

Stroop Tasks Reveal Abnormal Selective Attention Among Psychopathic Offenders

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Selective attention among offenders with psychopathy was investigated using 3 Stroop paradigms: a standard color–word (CW) Stroop, a picture–word (PW) Stroop, and a color–word Stroop in which the word and color were spatially separated (separated CW). Consistent with “overselective” attention, offenders with psychopathy displayed reduced Stroop interference on the separated CW and PW tasks relative to offenders who were not psychopathic. However, offenders with psychopathy displayed normal Stroop interference on the standard CW Stroop. Further, the reduced interference of offenders with psychopathy on the separated CW Stroop was accompanied by normal facilitation. These findings suggest a circumscribed attentional deficit in psychopathy that hinders the use of unattended information that is (a) not integrated with deliberately attended information and (b) not compatible with current goal-directed behavior.

People with psychopathy are known for persistent antisocial behaviors that they enact with no appreciable signs of guilt, remorse, or responsibility. Strikingly, these behaviors persist despite good intelligence, intact judgment and reasoning abilities, and relatively low levels of anxiety or neuroticism. This apparent lack of cognitive or affective pathology has been referred to as a *mask of sanity* (Cleckley, 1976) and has led many to attribute the antisocial behaviors of psychopathic individuals to willful disobedience or maliciousness.

Despite this mask of sanity, psychopathic individuals display subtle yet pervasive processing deficits that may underlie their disinhibited and antisocial behaviors. Psychopathic offenders are reliably distinguished from nonpsychopathic criminals by their poor passive avoidance (e.g., Lykken, 1957; Newman & Kosson, 1986), abnormal physiological responses to aversive cues (e.g., Hare & Quinn, 1971; Ogloff & Wong, 1990), unusual cerebral lateralization (e.g., Hare & Jutai, 1988; Hare & McPherson, 1984), insensitivity to peripheral information (e.g., Newman, Schmitt, & Voss, 1997), and abnormal language processing (e.g., Williamson, Harpur, & Hare, 1991).

The performance abnormalities associated with psychopathy can, in large part, be conceptualized as a failure to make use of information that is peripheral or secondary to the current attentional focus (see Newman, 1998, for a review). For example,

psychopathic individuals demonstrate poor passive avoidance of latent (Lykken, 1957; Newman & Kosson, 1986; Newman, Patterson, & Kosson, 1987) but not explicit (e.g., Newman & Kosson, 1986; Newman, Patterson, Howland, & Nichols, 1990) punishment cues. Similarly, psychopathic individuals fail to make use of feedback while engaged in reward-seeking behavior but readily accommodate feedback if they are forced to pause and reflect on it (Arnett, Howland, Smith, & Newman, 1993; Newman et al., 1987). People with psychopathy also demonstrate unusual event-related potentials (ERPs) to auditory stimuli when performing a concurrent task but exhibit normal ERPs to auditory stimuli presented without a concurrent task (Jutai & Hare, 1983; Jutai, Hare, & Connolly, 1987).

The relative imperviousness to unattended information among people with psychopathy has led to proposals that some form of attentional dysfunction, such as reduced attentional breadth (Kosson, 1996, 1998), reduced attentional capacity (Harpur & Hare, 1990), or overfocused attention (Forth & Hare, 1989; Hare, 1978; Kosson & Newman, 1986, 1989; Newman, Gorenstein, & Kelsey, 1983), may underlie the information-processing abnormalities of psychopathic individuals. These proposals are consistent with classic descriptions of psychopathic individuals as lacking in “the active, searching attention and organizing process that normally puts [relevant] information to use” (Shapiro, 1965, p. 179; see also Cleckley, 1976) and are also consistent with psychopathic individuals’ own statements such as the following: “I always know damn well I shouldn’t do these things . . . it’s just that when the time comes I don’t think of anything else. I don’t think of anything but what I want now” (Grant, 1977, p. 60).

Despite considerable theoretical consensus that psychopathy is associated with an abnormality of selective attention, empirical progress in understanding the attentional functioning of psychopathic individuals has been hampered by inconsistent findings and a lack of systematic research (Harpur & Hare, 1990). Furthermore, although the behavioral performance of psychopathic individuals suggests a selective impairment in the utilization of incidental contextual information, most investigations have assessed their ability to attend to information that is explicitly relevant (see Harpur & Hare, 1990; Kosson & Harpur, 1997). A notable exception is Jutai and Hare’s (1983) examination of ERPs associated

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with irrelevant tone pips. They reported that psychopathic offenders displayed normal N100 responses to irrelevant tone pips presented while they were sitting quietly but diminished N100 responses to irrelevant tone pips that were presented while they were playing a video game. This finding is consistent with overfocused attention, but the behavioral implications of the physiological abnormality are unclear. What is needed, therefore, is a straightforward investigation of psychopathic individuals' ability to accommodate unattended contextual information.

The Stroop paradigm is the gold standard for measuring the automatic influence of unattended information (MacLeod, 1992). In the basic Stroop task, participants are asked to focus on one component of a stimulus (e.g., an ink color) while ignoring its other components (e.g., a color word). When the task-irrelevant, ignored dimension conflicts with the attended dimension, healthy participants demonstrate a robust interference effect. This interference effect indicates that, among healthy populations, selectively attending to one dimension does not completely prevent processing of the ignored dimension.

Stroop interference is a robust effect that is readily observed in healthy populations. However, unusually large interference effects are indicative of poor selective attention, as they reflect excessive processing of the task-irrelevant information. Increased Stroop interference effects have been associated with many forms of psychopathology, including syndromes of disinhibition that are conceptually related to psychopathy—for example, attention-deficit/hyperactivity disorder (Carter, Krener, Chaderjian, Northcutt, & Wolfe, 1995), conduct disorder (Bauer, 2000), and violence associated with substance abuse (Fishbein, 2000). Exaggerated Stroop interference effects have been interpreted as indicative of disinhibition (Spieler, Balota, & Faust, 1996), poor impulse control (Stern & Prohaska, 1996), and poor executive control (e.g., Hanes, Andrewes, Smith, & Pantelis, 1996; Kramer, Reed, Mungas, Weiner, & Chui, 2002).

The increased Stroop interference exhibited in many syndromes of disinhibition suggests that these syndromes are associated with difficulty maintaining an attentional focus and excessive distraction from irrelevant information. However, the performance of psychopathic individuals on laboratory tasks suggests that their attention, once focused, is actually less permeable to unattended contextual information than that of nonpsychopathic controls. This leads to the interesting hypothesis that psychopathic individuals should demonstrate less, rather than more, Stroop interference than nonpsychopathic controls. Although it is somewhat counterintuitive that superior selective attention would be associated with psychopathology, it is consistent with the importance of incidental contextual and associative cues for regulating behavior (Newman & Lorenz, 2003). If attention is inflexibly focused on information of immediate concern, subtle yet potentially informative incidental cues, such as changes in the behavioral context, may be missed (see Newman & Wallace, 1993), resulting in a failure to modify maladaptive, context-inappropriate behavior. Insensitivity to context, therefore, may substantially contribute to the poor behavioral regulation of psychopathic individuals.

There is only one report of the Stroop performance of people with psychopathy in the literature. Smith, Arnett, and Newman (1992) presented psychopathic offenders with a version of the color-word Stroop and found comparable interference effects for psychopathic and nonpsychopathic offenders. However, they did not include a baseline in their interference measure, and their

findings have not been replicated. Moreover, Newman et al. (1997) reported evidence for reduced interference among psychopathic offenders on a task that involved Stroop-like response competition between line drawings of objects and printed object words, suggesting that psychopathic individuals are indeed insensitive to Stroop interference.

Thus, the existing literature provides one report of normal interference on a color-word Stroop and one report of reduced interference on a Stroop-like task involving pictures and words. This discrepancy suggests that the attentional performance of people with psychopathy may vary depending on the nature of the stimuli (e.g., picture-word or color-word). However, neither of these findings has been replicated, and any attempt to interpret the discrepancy is complicated by the many methodological differences between the two studies. In particular, the Newman et al. (1997) study was not specifically designed as a measure of Stroop interference, and their task required decisions about the conceptual relationship between stimuli rather than the simple stimulus naming required by the standard Stroop paradigm.

The present study was therefore designed to examine the reliability of the existing findings and provide a more comprehensive examination of selective attention in psychopathy as evidenced by Stroop performance. To allow for a more direct comparison of psychopathic individuals' performance on color-word and picture-word Stroop tasks, in Experiments 1 and 2 we used picture-word stimuli as in Newman et al. (1997) and color-word stimuli as in Smith et al. (1992) but presented both using standard Stroop methodology. In this way, we were able to examine the performance of psychopathic individuals on color-word and picture-word Stroop tasks that were matched with regard to experimental format and response requirements. In Experiment 3 we used a spatially separated color-word Stroop in order to further examine the factors driving the performance of psychopathic individuals on the picture-word and standard color-word Stroop tasks.

General Method

Participants

Participants were Caucasian men incarcerated at either a minimum- or maximum-security prison in south-central Wisconsin. Prescreening of files was used to eliminate individuals who were 40 or more years of age, had performed below the fourth-grade level on the prison's standardized measures of reading and math achievement, had diagnoses of psychosis or bipolar disorder, or were being prescribed psychotropic medication. Individuals reporting color blindness were also excluded from participation. All participants were presented with the elements of informed consent both orally and in written form.

Psychopathy Assessment

Since the 1980 introduction of Hare's Psychopathy Checklist (now in its revised form, PCL-R; Hare, 1991), the term *psychopathy* has increasingly been equated with high Psychopathy Checklist scores. However, the PCL-R does not screen for intelligence, thought disorder, or neuroticism, and individuals obtaining high PCL-R scores for any of these reasons are presumed to be etiologically distinct from individuals with low-anxious, primary psychopathy (Brinkley, Newman, Widiger, & Lynam, 2002; Schmitt & Newman, 1999). To identify a relatively homogeneous group of individuals with primary psychopathy, as set out by Cleckley, PCL-R scores should be supplemented by measures of intelligence, psychosis, and neuroticism (see Newman & Brinkley, 1997, for further discussion). For this reason, we administered brief measures of intelligence and anxiety in

order to exclude participants with borderline or lower intelligence and to distinguish between low-anxious (non-neurotic) and high-anxious (neurotic) participants. We also used file information (i.e., psychological reports) to exclude individuals with diagnoses of psychosis or bipolar disorder, administered a self-report measure of general psychopathology, and informally screened for thought disorder during the course of the interview.

Because we were primarily interested in classic Cleckley psychopathy, our hypotheses, like those of Newman et al. (1997) and Smith et al. (1992), were directed toward low-anxious participants. However, in the interest of providing maximal information and contributing to the literature on “secondary,” or high-anxious, psychopathy, we also report (without comment) the data from high-anxious participants.

Procedure

Ratings on the PCL-R were made by trained research staff following a 60- to 90-min structured interview and a review of the participant’s prison file. The PCL-R is a 20-item checklist of behaviors and characteristics associated with psychopathy. Each item is scored 0, 1, or 2, for a maximum total score of 40. In accord with standard practice (Hare, 1991), individuals scoring 30 or above were considered to have psychopathy, individuals scoring 20 or below were considered to be nonpsychopathic controls, and individuals scoring between 20 and 30 (“middles”) were excluded from data analyses.

Following the structured interview, participants were administered the Shipley Institute of Living Scale (SILS; Zachary, 1986) and the Welsh Anxiety Scale (WAS; Welsh, 1956). The SILS provides an estimate of general intelligence and was used to exclude participants with borderline or lower intelligence (i.e., estimated IQ < 70). Median splits on the WAS were used to divide participants into high- and low-anxious groups for planned comparisons.

A subset of participants (84%) completed the Symptom Checklist-90 (SCL-90; Derogatis, 1992). The SCL-90 provides a measure of general psychopathology, the Global Symptom Index (GSI). GSI scores were compared across groups to ensure comparable overall levels of psychopathology. There were no significant main effects or interactions involving group, indicating that levels of psychopathology were comparable among psychopathic and nonpsychopathic participants.

Participants returned on subsequent days to complete the experimental tasks. Each task was presented as one of four to six counterbalanced tasks during a 1-hr testing session. Only one Stroop task was presented during any given testing session. Participants were tested individually by one of two male experimenters who were blind to participants’ group membership. No feedback was given during the reported tasks. After each of the tasks, participants were informed that they had earned \$3 for their participation.

Statistical Analyses

Overall group analyses were conducted using analyses of variance (ANOVAs). Levene’s (1960) test for homogeneity of variance was examined for each analysis; where there was evidence of heterogeneity, the correction for unequal variances was used to adjust the degrees of freedom used in *t* tests comparing group means. Comparisons between low-anxious psychopathic and control participants were conducted using one-tailed *t* tests. One-tailed, rather than two-tailed, *t* tests were indicated because each study was conducted to investigate the a priori hypothesis of overselective attention among psychopathic individuals. That is, the question of interest was whether psychopathic individuals’ Stroop interference would be reduced relative to that of nonpsychopathic controls. In no case was it predicted that low-anxious psychopathic participants would show increased interference relative to low-anxious control participants.

Experiment 1

We first presented a standard color-word Stroop task to assess the reliability of the Smith et al. (1992) findings. Although Smith

et al. used participants’ color-naming time on a single card (color words presented in colored ink) as their measure of interference, we used the more standard Stroop procedure of comparing reading times for an interference and a baseline card. Specifically, participants were presented with three different cards (color words in black ink, nonwords in colored ink, and color words in colored ink, respectively), and interference was computed by subtracting the color-naming time for the card with nonwords from the color-naming time for the card with color words. If psychopathic individuals are characterized by abnormally strong selective attention, they should experience less interference than controls from the incongruent color words.

Method

Participants. Participants were 63 Caucasian male inmates with PCL-R scores in either the psychopathic (30 or higher, $n = 29$) or nonpsychopathic (20 or lower, $n = 34$) range. Low-anxious groups were identified using a median split on the WAS, resulting in 10 low-anxious psychopathic and 22 low-anxious control participants.

Task and procedure. The color-word Stroop task, a modified version of the Dodrill (1978) task used by Smith et al. (1992), consisted of three 8.5×11 in. (about 21.6×27.9 cm) cards. Card 1 contained color words written in black ink; Card 2 contained strings of the letter *X* (e.g., XXXXX) written in red, blue, green, and yellow ink; and Card 3 contained color words written in incongruent colors. Each card consisted of 13 rows of 13 to 15 stimuli each, for a total of 178 stimuli per card. Cards 1, 2, and 3 were always presented first, second, and third, respectively. Participants were instructed to read the words on Card 1, to name the colors on Card 2, and to name the colors while ignoring the words on Card 3. Card 3 reliably produces the longest reaction times (RTs) because of the interfering effects of the conflicting words, whereas Card 2 is considered a baseline card (MacLeod, 1991).

Accuracy and RT for each card were recorded by the experimenter. The interference created by incongruent color words was computed for each participant by subtracting his RT on Card 2 (baseline color naming) from his RT on Card 3 (color naming of incongruent color words).

Results

Preliminary analyses. Group differences in intelligence were assessed by conducting a 2 (psychopathic or control) by 2 (high or low anxious) ANOVA with SILS-estimated IQ as the dependent variable. This analysis revealed a significant main effect for psychopathy, $F(1, 59) = 4.49, p < .05$, indicating significantly higher estimated IQ among controls ($M = 97.02, SD = 11.76$ for psychopathic participants; $M = 102.72, SD = 9.41$ for controls; see Table 1). Supplemental analyses revealed that this difference had no meaningful effect on the results.¹ No other main effects or

¹ To examine the impact of the group differences in IQ, we conducted two supplementary analyses. First, we repeated the primary analyses while including SILS as a covariate. All appropriate analysis of covariance assumptions were met, and psychopathy and IQ are statistically (see Hare, 1991) and theoretically (e.g., Cleckley, 1976) independent in the population. Including SILS as a covariate in later analyses had no meaningful effect on the results. Second, dichotomized SILS scores were included as a factor in the overall analysis of Stroop interference. This analysis revealed no significant interactions involving psychopathy and SILS (all $F_s < 2.0, p_s > .15$). Thus, the group differences in IQ appear to have had no substantial effect on the results.

Table 1
Participant Characteristics

Measure	Psychopathic						Control					
	Low anxious		High anxious		Total		Low anxious		High anxious		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Experiment 1	<i>n</i> = 10		<i>n</i> = 19		<i>n</i> = 29		<i>n</i> = 22		<i>n</i> = 12		<i>n</i> = 34	
Age	27.50	5.36	28.00	4.32	27.83	4.61	29.77	7.00	26.83	4.37	28.74	6.29
SILS-estimated IQ	95.83	16.14	97.64	9.15	97.02	11.76	102.62	8.82	102.89	10.82	102.72	9.41
PCL-R	31.00	1.05	32.16	1.64	31.76	1.55	14.45	5.13	15.08	4.10	14.68	4.74
WAS	4.30	3.27	18.95	6.83	13.90	9.14	4.64	2.95	15.25	3.62	8.38	6.04
Experiment 2	<i>n</i> = 12		<i>n</i> = 15		<i>n</i> = 27		<i>n</i> = 24		<i>n</i> = 24		<i>n</i> = 48	
Age	31.08	5.99	27.73	5.82	29.22	6.03	29.42	6.83	25.92	4.91	27.67	6.14
SILS-estimated IQ	97.65	11.75	96.01	10.31	96.74	10.79	96.31	12.30	97.79	10.34	97.05	11.26
PCL-R	31.58	1.78	33.33	2.47	32.56	2.33	13.96	4.97	16.38	3.40	15.17	4.39
WAS	3.67	2.50	16.93	8.24	11.04	9.18	4.67	2.20	17.92	6.83	11.29	8.37
Experiment 3	<i>n</i> = 11		<i>n</i> = 15		<i>n</i> = 26		<i>n</i> = 24		<i>n</i> = 18		<i>n</i> = 42	
Age	27.27	4.31	27.60	6.61	27.46	5.65	27.92	5.85	29.61	6.70	28.77	6.14
SILS-estimated IQ	95.16	12.54	98.93	10.76	97.33	11.46	99.34	12.50	98.94	11.45	99.23	11.72
PCL-R	31.82	1.47	31.67	1.50	31.73	1.46	15.25	4.00	15.39	4.37	15.25	4.05
WAS	9.55	3.72	21.67	5.98	16.54	7.93	8.71	3.90	20.33	4.39	13.69	7.10

Note. SILS = Shipley Institute of Living Scale; PCL-R = Psychopathy Checklist—Revised; WAS = Welsh Anxiety Scale.

interactions approached significance. Participant characteristics are presented in Table 1.

Before analyzing group differences in interference, we assessed accuracy by means of a 2 (psychopathic or control) by 2 (high or low anxious) ANOVA with Card 3 (interference card) accuracy as the dependent variable. This analysis revealed no significant main effects or interactions, indicating comparable accuracy among psychopathic participants and controls. Table 2 presents the mean accuracy and RT for each group on each of the three stimulus cards.²

Primary analyses. Group differences in interference were assessed by conducting a 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with interference (Card 3 RT minus Card 2 RT) as the dependent variable. The overall interference effect was highly significant, $F(1, 59) = 233.71, p < .001 (M = 73.59 \text{ ms}, SD = 35.89 \text{ ms})$. No other main effects or interactions approached significance, indicating comparable interference among psychopathic and control participants. Similarly, the planned comparison for the low-anxious groups revealed no differences in interference between psychopathic and control participants, $t(9.90) < 1.0, ns$, one-tailed.³

Discussion

Replicating the findings of Smith et al. (1992), Experiment 1 revealed no evidence of reduced color–word Stroop interference among psychopathic individuals relative to nonpsychopathic controls. Contrary to our predictions, participants with psychopathy were as affected as controls by the presence of incongruent contextual information. Thus, the results of Experiment 1 suggest that the permeability of selective attention among psychopathic individuals does not differ from that of nonpsychopathic controls.

Experiment 2

Experiment 1 confirmed that psychopathic individuals show normal interference on the standard color–word Stroop. This result, like that of Smith et al. (1992), appears to contradict the

reduced picture–word interference reported by Newman et al. (1997). Experiment 2 was designed to investigate the reliability of the discrepant Newman et al. (1997) finding using a conceptually similar task that is more directly analogous to the color–word Stroop. Thus, Experiment 2 presented picture–word stimuli using

² Because low-anxious participants with psychopathy appeared to have faster reading times on Card 1 than the other groups, we conducted a series of 2 (psychopathic or control) by 2 (high or low anxious) ANOVAs with reading times for each card as the dependent variables. These analyses revealed a significant main effect of anxiety for Card 1, $F(1, 59) = 4.68, p < .05$, with low-anxious participants reading faster than high-anxious participants. There were no other significant main effects or interactions. Card 1 reading time was not correlated with interference among low-anxious participants ($r = .14, p > .40$). Moreover, including Card 1 reading time as a covariate in the primary analyses did not affect the results. Thus, the apparent group differences in Card 1 reading time appear to have had no meaningful effect on the Stroop interference findings.

The nonsignificantly slower color naming on Card 2 of participants with psychopathy might lead to concern that these participants' interference scores were artificially deflated, possibly masking evidence of greater interference among psychopathic participants compared with controls. Although we cannot rule out this possibility, we feel it is unlikely. First, the group differences on Card 2 were not significant. Second, although Card 2 reading time was correlated with interference, the correlation was positive ($r = .35, p < .01$). Moreover, participants named the ink colors on both Card 2 and Card 3, so slower color naming should affect both cards equally and should not impair the ability to measure interference. Finally, no prior studies have found evidence of greater Stroop or Stroop-like interference among well-defined groups of people with psychopathy (i.e., Newman et al., 1997; Smith et al., 1992).

³ To address potential concerns regarding the unequal cell sizes among low-anxious groups, we conducted a supplementary ANOVA and planned comparison for which low-anxious group sample sizes were equated ($n = 10$) by random elimination of low-anxious controls. As with the original analyses, these analyses revealed no significant main effects or interactions ($F_s < 2.0, t < 1.0, ps > .19$).

Table 2
Color-Word Stroop Performance

Measure	Psychopathic						Control					
	Low anxious		High anxious		Total		Low anxious		High anxious		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Reaction time (s)												
Card 1	71.14	8.62	86.88	22.48	81.45	20.17	81.79	12.58	84.59	14.49	82.78	13.13
Card 2	116.73	13.60	125.02	27.91	122.16	24.01	110.62	14.59	112.49	21.54	111.28	17.06
Card 3	185.50	68.73	210.28	52.42	201.74	58.56	178.68	30.65	181.78	39.63	179.78	33.52
Interference	68.77	68.05	85.26	28.25	79.57	45.45	68.06	22.36	69.29	29.57	68.49	24.70
Errors, Card 3	10.20	4.73	10.00	6.16	10.07	5.62	7.82	4.26	8.67	7.00	8.12	5.30

Note. Card 1 = color words in black ink; Card 2 = colored Xs; Card 3 = color words in incongruent colored ink; interference = Card 3 minus Card 2.

standard Stroop methodology. On the basis of the Newman et al. (1997) findings, we predicted that psychopathic participants would show reduced interference on the present task.

Method

Participants. Participants were 75 Caucasian male inmates with PCL-R scores in either the psychopathic (30 or higher, $n = 27$) or nonpsychopathic (20 or lower, $n = 48$) range. Low-anxious groups were identified using a median split on the WAS, resulting in 12 low-anxious psychopathic and 24 low-anxious control participants.

Task and procedure. The picture-word Stroop task, a modified version of the task used by Rosinski, Golinkoff, and Kukish (1975) and Golinkoff and Rosinski (1976), consisted of four 8.5×11 in. (about 21.6×27.9 cm) cards. Card 1 contained object words only; Card 2 contained picture outlines only; Card 3 contained picture outlines with superimposed, incongruent object words; and Card 4 contained picture outlines with superimposed, three-letter trigrams (nonwords). Each picture, word, or picture-word combination was presented centrally within 1 of 20 squares, 2×2 in. (about 5.1×5.1 cm), arranged on each card in a 4×5 grid. The same set of stimuli was used for each card, but the order of the stimuli varied. Cards 1 and 2 were always presented first and second, respectively. Cards 3 and 4 were counterbalanced in order to control for practice effects. Participants were instructed to read the words on Card 1, to name the pictures on Card 2, and to name the pictures while ignoring the words on Cards 3 and 4.

Accuracy and RTs for each card were recorded by the experimenter. The interference created by incongruent object words was computed for each participant by subtracting his RT on Card 4 (pictures with nonword trigrams) from his RT on Card 3 (pictures with incongruent object words).

Results

Preliminary analyses. Group differences in intelligence were assessed by conducting a 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with SILS-estimated IQ as the dependent variable. No main effects or interactions approached significance. Participant characteristics are presented in Table 1.

A 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with Card 3 (interference card) accuracy as the dependent variable revealed no significant main effects or interactions, indicating comparable accuracy among psychopathic and nonpsychopathic participants. Table 3 presents the mean accuracy and RT for each group on each of the four stimulus cards.

Primary analyses. Group differences in interference were assessed by conducting a 2 (psychopathic or control) \times 2 (high or

low anxious) analysis of covariance (ANCOVA) with order (Card 3 before Card 4 or vice versa) as the covariate.⁴ The overall interference effect was highly significant, $F(1, 70) = 30.44$, $p < .001$ ($M = 2.09$ s, $SD = 3.09$ s). The main effect for order was also significant, $F(1, 70) = 14.05$, $p < .001$, with participants displaying greater interference when Card 3 preceded Card 4. In addition, this analysis revealed a significant Psychopathy \times Anxiety interaction, $F(1, 70) = 4.25$, $p < .05$, indicating that, among low-anxious participants psychopathic individuals demonstrated less interference than controls, whereas among high-anxious participants, controls demonstrated less interference than psychopathic individuals (see Table 3).

In accord with the overall analyses, the planned comparison between the low-anxious groups indicated significantly reduced interference among low-anxious psychopathic participants as compared with low-anxious controls, $t(34) = 2.00$, $p < .05$, one-tailed ($M = 0.99$, $SD = 2.45$; $M = 2.97$, $SD = 3.73$, respectively). Indeed, the interference displayed by low-anxious psychopathic participants was not significantly different from zero, $t(11) = 1.40$, ns , two-tailed.

Discussion

Low-anxious psychopathic participants were insensitive to picture-word Stroop interference relative to low-anxious controls. This result supports the Newman et al. (1997) findings and confirms that psychopathic individuals exhibit reduced interference on picture-word Stroop tasks. Together with the results of Experiment 1, these findings demonstrate that the striking discrepancy between the normal color-word Stroop interference and the reduced picture-word Stroop interference of psychopathic individuals is reliable, suggesting that differences between the color-word and picture-word Stroop tasks tap an important parameter of the attentional abnormalities associated with psychopathy.

Experiment 3

Experiments 1 and 2 confirmed that both the Smith et al. (1992) finding of normal color-word interference and the Newman et al. (1997) finding of reduced picture-word interference among psychopathic individuals are reliable, and they indicate that differ-

⁴ Data met all ANCOVA assumptions.

Table 3
Picture–Word Stroop Performance

Measure	Psychopathic						Control					
	Low anxious		High anxious		Total		Low anxious		High anxious		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Reaction time (s)												
Card 1	8.72	2.43	7.76	1.07	8.19	1.83	8.62	1.99	9.23	1.84	8.92	1.92
Card 2	14.49	2.69	14.10	2.58	14.27	2.58	14.85	4.15	15.95	3.19	15.40	3.70
Card 3	16.03	1.48	18.83	4.95	17.59	4.01	18.47	4.69	18.51	3.96	18.49	4.29
Card 4	15.04	2.79	16.24	4.39	15.71	3.75	15.49	3.58	17.06	3.26	16.28	3.48
Interference	0.99	2.45	2.60	2.74	1.88	2.56	2.97	3.72	1.44	2.84	2.21	3.37
Errors, Card 3	1.00	1.04	0.53	0.92	0.74	0.98	0.92	1.02	0.83	0.92	0.87	0.96

Note. Card 1 = object words; Card 2 = pictures only; Card 3 = pictures with incongruent object words; Card 4 = pictures with nonwords; interference = Card 3 minus Card 4.

ences between the color–word and picture–word stimuli are critically affecting the performance of psychopathic participants. One of the most pronounced differences between the color–word and picture–word tasks is the spatial relationship between the attended and unattended stimuli, with the color–word Stroop using overlapping stimuli and the picture–word Stroop using spatially separated stimuli. In addition, the semantic relationship between the picture and object word stimuli is perhaps more distant, and thus may require more elaboration, than the semantic relationship of the color–word stimuli. Experiment 3 was conducted to investigate whether these stimulus differences may have contributed to the seemingly incompatible results of Experiment 1 and Experiment 2.

Experiment 3 used spatially separated color–word stimuli. If the insensitivity of psychopathic participants to interference from picture–word stimuli was due to the spatial separation between the attended and unattended elements, then spatially separating the color–word stimuli should, as in Experiment 2, produce reduced interference among psychopathic participants relative to nonpsychopathic controls. If the reduced picture–word interference of psychopathic participants was due to the greater semantic distance between the picture and object word stimuli as compared with the color and color word stimuli, psychopathic individuals should now, as in Experiment 1, display normal levels of interference.

Experiment 3 also differed from Experiments 1 and 2 in that it used computerized single-trial stimulus presentations rather than handheld stimulus cards. Computerized, single-trial Stroop tasks are becoming the standard for empirical research, and on the basis of the comparable results obtained in the picture–word card Stroop of Experiment 2 and Newman et al.'s (1997) computerized picture–word task, we expected the performance of psychopathic participants to be robust across formats. An additional benefit of the computerized procedure is that it allows measurement of facilitation in addition to interference. As facilitation from contextual cues has not been investigated among people with psychopathy, a secondary goal of this experiment was to examine whether any group differences in interference were paralleled by group differences in facilitation.

Method

Participants. Participants were 69 Caucasian male inmates with PCL–R scores in either the psychopathic (30 or higher, $n = 26$) or nonpsychopathic (20 or lower, $n = 43$) range. One participant (a low-

anxious control) was excluded from analyses because of performance that differed from the group mean by more than 2.5 standard deviations. Low-anxious groups were identified using a median split on the WAS, resulting in 11 low-anxious psychopathic and 24 low-anxious control participants.

Task and procedure. The task was administered on an IBM-compatible PC with a 14-in. (about 35.6 cm) color monitor using Micro-Experimental Laboratory (Schneider, 1988) software. Participants were seated in front of the computer screen and were instructed to give their response as quickly and accurately as possible by speaking clearly into a headset-mounted microphone. RTs for onset of verbal response were recorded automatically by a voice-activated relay connected to the computer. Experimenters coded the accuracy of each response by pressing keys 1 (correct), 2 (incorrect), or 3 (ambiguous–unclear) on the computer keyboard.

The task consisted of 40 practice and 120 experimental trials. All instructions and stimuli were presented centrally on the computer screen. Each stimulus appeared until the participant responded or 3,000 ms had elapsed. Each experimental trial consisted of the simultaneous presentation of a color word, written in a white font and presented in the center of the screen, and a colored rectangular frame, measuring 2.3×3.2 cm and centered around the word.

For the first 20 practice trials, color words (*red, blue, green, or yellow*, all written in a white font) were presented alone and participants were instructed to read the words. For the last 20 practice trials, the colored rectangular frames were presented alone and participants were instructed to name the color of the frame (red, blue, green, or yellow). After completing the 40 practice trials, participants were instructed to, on all remaining trials, name the color of the box while ignoring all other information.

The experimental trials were grouped into two blocks of 60 trials each, with a total of 40 congruent trials, 40 incongruent trials, and 40 neutral trials. All of the neutral trials consisted of strings of the letter *i* (i.e., *iiii*) surrounded by colored rectangles. The two experimental blocks were separated by a 30-s break. Trials were presented in a fixed order such that no words or colors appeared twice in a row.

Interference was measured for each participant by subtracting his mean RT on neutral trials from his mean RT on incongruent trials. Facilitation was measured for each participant by subtracting his mean RT on congruent trials from his mean RT on neutral trials.

Results

Preliminary analyses. Group differences in intelligence were assessed by conducting a 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with SILS-estimated IQ as the dependent variable. This analysis revealed no significant main effects or interactions. Participant characteristics are presented in Table 1.

A 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with incongruent-trial accuracy as the dependent variable revealed no significant main effects or interactions. Table 4 presents the mean accuracy and RT for each group by type of trials.⁵

Primary analyses. To examine group differences in interference, we conducted a 2 (psychopathic or control) \times 2 (high or low anxious) ANOVA with the interference measure (incongruent RT minus neutral RT) as the dependent variable. This analysis revealed a marginally significant main effect of psychopathy, $F(1, 64) = 3.93, p = .05$, with psychopathic participants demonstrating less interference than controls. No other main effects or interactions approached significance (see Table 4).

Consistent with the overall analysis, the planned comparison for the low-anxious groups revealed a significant group difference, $t(66.28) = 2.07, p < .05$, one-tailed, with low-anxious psychopathic participants demonstrating less interference than low-anxious controls ($M = 35.83, SD = 34.34$ for low-anxious psychopathic participants; $M = 71.39, SD = 57.87$ for low-anxious controls).⁶

Facilitation. Facilitation was first examined by means of a 2 (psychopathic or control) by 2 (high or low anxious) ANOVA with the facilitation measure (neutral RT minus congruent RT) as the dependent variable. The overall facilitation effect was highly significant, $F(1, 64) = 38.33, p < .001$. There were no other significant main effects or interactions. Psychopathic and control participants demonstrated comparable levels of facilitation (see Table 4). Similarly, the planned comparison for the low-anxious groups revealed no significant difference in facilitation between psychopathic and control participants, $t(33) < -1.0, ns$.

Discussion

Experiment 3 indicates that the spatial relationship between the attended and unattended dimensions of the Stroop stimuli is a critical determinant of the attentional performance of psychopathic individuals. In contrast to their normal interference on the standard color–word Stroop task of Experiment 1, psychopathic participants displayed markedly reduced interference relative to controls when the color word was spatially separated from the color. This reduced interference occurred despite the close semantic relationship between the color and the color word, indicating that spatial separation is the more substantial contributor to the performance differences of psychopathic participants across Experiments 1 and 2.

The apparently normal facilitation shown by psychopathic participants for congruent color words indicates that they did in fact process the color words, even though they showed markedly reduced interference. Further, the facilitation effect shown by psychopathic participants indicates that they can accommodate unattended contextual information, even when it is spatially separated from their attentional focus. Psychopathic individuals' difficulty in using unattended information appears to be specific to conditions in which that information is both spatially distinct from and incompatible with the attended information, suggesting that people with psychopathy have particular difficulty interrupting goal-directed behavior in the presence of contradictory cues that occur outside of their attentional focus.

General Discussion

We presented psychopathic offenders with three Stroop-like tasks to examine the factors underlying the discrepant Stroop

interference effects reported by Smith et al. (1992) and Newman et al. (1997). The results of these experiments reveal that psychopathy is associated with abnormally strong selective attention, but only under certain conditions. In particular, psychopathic individuals demonstrate normal Stroop interference when the attended and unattended dimensions are spatially coincident (Experiment 1) but show markedly reduced Stroop interference when there is a slight spatial separation between the attended and unattended dimensions (Experiments 2 and 3). Further, Experiment 3 demonstrated a dissociation between psychopathic individuals' use of congruent as opposed to incongruent contextual information. It appears that psychopathic individuals make full use of spatially separated contextual cues only when they are congruent with the task-relevant information.

These findings substantially inform our understanding of psychopathic individuals' failure to accommodate unattended contextual information. First, the normal interference shown by psychopathic participants on the standard version of the color–word Stroop task indicates that, despite their lack of interference on the spatially separated Stroop tasks, individuals with psychopathy do not have a global deficit in either response inhibition or conflict detection. Psychopathic participants, like nonpsychopathic controls, responded more slowly when presented with conflicting contextual cues, provided that those cues were spatially integrated with the attended, task-relevant information.

Second, the reduced interference shown by psychopathic participants in Experiment 3 indicates that these participants' normal use of incongruent contextual information, as evident in the standard version of the color–word Stroop task (Experiment 1), can be disrupted simply by spatially separating the attended and unattended dimensions. This finding suggests that people with psychopathy can readily accommodate incongruent contextual information that is presented directly within their attentional focus but are relatively unable to accommodate incongruent information that is presented somewhat outside of their attentional focus.

Third, the sizable facilitation shown by psychopathic participants in Experiment 3 suggests that spatial separation specifically insulates psychopathic individuals from information that is incompatible with their goal-directed behavior. Despite being spatially separated from the attended color, congruent color words substan-

⁵ Because low-anxious participants with psychopathy appeared to have slower RTs than those of the other groups, particularly on neutral trials, we conducted a series of 2 (psychopathic or control) by 2 (high or low anxious) ANOVAs with RTs for each trial type (neutral, congruent, and incongruent) as the dependent variables. These analyses revealed no significant group differences in RT (all F s $< 1.20, p$ s $> .25$). Moreover, including neutral-trial RT as a covariate in the interference and facilitation analyses did not substantially affect the results, although the main effect of psychopathy on interference was strengthened, $F(1, 63) = 5.96, p = .02$.

⁶ To address potential concerns regarding the unequal cell sizes among low-anxious groups, we conducted a supplementary ANOVA and planned comparison for which low-anxious group sample sizes were equated ($n = 11$) by random elimination of low-anxious controls. The results of these analyses did not differ from the original findings. The ANOVA, like the original ANOVA, revealed a marginally significant main effect of psychopathy, $F(1, 51) = 3.71, p = .06$, and no other significant main effects or interactions. Consistent with the original analysis, the planned comparison revealed significantly less interference among low-anxious participants with psychopathy than low-anxious controls, $t(15.94) = 1.81, p < .05$.

Table 4
Separated Color–Word Stroop Performance

Measure	Psychopathic						Control					
	Low anxious		High anxious		Total		Low anxious		High anxious		Total	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Reaction time (ms)												
Neutral trials	616.28	107.61	580.77	72.07	595.79	88.66	572.70	91.74	571.50	72.49	571.56	82.92
Congruent trials	590.32	104.04	561.12	65.40	573.47	83.31	550.91	92.19	557.10	69.80	553.34	81.92
Incongruent trials	652.11	130.54	637.97	83.14	643.95	103.62	644.09	129.30	645.68	101.92	644.19	118.36
Facilitation	25.96	19.24	19.65	22.26	22.32	20.88	21.79	28.76	14.40	28.89	18.22	28.15
Interference	35.83	34.34	57.21	42.98	48.16	40.28	71.39	57.87	74.18	60.24	72.62	58.48
Errors, incongruent trials	1.46	2.34	0.80	1.27	1.08	1.79	2.09	3.41	2.39	2.33	2.18	2.90

tially facilitated the color-naming responses of psychopathic participants whereas incongruent color words failed to produce normal levels of interference.

Thus, these findings suggest that psychopathic individuals' well-documented failures to accommodate contextual information (a) are not due to a global inability to interrupt ongoing responses or detect mismatches and (b) are not due to a global inability to accommodate unattended contextual information. Instead, psychopathic individuals' use of contextual cues appears to depend heavily on the relationship between those cues and the deliberately attended, goal-relevant information. Cues that were spatially integrated with the attended information were processed and accommodated even when they were inconsistent with the goal-directed behavior. Spatially separated cues appear to have been processed but were fully accommodated only when they were consistent with the goal-directed behavior.

Why is spatial separation critical? One possibility is that attentional selection may be less efficient when the relevant information is spatially integrated with, as opposed to separated from, the irrelevant information. That is, it may be more difficult to discriminate between the relevant and irrelevant dimensions when they are spatially integrated. As a result, spatially integrated contextual information may receive more preselection processing than spatially separated contextual information. Consistent with this proposal, MacLeod (1998) reported evidence suggesting that an additional processing stage, *overcoming integration*, is required by spatially integrated as opposed to spatially separated Stroop stimuli. This additional preselection processing may be integral to psychopathic individuals' ability to accommodate the unattended information.

An alternative, but not incompatible, perspective comes from the consideration of attentional systems. Location-based and feature-based selective attention appear to rely on separable attentional processes (e.g., Broadbent, 1958; Treue & Martinez Trujillo, 1999; Vecera & Behrmann, 2001). In addition, West and Bell (1999) demonstrated different patterns of cortical activity for spatially separated as opposed to spatially integrated Stroop stimuli, with spatially separated stimuli preferentially activating posterior attentional systems and spatially integrated stimuli preferentially activating anterior attentional systems. These distinctions suggest that the accommodation of unattended contextual information by people with psychopathy may vary depending on which processing systems are being used. People with psychopathy may be less able to accommodate unattended information when posterior, as opposed to anterior, attentional systems are engaged.

If spatial separation limits the ability of psychopathic individuals to accommodate unattended contextual information, why do they demonstrate robust facilitation? The answer may involve priming effects. As the attended frame color is processed, the color name (i.e., congruent color word) may be automatically primed. By enhancing the activation of the color name, this priming may allow congruent color words to be processed and accommodated by psychopathic participants (D. G. MacCoon, personal communication, March 18, 2001). Although speculative, this interpretation is consistent with the proposal that psychopathic individuals' ability to accommodate spatially integrated information may be due to greater preselection processing of spatially integrated as opposed to spatially separated contextual information. That is, unattended information may be processed or represented more weakly by psychopathic than nonpsychopathic individuals, and additional activation of that information may be required before it can be accommodated by people with psychopathy. Priming the contextual information, or spatially integrating it with the attended information, may provide the necessary increase in activation.

Regardless of the underlying mechanism, the present findings have multiple implications for theories of psychopathy. First, the remarkable ability of psychopathic individuals to selectively attend to task-relevant information, as evident in Experiments 2 and 3, suggests that psychopathy does not arise from poor executive control. If anything, the executive control of people with psychopathy appears to be greater than that of nonpsychopathic controls. This finding is consistent with the frequent failures to observe clear executive deficits among people with psychopathy in the existing literature (e.g., Ishikawa, Raine, Lencz, Birhle, & Lacasse, 2001; Roussy & Taupin, 2000; Smith et al., 1992) and indicates that although many of the deficits associated with psychopathy (e.g., poor behavioral inhibition) are suggestive of executive dysfunction, they are more likely due to dysfunction within nonexecutive (e.g., attentional) systems. Second, the present findings indicate that psychopathic individuals do not have a global deficit in response inhibition or conflict monitoring. The normal Stroop interference shown by psychopathic participants in Experiment 1 demonstrates that their responses are, under certain conditions, normally inhibited by incongruent or conflicting information. However, successful inhibition among people with psychopathy appears to depend on the degree to which the conflicting information is integrated with the active attentional focus. Finally, the current studies add to a growing body of evidence indicating that despite the prominence of emotion-processing theories of psychopathy, the deficits associated with psychopathy are not specific

to emotion. That is, Experiments 2 and 3 revealed that psychopathic individuals fail to make use of affectively neutral contextual information (e.g., object names and color words). Given that emotion cues are often “secondary,” in that they are often processed automatically rather than effortfully, it is possible that the emotion deficits and the abnormal Stroop interference of psychopathic individuals may arise from a common underlying mechanism.

Psychopathic individuals’ failure to accommodate contextual information is of considerable clinical interest. Many of the destructive and antisocial behaviors exhibited by people with psychopathy can be characterized as a single-minded pursuit of a current behavioral goal irrespective of internal and external cues that should constrain or interrupt the behavior (Cleckley, 1976; Shapiro, 1965). The present findings suggest that psychopathic individuals’ failure to make use of contextual cues may be the result of a circumscribed attentional deficit that hinders their ability to make use of unattended information that is (a) not integrated with information to which they are deliberately attending and (b) not compatible with their goal-directed behavior.

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