

Short communication

Implicit cocaine associations in active cocaine users and controls

Reinout W. Wiers^{a,b,c,*}, Katrijn Houben^a, Johnny de Kraker^{a,d}

^a Faculty of Psychology, Department of Experimental Psychology, Maastricht University, Maastricht, The Netherlands

^b Behavioral Science Institute, Radboud Universiteit Nijmegen, Nijmegen, The Netherlands

^c IVO, Addiction Research Institute, Rotterdam, The Netherlands

^d Centrum Maliebaan, Addiction Treatment Centre, in Utrecht, The Netherlands

Abstract

Implicit and explicit cocaine-related cognitions were assessed in a sample of 16 cocaine-dependent polysubstance abusers and 16 age, gender, and SES-matched controls. Implicit associations were assessed with four unipolar versions of the Implicit Association Test (IAT), assessing associations between cocaine and positive affect, negative affect, arousal and sedation, relative to the contrast category “sports”. Explicit cognitions were assessed with a questionnaire using the same words as the IAT. As expected, cocaine users scored higher on explicit arousal and lower on explicit sedation expectancies than controls. Unexpectedly, cocaine users demonstrated strong associations between cocaine and sedation and between cocaine and positive valence (relative to sports). Both associations were not found in controls. It is discussed that these paradoxical findings could be related to properties of the IATs used or that they may reflect a similar quieting effect as demonstrated for stimulants in children with ADHD.

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1. Introduction

During the past decade, research on implicit cognitive processes has become influential in alcohol and addiction research (see [Wiers & Stacy, 2006](#)). Implicit cognition measures aim to assess the automatic processes that play a role in addictive behaviors ([De Houwer, 2006](#)). Two major approaches can be

* Corresponding author. Experimental Psychology, Maastricht University, PO Box 616, 6200 MD Maastricht, The Netherlands. Tel.: +31 43 3881935; fax: +31 43 3884196.

E-mail address: R.Wiers@psychology.unimaas.nl (R.W. Wiers).

discerned: approaches assessing an Attentional Bias (AB) for drug-related stimuli and approaches assessing implicit drug-related memory associations. For many drugs it has been demonstrated that drug abusers demonstrate an AB toward stimuli related to the drug (review: Cox, Fadardi, & Pothos, 2006). Relatively few studies have examined an AB in cocaine dependence. An AB has been found in cocaine abusers as compared with controls (e.g., Carpenter, Schreiber, Church, & McDowell, 2006; Hester, Dixon, & Garavan, 2006). Within cocaine users, correlations with craving were found in one study (Franken, Kron, & Hendriks, 2000), but not in another (Hester et al., 2006). Carpenter et al. (2006) found a correlation of cocaine-AB in polydrug using cocaine abusers with treatment outcome.

Spontaneous memory associations have been demonstrated to predict subsequent alcohol and drug use (e.g. Stacy, 1997). Recently, researchers have begun to use RT-tests to assess alcohol- and drug-related associations. An often used RT-test for associations is the Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998). The IAT is a timed double categorization task during which stimuli are classified into two times two categories with two response keys. During the critical blocks of trials, the target and attribute categories are assigned to two response keys in two different combinations (see Table 1). The performance difference between the two combination tasks – the IAT effect – is assumed to reflect the strength of implicit associations between the target and the attribute categories (Greenwald et al., 1998). In previous studies (Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005; Wiers, van Woerden, Smulders, & de Jong, 2002), we assessed implicit associations for alcohol in two dimensions: valence (positive–negative) and arousal (arousal–sedation), following general models of emotion (e.g. Lang, 1995). We found that both heavy and light drinkers strongly associated alcohol with negative valence and that only heavy drinkers associated alcohol with arousal, which we hypothesized could reflect an automatic sensitized incentive salience reaction (Robinson & Berridge, 2003). Importantly, implicit associations predicted unique variance in prospective alcohol consumption after controlling for explicit expectancies (Wiers et al., 2002) and were differentially affected by a cognitive behavioral intervention than explicit expectancies (Wiers et al., 2005). Together, these and other findings suggest that they tap into different psychological process (Wiers & Stacy, 2006). More recently, Houben and Wiers (2006) assessed alcohol-associations in a unipolar fashion (i.e. positive, negative, arousal, and sedation vs. neutral), which has the advantage that ambivalent associations can be assessed (i.e. drinkers may be positive and negative). With

Table 1
IAT phases for all four attribute dimensions

| | Target concept discrimination | Attribute discrimination | Combination task | Reversed attribute discrimination | Reversed combination task |
|----------|-------------------------------|--------------------------|-----------------------|-----------------------------------|---------------------------|
| Positive | | | | | |
| Key 1 | Cocaine | Pleasant | Cocaine or pleasant | Neutral | Cocaine or neutral |
| Key 2 | Sports | Neutral | Sports or neutral | Positive | Sports or positive |
| Negative | | | | | |
| Key 1 | | Unpleasant | Cocaine or unpleasant | Neutral | Cocaine or neutral |
| Key 2 | | Neutral | Sports or neutral | Unpleasant | Sports or unpleasant |
| Arousal | | | | | |
| Key 1 | | Active | Cocaine or active | Neutral | Cocaine or neutral |
| Key 2 | | Neutral | Sports or neutral | Active | Sports or active |
| Sedation | | | | | |
| Key 1 | | Quiet | Cocaine or quiet | Neutral | Cocaine or neutral |
| Key 2 | | Neutral | Sports or neutral | Quiet | Sports or quiet |

Table 2
Participant characteristics

| | Cocaine patients | | Controls | | <i>p</i> |
|-------------------------|------------------|------|----------|-----|----------|
| | M | SD | M | SD | |
| Age | 37.1 | 6.1 | 36.8 | 5.5 | .53 |
| Educational level | 6.3 | 1.5 | 7.0 | 1.1 | .22 |
| Alcohol days past month | 3.5 | 7.4 | 8.1 | 7.4 | .51 |
| Binge days past month | 2.8 | 7.7 | .9 | 2.4 | .053 |
| Heroin days past month | 20.2 | 4.4 | – | – | <.001 |
| Methadon past month | 12.8 | 11.5 | – | – | <.001 |
| Cocaine days past month | 13.0 | 7.9 | – | – | <.001 |
| Cannabis past month | 10.2 | 12.7 | – | – | <.001 |
| Polydrug past month | 22.3 | 10.5 | – | – | <.001 |

this version it was replicated that negative associations were strongest, and that arousal associations predicted alcohol-use and problems. In the present study we used a similar unipolar version of the IAT to assess automatic cocaine associations (Table 1). To the best of our knowledge, this is the first study to investigate implicit cocaine associations with an IAT in active cocaine users.

2. Method

Participants were 16 active cocaine users and 16 age and SES-matched controls (15 men in both groups). Cocaine patients were chronic polydrug outpatients with a DSM-IV diagnosis of cocaine dependence, who reported cocaine or polydrug use as their main problem. Control participants were recruited from the community, and matched for gender, age, and level of education (Table 2). Apart from alcohol and nicotine they reported no history of illicit drug use. *Alcohol and Drug Use and demographics* were assessed with the EuropAsi (Kokkevi & Hartgers, 1995). *Implicit Associations* were assessed with four short IATs (Table 1). All attribute categories were combined with a unique set of neutral words. We used “sports” as contrast category for cocaine, because in both categories English words are used (see

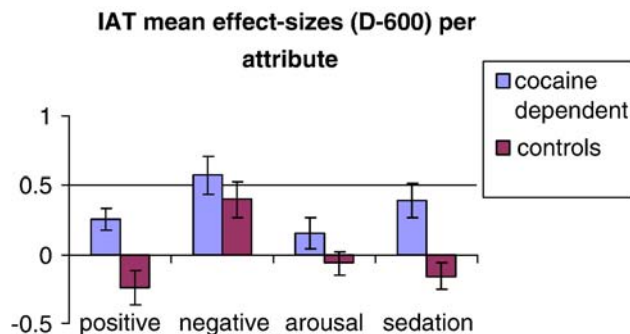


Fig. 1. Mean IAT effects (D600) separately for each evaluative IAT dimension by participant group (cocaine patients and controls).

Table 3

Correlations between implicit associations, explicit expectancies and clinical variables within active cocaine users ($N=16$)

| Variable | Cronbach alpha | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--------------------------|----------------|-----|---|---|---|------|------|-------|------|----|----|--------|
| 1. IAT positive ass | .45 | .43 | | | | | | .43 | | | | |
| 2. IAT negative ass | .47 | | | | | | -.40 | .42 | | | | |
| 3. IAT sedation ass | .63 | | | | | | | | | | | |
| 4. IAT arousal ass | .27 | | | | | | | | | | | |
| 5. Positive exp | .86 | | | | | -.45 | | .70** | .60* | | | -.53* |
| 6. Negative exp | .68 | | | | | | | | | | | |
| 7. Arousal exp | .75 | | | | | | | | | | | |
| 8. Sedation exp | .79 | | | | | | | | | | | |
| 9. Cocaine age of onset | | | | | | | | | | | | -.68** |
| 10. Cocaine years of use | | | | | | | | | | | | .41 |
| 11. Cocaine past month | | | | | | | | | | | | |
| 12. Craving (DDQ total) | .89 | | | | | | | | | | | |

Note: Only correlations with a p -value below .15 are shown. *= $p<.05$; **= $p<.01$.

Appendix). All IAT effects were calculated so that a larger value represents a stronger association between cocaine and the attribute category. Both the conventional difference in RTs and the new D600-algorithm were calculated (Greenwald, Nosek, & Banaji, 2003; cf. Wiers et al., 2005). The presentation order of the attribute dimensions was partially balanced with a Latin square. All participants first performed the IAT with cocaine paired with the relevant attribute category and then with cocaine paired with the neutral category. Procedural details were identical to Houben and Wiers (2006). *Explicit Cocaine-Related Cognitions* were assessed with an expectancy questionnaire using the same attributes as used in the IATs (as in Wiers et al., 2002, 2005). *Momentary craving* was assessed using an adapted version of the Desires for Alcohol Questionnaire (DAQ, Love, Jame, & Wilner, 1998). Participants filled out informed consent, and were administered the EuropASI, followed by the four IATs, the cocaine expectancies questionnaire and the DCQ.

3. Results

A Multivariate Analysis of Variance (Manova) with the four IAT scores as dependent variables indicated that cocaine patients differed significantly in their implicit cocaine associations from controls, $F(4,27)=6.29$, $p=.001$. Relative contributions to this multivariate difference (Discriminant analysis, Huberty & Morris, 1989) were: Sedation (.69), Positive (.63), Arousal (.29), Negative (.17). Unexpectedly, cocaine patients scored higher on sedation and positive associations than controls (Fig. 1). As expected, cocaine patients also associated cocaine more strongly with arousal than controls ($p=.012$, original scoring algorithm), but this was not significant for the new scoring-algorithm ($p>.10$). Patients and controls also differed significantly in their *explicit* cocaine expectancies, $F(4,27)=2.85$, $p<.05$ (MANOVA), relative contributions: Sedation (.82), Arousal (-.69), Negative (.39), Positive (.14). Follow-up t tests indicated that cocaine patients scored lower on sedation expectancies ($p=.006$) and higher on arousal expectancies ($p=.02$) than controls. Table 3 presents the correlations between the implicit associations, the explicit expectancies and clinically relevant variables. Implicit nor explicit cocaine cognitions correlated significantly with these variables.

4. Discussion

Main results of this study were that cocaine-dependent patients and age and SES matched controls differed both in their implicit and in their explicit cocaine-related cognitions. Findings on the explicit measures were as expected: patients scored higher on arousal expectancies and lower on sedation expectancies. Results with the IATs were more unexpected: patients scored *higher* on sedation associations than controls. How can the inconsistent findings between implicit and explicit measures of cocaine cognitions regarding sedation be explained? There are two classes of explanations for these findings: one that the implicit associations found are an artifact of the IAT procedure used (cf. Houben & Wiers, 2006) or a meaningful interpretation. Regarding an artifact explanation, the IAT contrasts cocaine associations with an opposite category, for which we chose “sports” (for use of English words). Perhaps cocaine-abusers associate sports with stress, rather than cocaine with sedation. Alternatively, the associations between cocaine and positive sedation (cf. Table 3) found in cocaine patients could reflect something meaningful. One possibility is that they reflect a paradoxical quieting reaction to cocaine, similar to methylphenidate in patients with ADHD. When measurement issues are improved (cf. Huijding & De Jong, 2006), perhaps better correlations with clinically useful outcome variables can be obtained.

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Appendix A

IAT Target Stimuli (in English)

Cocaine: coke, base, high, flash, blow, dope

Sports: golf, start, game, puck, smash, goal

IAT Valence Attribute and neutral control stimuli (all in Dutch)

Pleasant: cosy, good, nice, fun, sympathetic, agreeable

Neutral (1): square, yellow, connected, narrow, broad, supplement

Unpleasant: antisocial, bad, unpleasant, stupid, arrogant, obnoxious

Neutral (2): fully, ordinary, figurative, level, general, curved

IAT Arousal/Sedation Attribute and neutral control Stimuli (all in Dutch)

Active: talkative, jovial, restless, alert, unrestrained, rambunctious

Neutral (3): constant, wide, brown, digital, recent, usual

Quiet: silent, listless, sleepy, passive, relaxed, calm
Neutral (4): oval, compact, related, central, daily, steep

All sets of attribute words were matched in Dutch for the number of letters and syllables.

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