hunter* (with the kind permission of Universal City Studios, an MCA, Inc. Company, Universal City, CA); this was followed by the presentation of a revolver similar to that used in the movie. Both the audio and color visual components were presented for A. The B stimuli were a color videotape of a game show in which contestants were observed talking, although no sound was presented; a closed telephone book was presented after the videotape. Stressors eliciting negative affect characterized by Anxiety/Anger (A) and Boredom (B) were selected because these specific mood states have been frequently reported to be associated with drug relapses.

Dependent measures

Dimensional measures of mood. We used a modified version of the 47-item Mehrabian measure of emotional states. The original instrument (Mehrabian, 1978) was designed to measure three dimensions of emotional response assumed to account for the range of affective reactions occurring in everyday situations (Mehrabian & Russell, 1974, p. 27). These dimensions are pleasure, arousal, and dominance.

The modified scale differed from the original (Mehrabian, 1978) in that two additional synonyms or definitions were provided for each word on the 9-point semantic differential. These synonyms and/or definitions were included because pilot work indicated that many of the original words, developed and tested on college students, generally were not understood by the addict sample we studied. A. Mehrabian (personal communication, May 31, 1984) administered both the original and our modified scale to a group of 194 college students and found correlations for pleasure, arousal, and dominance of 0.92, 0.73, and 0.91, respectively.

Typological measures of mood. A shortened, 18-item version of the Profile of Moods (POMS) scale (McNair, Lorr, & Droppleman, 1971) was also used to assess the effects of stimulus conditions. Three items were selected to represent each of the six measured subscales, tension, vigor, anger, depression, confusion, and fatigue. The three items were those which correlated most highly with the factors defining the subscales. This 3-item format has yielded useful results in assessing mood during anxiety-provoking and monotonous tasks (Rose, Ananda, & Jarvik, 1984). An additional measure of anxiety is described below.

Craving, withdrawal sickness, and composite anxiety measures. Craving was measured in two ways at two different times. The first measure of craving was taken continuously during stimulus presentations by asking subjects to turn a "craving" dial (crave continuously). Five points surrounded the subject's dial with markings titled from left to right "not at all," "a little," "moderately," "quite a bit," and "extremely." The dial turned a potentiometer that provided a continuous record on a polygraph positioned out of sight of the subject. The polygraph tracing was calibrated to provide a measure ranging from 0–10. The second measure of craving was taken after each stimulus presentation (craving poststimulus) and was assessed on a 9-point semantic differential with "no heroin craving" at one point and "intense heroin craving" at the other.

Measurement of withdrawal sickness was obtained by asking subjects to report, on a 9-point scale, their degree of withdrawal sickness ("intense withdrawal sickness" to "no withdrawal sickness"; O'Brien, Testa, O'Brien, & Greenstein, 1976). Subjects in the present study were carefully briefed on what was being asked with the withdrawal sickness and heroin craving questions. Withdrawal sickness was defined in terms of the classic physical symptoms that are associated with acute abstinence, for example, "flu-like" feelings such as chills, runny nose, cramps, goose-flesh, and rhinorrhea. Because we wished to insure that subjects did not label negative affect, per se, as withdrawal, anxiety was not identified as a withdrawal symptom.

Craving was defined as the urge or desire to use heroin. All subjects reported familiarity with these feelings. We instructed subjects that a response indicating intense heroin craving implied the desire to use heroin "right now." We use the word "craving" in this paper rather than "urge" because craving was the word presented to subjects. We do not differentiate the two terms theoretically (Kozlowski & Wilkinson, 1987).

A three-item anxiety scale was presented along with the above two items and was presented in the same 9-point format as the craving and withdrawal measures. The endpoints for these three items were: anxious-nonanxious, not nervous-nervous, tense-at ease. Although the order of all 5 items (craving, withdrawal, and three anxiety items) was always the

same, the side on which a particular end point appeared varied both within and between subjects.

Procedures

Introductory and practice session. Each subject participated in two sessions. At the first session, subjects (in groups of 1–4) were informed about the general nature of the experiment and that it involved viewing videotapes of heroin use by addicts. After obtaining written consent, questionnaires regarding demographic information and drug history were administered with the trait scales. All subjects were then given practice with rating scales.

Experimental session. In the second session, subjects were instructed to communicate only with the experimenters and to avoid contact with one another. Prior to stimulus presentation, subjects were given the battery of scales in the following order: Mehrabian Mood Scale, craving (crave poststimulus), withdrawal and anxiety measures, and the POMS. Immediately prior to the first stimulus presentation, subjects were asked to turn the dial through its complete range and then set it at their present level of craving during a one-minute period. These data served as the baselines. Subjects set the craving dial at baseline craving levels at the beginning of each stimulus presentation.

Immediately thereafter, the first stimuli were presented and subjects were instructed to initiate the test battery one minute after the tape-relevant object was presented. The stimulus object remained visible while they responded to the test battery. The order of the battery was the same as during baseline assessment. Following the completion of the battery by all subjects (15–20 min), the stimulus object was removed and the next stimulus condition was presented. The sequence of stimulus presentations was varied; they were B-H-A, H-B-A, and A-H-B. These sequences were used because they permit the evaluation of the H stimuli after each of the other two stimuli conditions and when it was first in order. There were too few subjects to assess the impact of all possible stimulus orders. Subjects from each heroin treatment center were counterbalanced across stimulus sequences.

Statistical analyses. First, the effects of experimental treatments on all 13 dependent measures were submitted to an omnibus multivariate analysis of variance (MANOVA). Treatment effects were analyzed with a three-factor MANOVA ($2 \times 3 \times 4$); between-group factors were patient treatment (CH and RTC) and stimulus sequence (B-H-A, H-B-A, and A-H-B); the within-group factor was stimulus condition (Baseline and H, B, and A). Second, independent ANOVAs assessed the contribution of each dependent variable to factors found statistically significant in the MANOVA. In the ANOVAs, partitioning of treatment variance followed the same ($2 \times 3 \times 4$) design specified for the MANOVA. Consistent with guidelines recently suggested for repeated measures designs by Vasey and Thayer (1987), correction and sphericity violations associated with overall tests were conducted. The Greenhouse-Geisser procedure adjusted degrees of freedom based on epsilon estimates of sphericity. The latter computations, as well as the multivariate and univariate ANOVAs, were conducted with BMDP4V (BMDP Statistical Software, 1981). Third, comparisons among stimulus conditions were conducted only following a statistically significant main effect of stimulus conditions. Thus, familywise error due to pairwise comparisons were protected by the omnibus ANOVA (protected least significant difference, or Fisher test; Keppel, 1982). Pairwise comparisons were conditionalized in that only stimulus effects significantly different from baseline were compared, further reducing familywise error rates (Keppel, 1982). Consistent with our concerns for violating the sphericity assumption, estimates of error variance for these pairwise comparisons were derived from the error associated only with the means compared.

Relationship of craving and withdrawal to each other and mood were assessed with the

Table 1. Overall means & standard deviations (SD) for stimulus conditions

	Baseline	Game show (B)	Heroin (H)	Deer Hunter (A)	
Mehrabian scales					
Pleasure mean	26.34	13.97*	10.66*	3.37*	H, B > A[a]
(SD)	(32.32)	(25.75)	(26.45)	(29.88)	
Arousal	2.06	1.83	5.00	6.14*	
	(7.10)	(7.09)	(8.77)	(7.17)	
Dominance[b]	−6.34	−9.06*	−9.37	0.51*	
	(11.42)	(9.54)	(11.57)	(14.50)	
POMS					
Tension	3.40	3.60	4.63*	4.80*	
	(3.38)	(2.97)	(3.85)	(3.82)	
Vigor	4.86	3.26*	3.40*	4.54	
	(3.26)	(3.00)	(2.61)	(3.62)	
Anger[b]	2.11	2.26	2.97	4.46*	
	(3.09)	(2.50)	(3.21)	(4.02)	
Depression	3.17	3.23	3.80	3.37	
	(3.02)	(2.68)	(3.48)	(2.90)	
Confusion	3.37	2.77	3.46	3.31	
	(2.77)	(2.28)	(3.00)	(3.10)	
Fatigue	3.11	3.63	3.69	3.54	
	(2.69)	(2.57)	(3.31)	(3.15)	
Composite anxiety scale					
Anxiety/	12.74	13.54	16.66*	15.77*	
Tension/Nervousness	(6.25)	(6.68)	(6.66)	(7.60)	
Craving and withdrawal sickness					
Craving	0.86	.94	3.46*	1.67	
(Continuous)	(1.54)	(1.46)	(2.66)	(2.33)	
Craving[b]	2.46	3.14*	5.28*	3.11*	H > B,A[a]
(Post-stimulus)	(2.09)	(2.07)	(2.71)	(2.47)	
Withdrawal	1.66	2.03*	2.94*	2.11*	H > B,A[a]
	(1.35)	(1.69)	(2.42)	(1.86)	

[a]Indicates where the reactions to the Game show, Heroin, and Deer Hunter conditions differed from one another; conditions to the left of > are significantly greater than values to the right.
[b]Stimulus condition interacted with stimulus sequence.
* = $p < .05$ from baseline.

Pearson correlation coefficient and chi-square tests. In all tests of statistical significance alpha was $p < .05$.

RESULTS

The primary objectives of the present study were to: (a) compare the effects of heroin-related stimuli with control stimuli eliciting negative affect on self-report measures of heroin craving, withdrawal sickness, and mood; (b) determine possible effects of stimulus sequence on degree of self-reported craving and withdrawal sickness; and (c) assess the inter-relationships of the dependent measures.

Effects of experimental manipulation

Omnibus MANOVA. The only significant effects revealed by the omnibus MANOVA were due to stimulus conditions [F (39, 222.84) = 4.71, $p < .0001$], which interacted significantly with *sequence* of stimulus condition [F (78, 419.63) = 1.33, $p < .05$]. Table 1 presents the mean score and standard deviation for baseline and stimulus condition for each

dependent measure. The following analyses examine the effects of stimulus conditions on dependent measures. In three cases (Dominance, Anger, and Poststimulus Craving) stimulus condition interacted with sequence. In these cases the nature of the interaction is described.

Dimensional measures of mood

Pleasure. A significant effect of stimulus condition was found [F (1.74, 50.58) = 12.34, $p < .0001$]. Comparisons of each stimulus condition with baseline revealed that each stimulus significantly decreased pleasure [Fs (1, 29) > 9.15, ps < .006]. Subsequent comparisons among stimulus conditions revealed that the A condition produced less pleasure than the H and B conditions, [Fs (1, 29) > 9.58, $p < .005$] and the H and B conditions did not significantly differ from one another.

Arousal. Stimulus conditions differed [F (2.17, 62.94) = 5.96, $p < .004$]; relative to baseline only the A condition significantly increased arousal, [F (1, 29) > 12.92, $p < .002$].

Dominance. This measure was significantly influenced by stimulus condition, [F(2.40, 69.49) = 13.30, $p < .0001$] and significantly interacted with sequence, [F (4.79, 69.49) = 3.61, $p < .007$]. Averaged across all sequences, only the B condition elicited a statistically significant decrease in dominance, [F (1, 29) = 5.44, $p < .03$], whereas the A condition elicited a significant increase in dominance, [F(1, 29) = 10.88, $p < .003$]. (Although the H condition elicited a mean decrease in dominance comparable to that of the B condition, this change was only marginally significant due to the larger variance associated with changes from baseline, $p = .067$.) Analysis of the stimulus condition x sequence interaction revealed a significant simple main effect of stimulus condition for the B-H-A sequence only, [F (2.4, 69.49) = 14.57, $p < .0001$] and for this sequence, only the A condition elicited significant increases in dominance above baseline, [F (1, 29) = 19.73, $p < .0003$].

According to Russell and Mehrabian's (1977) three-factor theory of emotion, feeling states associated only with decreased pleasure are generally characterized as negative, although not clearly differentiated. When coupled with increased arousal, they are characterized by increased tension, nervousness and anxiety. Thus, the A condition may be characterized as producing anxiety-related affect. Note, however, that the A condition also increased dominance; according to three-factor theory, decreased pleasure, increased arousal and dominance characterizes increased anger. A dimensional analysis of the B condition shows that relative to baseline, it decreased pleasure and dominance,and had no effect on arousal. According to Russell and Mehrabian (1977) a number of feeling states might be indexed by this configuration, including feeling anguished, regretful and impotent. The H condition reliably produced only a decrease in pleasure, although it tended to increase arousal and decrease dominance.

Typological measures of mood

Tension. A significant effect of stimulus condition was obtained [F (2.47, 71.5) = 4.53, $p < .01$]. Relative to baseline, only the A and H conditions significantly increased tension [Fs (1, 29) > 5.10, ps < .03] and they did not differ from one another.

Vigor. Stimulus conditions differed, [F (2.17, 62.9) = 6.24, $p < .003$], as both the B and H conditions significantly decreased vigor relative to baseline [Fs (1, 29) > 11.3, ps < .003]; the A condition was without effect.

Anger. The effect of stimulus condition was significant [F (2.36, 68.53) = 8.45, $p <$ .0003] and significantly interacted with stimulus sequence [F (4.73, 68.53) = 2.8, $p < .03$]. Averaged across all sequences, only the A condition significantly elevated anger [F (1, 29) = 13.94, $p < .002$]. Analysis of the sequence x stimulus condition interaction revealed a simple main effect of stimulus condition only for sequence B-H-A [F (2.36, 68.53) = 9.39,

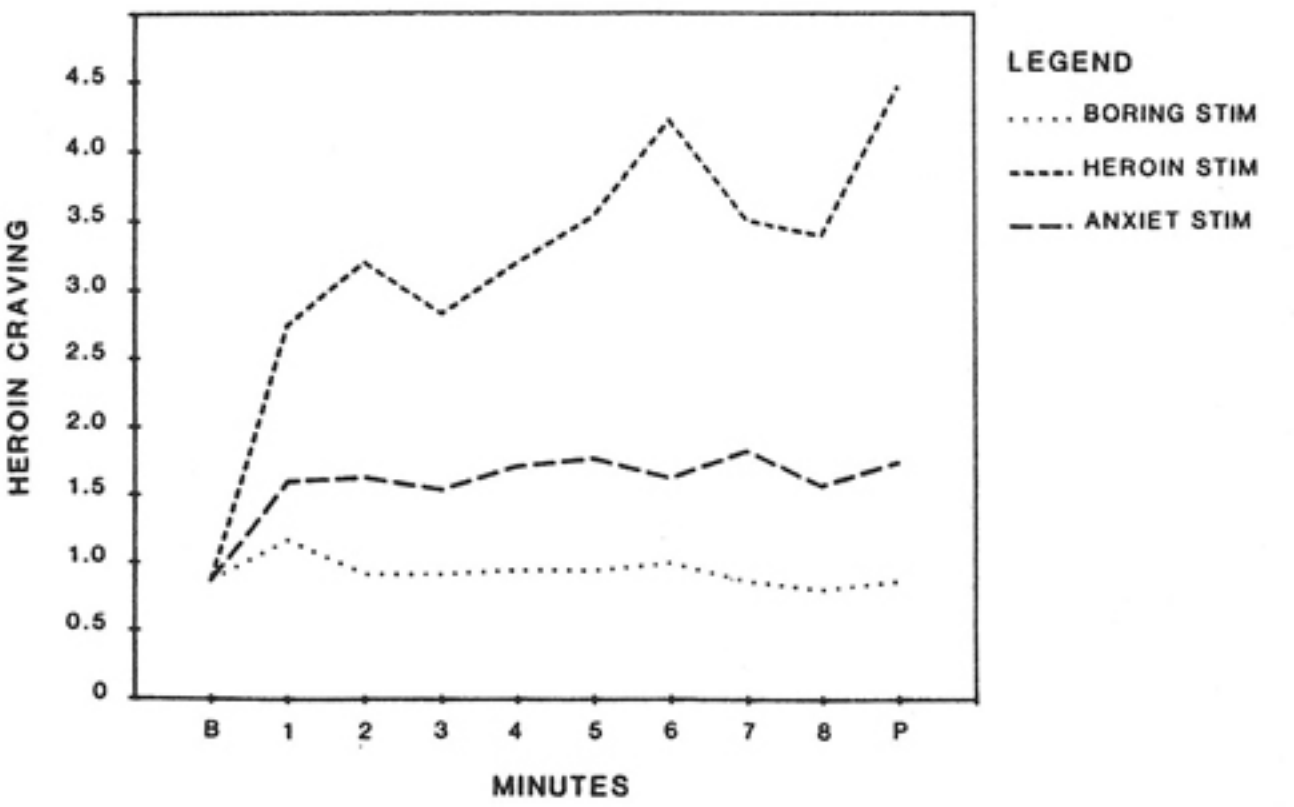

Fig. 1. Dial measure of craving.

$p < .0002$] where only the A condition significantly elevated anger [F (1, 29) = 16.28, $p < .001$].

Depression, confusion, fatigue. None of the remaining subscales of the POMS, depression, confusion or fatigue, revealed a significant effect of stimulus condition (all Fs < 1).

Composite anxiety measure. A significant effect of stimulus condition was obtained [F (2.65, 76.85) = 5.30, $p < .004$]. Relative to baseline, only the H and A conditions significantly increased Anxiety [Fs (1, 29) > 6.02, ps < .02] and they did not differ from one another.

The typological measures of mood showed that relative to baseline, the A and H conditions both elevated tension and anxiety, the B and H conditions decreased vigor, and the A condition increased anger, especially for the B-H-A sequence. These findings generally are consistent with the dimensional measures of mood. They differ in that the typological measures provide a clearer characterization of the H condition in that it was reliably associated with increased anxiety and decreased vigor. However, these changes were suggested by the dimensional measures: Nonsignificantly increased arousal and decreased dominance accompanied decreased pleasure. As with the dimensional analyses it is clear that the H condition produced components of affect induced by both the B and A conditions. This is unlikely to be due to the presence of the B and A conditions, per se, because the H-B-A sequence produced the same pattern of results as the other sequences (with respect to the effects of the H condition), and in this case the H condition occurred prior to the presentation of the other conditions.

It is clear that the B and A conditions evoked affective changes consistent with our characterization of them as boring and anxiety-inducing, respectively. However, it must be recognized that the A condition produced anger in addition to anxiety. The weight of evidence suggests that the affective reaction to the H condition can best be described as anxiety/tension.

Craving and withdrawal ratings

Craving (continuous assessment). Figure 1 presents the maximum dial measure of craving for the one-minute baseline period and for each of the nine minutes of the three stimulus

Table 2. Correlation of self-reported craving (poststimulus) with other dependent measures

	Baseline	Game show (B)	Heroin (H)	Deer Hunter (A)
Pleasure	−.32	−.31	−.37*	−.33*
Arousal	−.04	.40*	.39*	.23
Dominance	.06	.02	−.42*	−.10
POMS Anger	.38*	.24	.34*	.20
Tension	.30	.34*	.59**	.29
Vigor	−.24	−.13	.02	−.14
Depression	.28	.37	.47**	.26
Confusion	.21	.35*	.29	.01
Fatigue	.48**	.15	.15	.04
Composite Anxiety Scale	.39*	.61**	.65**	.56**
Craving (Continuous)				
Average	.43**	.46**	.64**	.13
Last minute	.43**	.38*	.70**	.02
Withdrawal	.52**	.62**	.52**	.73**

*$p < .05$; $N = 35$.
**$p < .01$; $N = 35$.

conditions. An ANOVA comparing baseline and the average maximum craving across all nine minutes of each stimulus condition proved statistically significant [F (2.42, 70.29) = 17.71, $p < .0001$]. Relative to baseline, only the H condition significantly increased craving [F (1, 29) = 38.92, $p < .0001$]. Of interest, the A condition tended to enhance craving, but this effect only yielded marginal statistical significance ($p < .07$). The means of baseline and each stimulus condition are presented in Table 1 under Craving (Continuous). Separate analyses of baseline and the last minute of each stimulus condition yielded the same pattern of statistical significance.

Craving (poststimulus assessment). The assessment of Craving at baseline and the end of each stimulus condition revealed a significant effect of stimulus condition [F (2.53, 73.33) = 22.72, $p < .0001$] and this effect significantly interacted with sequence [F (5.06, 73.33) = 2.73, $p < .03$]. Averaged across all sequences, all three stimulus conditions significantly increased craving above baseline [Fs (1, 29) > 5.23, $p < .03$]. The H condition yielded significantly greater Craving than either the B and A conditions [Fs (1, 29) > 38.21, $p < .0001$]; the latter did not differ from one another.

Analysis of the stimulus condition *x* sequence interaction revealed significant simple main effects for each sequence [Fs (2.53, 73.33) > 5.27, ps < .004]. Relative to baseline, the H condition significantly increased craving for all three sequences [Fs (1, 29) > 9.42, ps < .005]. The B and A stimuli only yielded significant increases above baseline for sequence H-B-A [Fs (1, 29) > 6.49, ps < .02]; for this sequence none of the stimulus conditions significantly differed from one another.

Withdrawal. A significant effect of stimulus condition was obtained [F (1.89, 54.72) = 9.73, $p < .0004$]. Relative to baseline, each stimulus condition significantly elevated self-reported withdrawal sickness [Fs (1, 29) > 4.74, ps < .04]. The H condition yielded significantly greater withdrawal sickness than either of the B or A conditions [Fs (1, 29) > 7.83, ps < .009], which did not differ significantly from one another.

The two measures of craving yielded generally consistent findings. For both measures the H condition significantly elevated craving above baseline. The measures were discrepant in that: (a) only the poststimulus measure showed that the other two stimulus conditions also reliably increased craving, although significantly less than the H condition; and (b) an

interaction of stimulus condition with sequence was obtained only with the poststimulus measure. However, it is important to note the agreement of the two assays — that is, only the H condition consistently evoked increased craving. Only with respect to a single craving measure, using a single stimulus sequence, did the B and A stimuli increase craving over baseline.

In general, sequence effects do not compromise interpretations. In the case of Dominance ratings the same stimulus condition, A, produced the greatest ratings across sequences, and the H stimuli consistently elicited decreased *Dominance* ratings. In the case of Anger ratings, the A sequence produced ratings that were the highest, or equal to the highest, across sequences. The H stimuli produced the greatest craving ratings across all sequences. One aspect of the sequence data may be of interest, however. If subjects were shown the H stimuli first (H-B-A sequence), they tended to rate their craving higher in response to the other stimuli. It may be that seeing the H stimuli first "primed" subjects to code later negative affect reactions as craving, or that it actually altered later craving information processing.

Lastly, self-reported withdrawal was shown to be increased by all three stimulus conditions. As with the craving measures, however, the greatest withdrawal was evidenced in the H condition.

Relationship among craving, withdrawal and mood

Table 2 presents the correlations of the poststimulus craving ratings with each of the mood measures under each stimulus condition. Although the correlations between the poststimulus craving and the continuous craving measures (both the average and last minute of continuous measurement period) were variable, these correlations were significant in all conditions but the A condition. Perhaps the most striking characteristic of the correlational data is that intercorrelations of measures with craving are greater in the H condition than in the other conditions. It is doubtful that this is merely an artifact of measurement procedures; standard deviations of the principal measures were not significantly different, and floor and ceiling effects were not evident. Thus, while the H stimuli may not have been more effective than other stimuli in creating overall changes in affect (see Table 1), the affective changes they did produce were more tightly coupled with self-reported craving levels.

Craving and mood. Across all stimulus conditions, craving was associated with low pleasure and high anxiety. Some differences among stimulus conditions do emerge, however. When significant elevations in craving are obtained (i.e., in the H condition), both depression and anxiety are related to craving self-report. In the baseline condition fatigue and anger are related to craving. These results show that craving cannot be linked to any particular self-rated affect. Depending on environmental conditions, craving reports may be associated with depression, fatigue, anxiety, or anger.

Craving and withdrawal sickness. As Table 2 shows, Craving and self-reported withdrawal sickness were found to be positively correlated under all stimulus conditions, including baseline. This finding does not allow us to assess whether, or to what extent, increases in stimulus-specific craving are related to increases in withdrawal sickness. Consequently, we further examined the relationship between increased craving and withdrawal sickness under the H stimulus condition — the stimulus condition found to elicit the greatest increases in ratings of craving and withdrawal sickness. Table 3 shows the frequency of addicts reporting, *relative to baseline,* an increase or *no* increase in withdrawal sickness and craving (poststimulus) to the H condition. A chi-square test of independence showed that these two variables were statistically related [$\chi^2(1) = 4.61, p < .01$].

Of the 27 addicts showing increased craving, 15 (55.5%) showed an increase in withdrawal symptoms above baseline, whereas 12 (44.5%) reported no increase in withdrawal sickness. Clearly, increased craving occurs in nearly equal proportions whether

Table 3. Relative to baseline, number *(N)* and percentage of addicts showing an increase or no increase in craving (poststimulus) and withdrawal during the heroin stimulus condition

	Withdrawal		
Craving	Increase	No increase	(Marginal totals)
Increase	15 94%[a]	12 63%[a]	(27) 77%[b]
No Increase	1 6%[a]	7 37%[a]	(8) 23%[b]
	(16)	(19)	(35)

[a]The percentage of each of the two withdrawal groups ("Increase" vs. "No increase") in each of the two craving categories.
[b]Percentage of total *N*.

or not it is accompanied by increased ratings of withdrawal sickness. Also, the magnitude of increased craving did not significantly differ between subjects rating increased withdrawal (group +with) and those that did not (group NoWith); mean increases in craving from baseline for groups + with ($n = 15$) and NoWith ($n = 12$) were 4.2 and 3.75, respectively, $t\,(25) = .60$. It would seem that addicts' self-report of increased withdrawal sickness does not necessarily mean greater craving. Chi-square tests revealed that these two subgroups did not differ with respect to stimulus sequence or treatment facility. Thus, the subgroups of addicts constituting +With and NoWith are not the consequences of experimental treatment.

Table 3 also shows that if withdrawal sickness were reported, the proportion of addicts reporting increased craving was .94 (15/16). Thus, those addicts who, in fact, did report increased withdrawal sickness were almost certain to report an increase in craving. In contrast, if addicts did not report increased withdrawal sickness, the proportion of addicts reporting increased craving was .63 (12/19); the difference in proportion between .94 and .63 was statistically significant ($z = 2.14$, $p < .01$).

In general, the picture of craving yielded by the analysis of mood and withdrawal measures is that craving is a heterogeneous phenomenon. The mood analysis revealed that craving is most frequently associated with self-reported anxiety, but it may under some conditions be associated with fatigue, depression, or anger. Additionally, craving may or may not be accompanied by withdrawal—although perceptible withdrawal is invariably accompanied by craving.

GENERAL DISCUSSION

This research determined that: (a) Drug cues presented to abstinent heroin addicts were more effective than boring or anxiety-eliciting cues in prompting self-reports of drug craving and withdrawal; (b) drug cues produced an affective state characterized by self-reported low pleasure,and high anxiety/tension; (c) craving was not correlated with any particular affective state, but rather was associated with a variety of negative affects—anxiety, depression, fatigue, and anger; (d) the coherence (intercorrelations) of affective, craving, and withdrawal measures was greatest when subjects made such ratings immediately after exposure to drug stimuli; and (e) while addicts routinely reported craving without simultaneously reporting withdrawal sickness, addicts virtually never reported withdrawal sickness without reporting craving.

These findings may not only have descriptive value but may also suggest mechanisms operative in the experience of craving. The heroin stimuli alone reliably elicited craving reports. At least two hypotheses could be advanced to account for this. One hypothesis is that

drug cues uniquely elicit the particular affective responses that manifest themselves, phenomenologically, as craving. Thus, drug cues elicit a unique pattern of conditioned drug responses, conditioned affective responses, and so on, that addicts label as craving. This is akin to the argument that different perceived emotions are produced by unique patterns of autonomic/physiologic arousal (James, 1890; Lange, 1967). A second hypothesis is that while craving may be influenced by affective state (e.g., low pleasure, high arousal/anxiety, and low control/dominance) crucial determinants of craving are the addicts' attributions and expectations; namely, "I feel bad because I don't have drug" or "I feel bad and drug will help." Just as anger/aggression demands an attribution of blame (Weiner, 1986), cravings demand an attribution about drug. This approach, of course, resembles an attributional model of emotion (Schachter & Singer, 1962).

We favor the attribution interpretation of our data for several reasons. First, the heroin stimuli did not produce affective reactions that were strikingly different from those elicited by other stimuli (Table 1). For example, the gameshow produced comparable displeasure and comparably decreased dominance and vigor ratings. The *Deer Hunter* film produced *higher* displeasure, tension, and arousal ratings, and comparable anxiety ratings. It is true that no other stimulus produced the exact pattern of affective responses as was produced by the heroin stimuli, but in many respects the affective responses were quite similar.

What seems unique about the affective responses elicited by the heroin stimuli is not the type and level of affective responding elicited, but rather the extent to which elicited affective responses were *labeled* as craving. Not only were addicts more likely to report craving in response to the heroin stimuli, but they did so as a direct function of the affective responses to those stimuli: tension, anxiety, depression, and so on. Thus, nondrug and drug stimuli elicited similar magnitudes of affective change, but only following drug stimuli were affective changes associated with craving; that is, there was greater mood/craving self-report coherence. For the most part, these self-reported affective responses were *unrelated* to reported craving levels following nondrug stimuli (Table 2).

An account of craving that emphasizes attributions and expectancies is supported (but not uniquely) by the significant elevation in craving ratings elicited in the gameshow and *Deer Hunter* conditions in the H-B-A sequence. If negative affect were initially elicited by drug stimuli, then this permitted later attribution of continued negative affect to the original pharmacologic stimulation; hence, affective responses were labeled as craving throughout the H-B-A sequence. However, original elicitation of negative affect by a non-drug-related stimulus interfered with generalization of the drug attributional process, and resulted in craving self-reports being discriminated on drug-related stimuli per se.

As noted earlier, if addicts reported withdrawal, they almost universally also reported craving. This might be due to the fact that craving responses and withdrawal responses have different thresholds for elicitation, and that the greater threshold of withdrawal means that withdrawal will rarely be elicited without craving. Another explanation is that craving really reflects withdrawal responses, hence their co-occurrence (e.g., Ludwig & Wikler, 1974). Both of these accounts are at odds with aspects of our data, however. If craving has a lower threshold of elicitation than withdrawal responses, one should expect craving levels in the presence of withdrawal to be higher than craving in the absence of withdrawal; such differences were not obtained. Moreover, it seems unlikely that craving reflects withdrawal responses per se as Ludwig and Wikler (1974) have suggested, because the probability of reporting withdrawal was independent of addicts' reporting increased craving (Table 3). One explanation of the high probability of craving, given withdrawal, versus the relatively low probability of withdrawal, given craving, is that craving is multidetermined: Only in some instances is it associated with withdrawal (e.g., Baker et al., 1987). Self-described withdrawal sickness, however, is an aversive affective state intrinsic to which is an

attribution and expectation about drug. For example, "This state is caused by drug absence, and would be alleviated by drug presence." Hence, phenomenological withdrawal is comprised by the concept of craving.

One purpose of this research was to examine the relationship between the affective state(s) labeled as urges or craving and the nature of eliciting stimuli. Affective states labeled as urges typically were characterized as unpleasant, associated with feelings of loss of control, and associated with the moods of anxiety and depression (see Table 2). However, the heterogeneity of the mood correlates of craving is striking. Under some conditions, either fatigue, anxiety, depression or anger were all associated with craving (Table 2). Some traditional models of drug motivation suggest that drug motivational states depend upon the activation of unique psychopharmacological responses such as withdrawal responses or conditioned compensatory responses (Lindesmith, 1968; Siegel, 1983; Wikler, 1973). If drug motivation, though, were dependent upon unique or particular responses (e.g., withdrawal responses) such responses should manifest themselves in a particular affective response pattern that would be associated with craving. This was not the case.

Drug motivation processes are clearly related to affective state (Table 2; Baker et al., 1987), but not to any *particular* affective state. Drug craving may even be associated with positive affect (Baker et al., 1987). This suggests that drug craving may best be conceptualized as a *process* not a *state*. The process may be activated by affective states, but additional information must be processed before affect is experienced as an urge; the affect may be attributed to drug absence (withdrawal), the addict must expect drug to provide masking of, amelioration of, or distraction from the affect (i.e., negative reinforcement), and so on. Therefore, our interpretation of the present results is consistent with models of drug motivation that emphasize cognitive appraisal processes (e.g., Marlatt & Gordon, 1985).

A number of caveats must be observed regarding our interpretation of our data. First, the data are all based on self-reports. This is problematic for a variety of reasons: the major one being that self-report is an incomplete index of the urge construct. Another caveat is that we implicate attributions and expectations in our interpretation of our findings, yet we made no independent assessment of attributional processes. These inadequacies must be addressed in future research.

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