INTACT VISUAL WORD PRIMING IN COCAINE DEPENDENT SUBJECTS WITH AND WITHOUT COGNITIVE DEFICIT

PAUL JASIUUKAITIS and GEORGE FEIN

Psychiatry Research, University of California
and Veterans Affairs Medical Center
San Francisco, CA, USA

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Abstract


1. The effects of semantic and repetition priming on reaction time were assessed in 27 recently abstinent cocaine and cocaine/alcohol dependent volunteers and 12 controls without substance abuse history.
2. The 27 cocaine dependent subjects were further divided into cognitively intact (N=13) and moderate-to-severe cognitively impaired (N=14) groups on the basis of neuropsychological testing.
3. Both cognitively intact and cognitively impaired cocaine dependent groups showed motor-response facilitation by semantic and repetition priming not significantly different from that of non-abusing controls.
4. It is proposed that both semantic and perceptually mediated visual word priming are implicit cognitive processes resilient to the sequelae of cocaine dependence which impact upon explicit cognitive systems.

Keywords: automatic processes, effortful cognition, implicit memory.

Abbreviations: analysis of variance (ANOVA), clinical impairment score (CIS), controlled word association test (COWAT), global clinical impairment score (GCIS), multivariate analysis of variance (MANOVA), microCog (MC), reaction time (RT).

Introduction

There is growing evidence that chronic cocaine use can result in enduring cognitive deficits. Beatty et al. (1995) found that at 3-5 weeks of abstinence, both alcoholics and cocaine abusers performed more poorly than controls on measures of learning, memory, problem solving, executive functioning and perceptual-motor speed. Strickland...
et al. (1993) studied 8 chronic cocaine abusers who were drug free for at least 6 months and found that the heavy users still showed deficits in attention, concentration, new learning, visual and verbal memory, word production and visuomotor integration. O'Malley et al. (1992) found neuropsychological impairment in all areas except motor skills and verbal fluency for inpatient chronic cocaine users at 24 days abstinence. In another cohort of outpatients, O'Malley et al. (1992) found poor (although clinically normal) performance in all domains of cognitive functioning among chronic cocaine users abstinent for an average of 135 days. Fein and Tolou-Shams (submitted) performed a longitudinal comparison of cocaine and cocaine plus alcohol dependent individuals at both 5-6 weeks and 6 months abstinence. At both timepoints, both groups were significantly impaired compared to controls across the cognitive domains of attention, abstraction, spatial reasoning, immediate and delayed memory, psychomotor functioning and response speed. A combined summary score of cognitive functioning indicated modest recovery between 5-6 weeks and 6 months abstinence for the cocaine dependent groups.

All of the above studies dealt with the association of chronic cocaine with what are considered the controlled or explicit aspects of cognition. In contrast to such processes, there are automatic or implicit types of learning believed to mediate the phenomenon of perceptual fluency and the acquisition of motor skills (Posner and Snyder, 1975; Schacter, 1987; Tulving, 1987). This implicit type of memory is often found to be relatively intact in the face of severe deficits in explicit cognitive functioning. Priming, which reflects the effect of implicit memory, is the development of specific perceptual fluency, i.e. when previous experience with stimulus elements facilitates later performance with the same or similar stimulus elements. Priming can be of two basic types. These are repetition or identity priming and conceptual or semantic priming. Repetition priming involves using the exact same stimulus as both prime and target. Conceptual priming involves using different stimuli as prime and target, with the prime having some cognitive association with the target. In the case of lexical priming (i.e. priming between word stimuli), this relationship is semantic.

Warrington and Weiskrantz (1968; 1974; 1982) first demonstrated priming effects in densely amnestic Korsakoff's patients. That
repetition priming is present in Korsakoff's patients has been evidenced by word identification (Cermak et al. 1985), word fragment and word stem completion tasks (Shimamura et al. 1987; Warrington and Weiskrantz, 1974). Semantic priming in Korsakoff's syndrome has been shown by tasks which require the patients to generate category examples (Shimamura and Squire, 1984) or to free-associate (Salmon et al. 1988). These effects were found among patients exhibiting severe explicit or intentional memory disturbance. Like Korsakoff's patients, individuals with Huntington's disease display normal lexical priming effects on word stem completion (Shimamura et al., 1987) and completion of semantically related paired associates (Salmon et al., 1988). Alzheimer's patients show no effect of semantic priming in lexical decision (Ober and Shenaut, 1988) and word stem and paired associate completion tasks (Salmon et al., 1988). In contrast to their semantic priming deficit, Alzheimer's patients show normal enhancement of reaction time with repetition priming (Moscovitch, 1982). This pattern of deficits has led Heindel et al. (1993) to propose that Alzheimer's disease causes deterioration in the "hierarchic associative network that forms the skeletal structure of semantic knowledge" (p. 754). Jasiukaitis and Fein (1999) found that HIV+ individuals with neuropsychological impairment show reduced semantic priming facilitation of reaction time (RT), but intact repetition priming RT facilitation. These results were consistent with a frontal sub-cortical disease in HIV that impairs automatic activation of semantic systems but spares the facilitation of word form processing in extrastriate cortex.

While there is evidence for impairment in multiple explicit cognitive domains following chronic cocaine abuse, there has been little investigation of the effect of chronic cocaine upon the automatic or implicit types of cognition. Given the pattern of dissociation between implicit and explicit cognitive functions found in other neurological syndromes, it cannot be predicted what the status of implicit memory would be after chronic cocaine abuse. To test the resiliency of implicit memory in chronic cocaine dependency, the cocaine dependent individuals who participated in the Fein and Tolou-Shams (submitted) study were selected for the present experiment only if they exhibited moderate to severe cognitive impairment. They were then tested for both semantic and repetition priming of visual word stimuli.

Methods
Subjects

Twenty-seven cocaine dependent individuals (8 dependent on cocaine only and 19 dependent on both cocaine and alcohol) were studied and compared to twelve non-substance abusing controls. Cocaine and/or alcohol dependence was defined by DSM-IV (American Psychiatric Association, 1994) criteria. No individual met DSM-IV criteria for dependence on any substance other than cocaine, alcohol or nicotine. Control subjects were screened to exclude those with any psychiatric disorder by DSM-IV criteria. Substance dependent subjects were screened to exclude those with any non-substance related Axis I psychiatric disorder (with the exception of Obsessive-Compulsive and Eating Disorders). All subjects were screened to exclude anyone with a history or presence of a neurological disorder including head injury with loss of consciousness, cerebral ischemia (not occurring in temporal relationship to an episode of drug use), vascular headache, epilepsy, brain tumor, dementia, neurosyphilis, Parkinson's disease or Huntington's Disease.

All female participants (N=13) were tested to assure that they were not pregnant at the time of study (for reasons having to do with other aspects of the research program).

All cocaine dependent individuals were active patients in substance abuse residential and outpatient treatment centers within the San Francisco Bay area. Random urine screens were performed on a weekly basis by the treatment centers to verify abstinence. Urine screens for cocaine, amphetamines, benzodiazepines and opiates were performed on all participants (including controls) on the day of neuropsychological testing. All participants were established to be HIV-seronegative through polymerase chain reaction testing conducted at the San Francisco Veterans Affairs Medical Center.

The Fein and Tolou-Shams study included both individuals who were studied initially at 5-6 weeks abstinence and individuals who were first studied at 6 months abstinence. For the present study, we selected 14 subjects from the Fein and Tolou-Shams study who evidenced moderate to severe cognitive impairment. That sample consisted of eight individuals studied at 4-5 weeks abstinence (3 cocaine dependent only and 5 cocaine and alcohol dependent) and 6 individuals studied at 6 months abstinence (2 cocaine dependent only and 4 cocaine and alcohol dependent). All of
these cocaine dependent individuals had obtained Global Clinical Impairment Scores (GCIS, described below) of 4 or greater on neuropsychological testing, indicative of moderate to severe cognitive impairment. In addition, 13 more cocaine dependent individuals who did not exhibit cognitive impairment (GCIS of 0 or 1) were recruited at 4-5 weeks abstinence with identical selection criteria. Of this second group of substance dependent individuals, 3 were dependent on cocaine only while 10 were dependent on cocaine and alcohol. All members of both substance dependent groups preferred to self-administer cocaine by smoking it in its "crack" form.

Control volunteers (N=12) were recruited from the community. They were non- or light social drinkers (alcohol use varied from 0 to 32 drinks/month; mean 9.3 +/-9.2), had no recreational cocaine use and no history of abuse or dependence on any substance. They also passed all psychiatric and neurologic exclusionary criteria, were verified to be HIV-seronegative and obtained GCISs of 0 or 1 upon neuropsychological testing. Priming data for all study participants was gathered within one week of the neuropsychological assessments. The UCSF Committee on Human Research approved all procedures and written consent was obtained from all participants prior to study.

Neuropsychological Testing

All participants underwent a battery of neuropsychological tests administered over 2 days, with each day’s assessment lasting about 1 hr. The first half of the battery was administered by a psychometrician and included the Grooved Pegboard (Kløve, 1963), Stroop (Golden, 1975), Shipley Institute of Living Scale (SILS: Shipley, 1940), Symbol Digit Modalities subtest (Smith, 1968), Trail Making Tests A and B (Reitan and Wolfson, 1985), Controlled Word Association Test (COWAT: Benton and Hamsher, 1983), Short Category Test (Wetzel, 1982) and Rey-Osterrieth Complex Figure Test (Osterrieth, 1944). The remainder of the battery consisted of the MicroCog Assessment of Cognitive Functioning (MC: Powell et al., 1993) administered on an IBM-compatible microcomputer.

Age and education adjusted z-scores (based on each test’s above-cited normative data) were calculated for all tests (including the MicroCog subtests). Z-scores were then averaged within the following cognitive domains: (1) attention (Numbers Forward, Numbers Reversed, MC Alphabet and MC Word 1), (2) verbal (COWAT and Shipley vocabulary tests), (3)
abstraction (Shipley abstract score, Short Categories Test, Stroop interference score, Trail Making Test B, MC Analogies and MC Object Match A and B), (4) spatial processing (MC Tic Tac and MC Clocks), (5) psychomotor (Trails A and Oral and Written Digit Symbol), (6) immediate memory (MC Story immediate 1 and 2, Rey immediate and MC Word list 2), (7) delayed memory (MC Story delay 1 and 2, MC Address delay and Rey delay recall), (8) motor (Grooved Pegboard), and (9) reaction time (MC Timers 1 and 2).

The normalized z scores for all tests within a domain were averaged and converted to a domain percentile score. Each domain percentile score was then assigned a clinical impairment score (CIS) from 0 to 2. A CIS of 0 was assigned to domain scores above the 15th percentile, a CIS of 1 was assigned to domain scores falling at or below the 15th and above the 5th percentile, and a CIS of 2 was assigned to domain scores falling at or below the 5th percentile. The clinical impairment scores for the nine cognitive domains were summed to yield a Global Clinical Impairment Score (GCIS), ranging from 0 to 18. Thus for the control and cognitively intact cocaine dependent samples, all individuals were at least above the 15th percentile in eight domains and above the 5th in one.

Apparatus and Procedure

Participants were relaxed, awake, and seated upright in a sound attenuated chamber. They were asked to fixate on a 14" computer monitor and perform a two-choice reaction time task (lexical decision for semantic priming; word vs. picture stimulus identification for repetition priming, described below) by lifting as quickly as possible the index finger of one hand or the other. Hand assignment for each task was counterbalanced across groups, as was the order of the lexical decision and word/picture stimulus identification tasks.

Stimuli were displayed by a 20 Mhz Intel 80386 microcomputer slaved to the data acquisition computer. Response data were measured using a photo-diode system. The relaxed finger blocked a light beam. With a finger lift, the beam was allowed to connect and a response was detected. Responses occurring 1000 ms after stimulus onset were excluded as being unacceptably delayed. Responses occurring prior to 100 ms after stimulus onset were excluded as being possibly delayed responses to the previous stimulus. If a participant made more than one response during the 100 to 1000 ms post-stimulus interval, only the first response was
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recorded.

Lexical Decision Task (Semantic Priming)

In the lexical decision task, participants were presented with 150 English words and 148 nonword letter strings (both ranged from two to seven letters) and were asked to respond with one hand if the stimulus was a word, and the other hand if the stimulus was a nonword. Response accuracy and speed were equally stressed. The nonwords were orthographically and phonologically correct and were created from rearranging the letter sequence of legal English words (i.e., "ulpit", "aceep"). The actual words were matched with antonym pairs (i.e., "enter-exit") or words that had another obvious antonym but were unrelated (i.e., "deep-hire"). Eighty-two words were preceded by nonwords. Fifty-one words were preceded by their antonym. These 51 words comprised the antonym primed condition. Seventy-two words preceded by an unrelated word served as the unrelated word comparison for the semantically antonym primed condition. A random ordering of presentations was created with the restriction that antonym pairs always occurred together. The stimuli were presented as white letters in the center of the otherwise black, blank 14" screen. The intertrial interval was 2800 ms with a random jitter of 200 ms. Stimulus duration was 200 ms.

Stimulus Identification Task (Repetition Priming)

In the word vs. picture stimulus identification task, participants were presented with 250 English words, 250 line-drawings of objects selected from the Snodgrass and Vanderwart (1980) set of pictures, and computer pixel-shuffled scrambles of words and object pictures (50 each). In this task, participants were asked to respond with one hand if a stimulus was a recognizable word, and with the other hand if the stimulus was a recognizable picture. If the stimulus was a scrambled word or picture, they were to make no response. Response accuracy and speed were equally stressed. The stimuli were presented in pseudo-random order with the following constraints. For 60 trials during the task the exact same word stimulus was repeated twice in a row. The second stimulus of each such pair constituted the repetition primed or word same condition. For another 60 trials, word stimuli were immediately preceded by other semantically unrelated word stimuli. The second stimulus of these pairs constituted the word different comparison for
the identity primed word same condition. For the remaining 480 trials of the stimulus identification task, 130 other word stimuli were preceded by either images or scrambles. All stimuli were presented in white on a black background at the center the 14" computer monitor. All stimuli were approximately 10 cm in height and width, subtending a visual angle of 5 to 6 degrees. The intertrial interval was 2800 ms with a random jitter of 200 ms. Stimulus duration was 200 ms.

Data Analysis

Only reaction times (RT) from trials with correct responses were considered for analysis. Because individual RT distributions can be non-normally distributed, each individual's summary RT measures were computed from the median, rather than mean, of each condition. Medians are less sensitive to outlying values than means, and in the case of normally distributed data the median is identical to the mean (Woodworth and Schlosberg, 1954). Individual subjects' median RTs were then analyzed by condition using a repeated-measures analysis of variance (ANOVA). The ANOVA had a 3-level between-subjects Group factor (Substance Dependent / Cognitively Intact vs. Substance Dependent / Cognitively Impaired vs. Non-using Control / Cognitively Intact), and within-subjects factors of Priming Condition (primed vs. not primed word stimuli) and Stimulus Task (lexical decision vs. stimulus identification). The primary F-test of interest is any interaction of the Group and Priming Condition terms. In addition to the reaction time analysis, an identical ANOVA was performed with each subject's percent correct trials in the same four stimulus conditions.

Results

Demographics

Table 1 presents the demographic variables for the study sample. There were no significant group differences with regard to age (F(2,36) = 1.6, p = .2157), gender (Fisher's Exact 2-tail p = .581) or ethnic (Fisher's Exact 2-tail p = .614) composition. There was a trend for an education difference to emerge between groups (F(2,36) = 2.35, p = .1097). This trend appears to be due to the control group having roughly one more year of education than both substance dependent groups.

Relation of Substance Dependence to Cognitive Status

Table 2 presents the frequency counts of cocaine only and cocaine and
alcohol dependent subjects in the cognitively intact and cognitively impaired groups. Non-parametric analysis revealed no significant difference in the distribution of the two types of substance dependence between cognitively intact and impaired groups (Fisher’s Exact 2-tail p = .678).

Table 1.

Mean Age and Education, ± Standard Deviation, and Group Ethnicity/Gender Frequencies
(ethnicity: AA=African American, H=Hispanic, C=Caucasian)

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Age (years)</th>
<th>Education (years)</th>
<th>Ethnicity</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine Dependent/</td>
<td>13</td>
<td>40.4 ± 6.2</td>
<td>13.5 ± 1.4</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Cognitively Intact</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Cocaine Dependent/</td>
<td>14</td>
<td>36.9 ± 4.7</td>
<td>13.0 ± 2.0</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Cognitively Impaired</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Non-using Controls</td>
<td>12</td>
<td>36.9 ± 6.3</td>
<td>14.4 ± 1.4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2.

Distribution of Substance Dependence Type Within Cognitive Status Groups

<table>
<thead>
<tr>
<th>Substance Dependence Type</th>
<th>Cognitively Intact</th>
<th>Cognitively Impaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine Only</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Cocaine and Alcohol</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

Severity of cocaine dependence was assessed by subjects’ self-report of duration (in months) and average dollar amount spent (monthly) during a self-defined period of peak cocaine use. (This information had not been obtained from two of the cognitively intact substance dependent subjects.) The average dollar monthly expense was multiplied by peak-use period duration to obtain a single index of cocaine habit intensity. Estimated mean total dollar amount spent on cocaine during peak use for the cognitively impaired group was roughly $64,000 with a standard deviation of $87,000 (indicative of a skewed distribution with a tail towards the higher end). For the cognitively intact group it was roughly $22,000 with a standard deviation of $12,000. Because of the non-normal
distribution for the habit intensity variable, a median 2-sample test
was performed for the cognitively intact and impaired groups. This
approached significance (Probability > |Z| = .0716).

Multivariate analysis of variance (MANOVA) was performed comparing the
non-using controls and cognitively intact substance dependent group’s z
scores in the nine cognitive domains. No significant difference was
found (Wilk’s λ = 0.7201, df = 9,16, p = .6842). To test if some
cognitive domains were more affected than others in the cognitively
impaired substance dependent group, repeated measures ANOVA was
performed for that group only with the nine cognitive domains as a
within-subjects factor. No significant trend emerged (F(8,104) = 0.87, p
= .5417). Table 3 presents the group mean z scores for the nine
cognitive domains. Figure 1 depicts the corresponding group mean
percentile rankings.

Table 3.

<table>
<thead>
<tr>
<th>COGNITIVE DOMAIN</th>
<th>Cocaine Dependent/ Cognitively Impaired (N=14)</th>
<th>Cocaine Dependent/ Cognitively Intact (N=13)</th>
<th>Non-using Controls (N=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>-0.82 ± 0.41</td>
<td>0.47 ± 0.83</td>
<td>0.65 ± 0.70</td>
</tr>
<tr>
<td>Motor</td>
<td>-0.90 ± 1.47</td>
<td>0.58 ± 2.05</td>
<td>0.06 ± 0.63</td>
</tr>
<tr>
<td>Psychomotor</td>
<td>-0.95 ± 0.42</td>
<td>-0.09 ± 0.54</td>
<td>-0.41 ± 0.76</td>
</tr>
<tr>
<td>Abstraction</td>
<td>-0.85 ± 0.42</td>
<td>-0.05 ± 0.60</td>
<td>0.25 ± 0.54</td>
</tr>
<tr>
<td>Spatial</td>
<td>-0.75 ± 0.47</td>
<td>-0.29 ± 0.50</td>
<td>-0.19 ± 0.43</td>
</tr>
<tr>
<td>Attention</td>
<td>-0.98 ± 0.56</td>
<td>-0.03 ± 0.60</td>
<td>-0.02 ± 0.47</td>
</tr>
<tr>
<td>Delayed Memory</td>
<td>-1.35 ± 0.55</td>
<td>-0.08 ± 0.73</td>
<td>-0.08 ± 0.49</td>
</tr>
<tr>
<td>Immediate Memory</td>
<td>-1.22 ± 0.70</td>
<td>-0.15 ± 0.80</td>
<td>-0.06 ± 0.75</td>
</tr>
<tr>
<td>Reaction Time</td>
<td>-0.88 ± 1.09</td>
<td>-0.18 ± 0.76</td>
<td>-0.14 ± 0.46</td>
</tr>
</tbody>
</table>

Measures of Stimulus Priming

Table 4 presents the group mean reaction times. The main effect of
Priming Condition was highly significant (F(1,36) = 56.52, p = .0001).
However, there was no significant difference between groups for the
priming effect itself (Group by Priming Condition F(2,36) = 1.77, p = .1847; Group by Priming Condition by Stimulus Task F(2,36) = 0.04,
p = .9572). There also was no significant Group main effect on reaction
time (F(2,36) = 0.21, p = .8138). Figure 2 shows that for all three
groups, reaction time was facilitated with both types of priming.
Cognitive Domain Group Mean Percentile Scores

Fig. 1. Cognitive domain mean percentile scores for control and cognitively intact and cognitively impaired cocaine dependent groups. 0.5 ranking represents standardized normal performance.
Table 4.
Mean Group Reaction Time (milliseconds) and ± Standard Deviation by Task and by Priming Condition

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Semantic Priming (Lexical Decision Task)</th>
<th>Repetition Priming (Word or Picture Task)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Word Condition</td>
<td>Unrelated Word Condition</td>
</tr>
<tr>
<td>Cocaine/Cognitively Impaired (N=14)</td>
<td>536 ± 69</td>
<td>566 ± 53</td>
</tr>
<tr>
<td>Cocaine/Cognitively Intact (N=13)</td>
<td>526 ± 98</td>
<td>564 ± 83</td>
</tr>
<tr>
<td>Non-using Controls (N=12)</td>
<td>552 ± 98</td>
<td>566 ± 98</td>
</tr>
</tbody>
</table>

Table 5 presents the group mean percent accuracy for each stimulus condition along with the mean equivalent number of trials represented by that accuracy rate. The main effect of Priming Condition was again highly significant \( F(1,36) = 14.79, p = .0005 \). There were no significant interactions of priming effect with the Group factor (Group by Priming Condition \( F(2,36) = 0.06, p = .9455 \); Group by Priming Condition by Stimulus Task \( F(2,36) = 0.72, p=.4930 \)). There was a significant Group main effect on percent accuracy \( F(2,36) = 8.47, p=.0010 \). Figure 3 reveals that while all three groups' accuracy was enhanced by priming effects, the substance dependent / cognitively impaired group's accuracy was depressed overall by approximately 10% compared to the other two groups.

Discussion

Priming Effects

Motor speeding and accuracy enhancement of response to visual word stimuli by either semantic association or orthographic identity were found to be relatively unaffected in recently abstinent cocaine dependent and cocaine and alcohol dependent subjects, even in the face of moderate to severely impaired performance across multiple explicit cognitive domains. The cognitively impaired substance dependent group did exhibit a significant overall reduction in response accuracy, yet they were still able to benefit from stimulus priming with regard to both the speed and accuracy measures. These findings strengthen the
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Group Mean RT by Stimulus Conditions

![Graph showing group mean reaction times by stimulus conditions.]

**Fig. 2** Group means of subjects' median reaction times showing semantic (antonym vs. unrelated) and repetition (same vs. different) priming effects.
Group Mean Accuracy by Stimulus Conditions

Fig. 3 Group means of subjects' percent accuracy showing semantic (antonym vs. unrelated) and repetition (same vs. different) priming effects.
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position that stimulus priming mechanisms are orthogonal to the other more integrated aspects of neuro-cognitive functioning (Schacter, 1987).

Table 5.

<table>
<thead>
<tr>
<th>Grouping</th>
<th>Semantic Priming (Lexical Decision Task)</th>
<th>Repetition Priming (Word or Picture Task)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Antonym Word Condition</td>
<td>Unrelated Word Condition</td>
</tr>
<tr>
<td>Cocaine/Cognitively Impaired (N = 14)</td>
<td>85 ± 13 (43.3)</td>
<td>82 ± 7 (13.9)</td>
</tr>
<tr>
<td>Cocaine/Cognitively Intact (N = 13)</td>
<td>94 ± 4 (47.9)</td>
<td>89 ± 7 (15.1)</td>
</tr>
<tr>
<td>Non-using Controls (N = 12)</td>
<td>94 ± 4 (47.9)</td>
<td>90 ± 8 (15.3)</td>
</tr>
</tbody>
</table>

The finding of no priming deficit accompanying explicit cognitive deficit in cocaine dependent individuals contrasts with our previous finding of a semantic priming deficit in individuals with HIV-related cognitive impairment (Jasiukaitis and Fein, 1999). This difference in results suggests that priming tasks might be useful tools with which to probe the differential nature of neuro-cognitive syndromes. The semantic priming deficit accompanying HIV-related cognitive impairment is consistent with frontal sub-cortical disease seen upon imaging studies of that syndrome (Sardar et al., 1995; Meyerhoff et al., 1996). It should be noted that in the HIV infected and cognitively impaired sample, the lowest explicit cognitive percentile ranking was for the psychomotor domain. In the present cognitively impaired cocaine dependent sample, the lowest cognitive domain percentiles were in immediate and delayed memory. This suggests that impaired semantic priming and psychomotor difficulty may be inherently associated consequences of frontal sub-cortical disease. The neurological sequelae of chronic cocaine abuse, possibly striking initially at the hippocampus and other limbic structures subserving memory, might exert their negative effects most strongly upon memory as opposed to psychomotor function.
Cognitive Deficits

It is unlikely that cultural and pre-morbid factors would be the sole determinants of the general neuropsychological deficits exhibited by the cognitively impaired substance dependent group. With regard to cultural and pre-morbid factors, they were similar to the cognitively intact substance abusers, yet the latter group did not exhibit neuropsychological performance difference from controls. One factor that did discriminate the cognitively impaired from cognitively intact substance abusers, however weakly, was the estimated amount of cocaine taken during a period of peak use. Given that “cocaine loading” is hypothesized to also raise the set point for drug satiation (Ahmed and Koob, 1998), this would suggest that binge behavior with cocaine places the user at serious risk for neuropsychological impairment.

Selectivity of Cocaine’s Effects

Bauer (1994; 1996) reported a complex picture with regard to cocaine’s effects upon psychomotor functioning. They have found that while cocaine dependent individuals exhibit slower RT than controls during protracted vigilance and divided attention tasks, the visual tracking accuracy of cocaine dependent patients was superior to controls both in early and late abstinence. Gillen et al. (1998) found that while cocaine-dependent subjects were impaired on tasks assessing higher verbal skills, they performed better than controls on a task assessing smooth pursuit eye tracking accuracy. Bauer (1996) concluded that cocaine dependence might simultaneously depress and enhance different aspects of brain function in the same individual. While not enhanced in the present cocaine dependent samples, intact priming for visual word stimuli is consistent with Bauer’s proposal for selectivity in cocaine’s chronic effects upon psychomotor functioning.

Conclusion

Evidence is presented for normal semantic and repetition priming effects in both cognitively intact and cognitively impaired recently abstinent cocaine dependent individuals. The cognitively impaired cocaine dependent sample’s pronounced deficits in explicit cognitive functioning make it likely that preservation of these aspects of implicit memory function in cocaine dependence is a real phenomenon. This finding adds to the growing body of evidence that semantic and
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repetition priming RT facilitation are automatic and relatively insulated processes in the overall structure of human cognition.

References


Inquiry and reprint requests should be addressed to:

George Fein, Ph.D.
Psychiatry Research (116R),
Veterans Affairs Medical Center,
4150 Clement St.
San Francisco, CA 94121