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Semantic processing in psychopathic offenders

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Abstract

Clinical observation (Cleckley, 1976) and experimental research (Hare, 1998) suggest psychopaths have difficulty processing the semantic aspects of stimuli, especially in situations requiring significant semantic processing (Hare & Jutai, 1988). Interpreting this semantic deficit as a problem processing a word's secondary connotations, we predicted that the performance of psychopathic individuals would be (1) less facilitated by the congruent connotations and (2) less disrupted by the incongruent connotations of secondary linguistic stimuli. To test this hypothesis, we administered two tasks to Caucasian male inmates from Wisconsin correctional facilities—a semantic priming task and a semantic Stroop task. Contrary to expectation, all participants demonstrated semantic priming regardless of psychopathy status, level of anxiety, or the time between primes and targets. Psychopathic individuals also showed comparable interference to controls on incongruent semantic Stroop trials.

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1. Semantic processing in psychopathic offenders

Psychopathy is a personality disorder characterized by egocentric, callous, manipulative, and impulsive behavior (Hare, 1996). Psychopaths possess good intelligence, but engage in self-destructive behavior (Hare, McPherson, & Forth, 1988a; Hart & Hare, 1989; Smith & Newman, 1990). This discrepancy led Cleckley (1976) to propose they have “a selective defect or elimination” (p. 374) that is “semantic” in origin and, thus, may be reflected in linguistic processes.

Consistent with this idea, observation suggests psychopaths understand denotative, but not connotative, meaning (Hare, Williamson, & Harpur, 1988b). Research also suggests psychopaths do not make use of semantic information. Controls, but not psychopaths, had faster lexical decisions and greater event related potentials when responding to affective rather than neutral stimuli (Lorenz & Newman, 2002; Williamson, Harpur, & Hare, 1991). Controls, but not psychopaths, also differentiated in voice emphasis between neutral and affective words (Louth, Williamson, Alpert, Pouget, & Hare, 1998). Because affective content is one kind of semantic information (Challis & Krane, 1988), psychopaths’ failure to use it is consistent with a semantic deficit.

Nor are psychopaths’ deficits limited to processing affective content. Hare et al. (1988b) reported psychopaths were more likely than controls to group words based on literal meanings rather than associated connotative information. Newman, Schmitt, and Voss (1997) found that controls, but not psychopaths, were slower to indicate two stimuli were unrelated when a semantically related distracter stimulus was present. These data suggest psychopaths are impaired at using semantic associations generated by words and other stimuli (Hare, 1998; Newman & Lorenz, 2003). Smith, Arnett, and Newman (1992), however, found that psychopaths demonstrated comparable interference to controls on a traditional color-word Stroop task—evidence that the semantic color information did interfere with their performance.

Regarding the inconsistent evidence for semantic processing deficits in psychopaths, Hare et al. (1988b) proposed that observing performance differences may depend upon the degree of semantic complexity required. Following this lead, we predicted that words not directly related to primary task performance would have less impact on psychopaths than controls when efficient processing of their connotations is required. In contrast, we predicted that psychopaths and controls would be equally affected by simple semantic information that is directly related to task performance.

To test these hypotheses, we employed two tasks—a semantic priming/lexical decision task and a Stroop task using traditional color-word trials and semantic color-related word trials. We expected controls, but not psychopaths, to use semantic information from priming stimuli to show facilitation on the lexical decision task. We expected controls, but not psychopaths, to show inhibition to the semantic Stroop trials. In contrast, we expected both groups to show inhibition on the traditional, color-word Stroop trials which does not rely on processing a word’s connotations because there is a direct conflict between the words’ phonology and color names.

2. Experiment 1

This task was used to determine if presentation of a related word would facilitate recognition of target words in psychopaths. The task requires participants to make lexical decisions about letter strings (i.e., targets), each preceded by a priming word. Primes can be either semantically related

or unrelated to targets. Normal individuals are faster to indicate that a target is a word if it is preceded by a semantically related prime than if it is preceded by an unrelated word (Henik, Nissimov, Priel, & Umansky, 1995). If psychopaths do not show facilitation on this task, it would provide strong support for a specific “semantic” deficit. We also manipulated the interval between the prime and target to determine if psychopaths are slower to process the prime or have difficulty maintaining its meaning over time.

2.1. Methods

2.1.1. Participants

Participants were 58 Caucasian male inmates from Wisconsin state prisons selected from a comprehensive roster. Individuals were not included if they met any exclusion criteria: older than age 45, current use of psychotropic medication, schizophrenia or bipolar diagnoses, and documented reading or math skills below the fourth grade level. Individuals were told that their decision to participate or refuse would have no influence on their status within the correctional system.

2.1.2. Assessment measures

Psychopathy was assessed using the PCL-R (Hare, 1991)—a 20 item checklist of prototypic psychopathic characteristics. Following Hare (1991), scores of 30 or more were used to identify psychopaths and scores of 20 or less to identify controls. Ratings were based on interviews and file information. PCL-R scores determined in this manner are highly reliable (Hare, 1991).

To date there is limited evidence regarding the validity of the PCL-R when used with African-Americans. PCL-R scores do not appear as predictive of task performance in African-American samples as they are in Caucasian samples (Kosson, Smith, & Newman, 1990; Lorenz & Newman, 2002; Newman et al., 1997; Newman & Schmitt, 1998; Thornquist & Zuckerman, 1995). We, therefore, tested our hypotheses only in Caucasian inmates.

The Shipley Institute of Living Scale (SILS; Zachary, 1986) was used to insure differences in task performance were not due to differences in intelligence. The SILS is a brief measure of general IQ. It consists of a 40-item vocabulary test and a 20-item abstraction test, has good psychometric properties, and yields reliable estimates of Wechsler Adult Intelligence Scale—Revised scores (Zachary, 1986).

The Welsh Anxiety Scale (WAS; Welsh, 1956) is a 39 item true/false scale derived from the MMPI to measure anxiety/negative affect. We used the median score on the WAS to select low-anxious psychopaths and controls for planned comparisons. As noted in numerous publications (e.g., Newman, 1998), we focus planned comparisons on low-anxious psychopaths because they correspond most closely to the prototypical psychopaths described by Cleckley and thus, we presume, are the individuals most likely to display the semantic deficit (Schmitt & Newman, 1999).

2.1.3. The semantic priming task

This task was a modified version of one used by Henik et al. (1995). Participants were presented with four blocks of 40 trials. The primary task was to determine if a pronounceable letter string was an English word by pressing one of two buttons with the right hand. For half the trials in each

block the target was a word and for half it was not (20 trials each). A priming word with an asterisk above and below it preceded each trial. On half the word trials (10 trials), the prime was semantically and associatively related to the target (e.g. Doctor–Nurse) and for half they were unrelated (e.g. Knife–Cotton).

Each prime was presented for 140 ms. Targets were presented 100 ms after the primes in blocks 1 and 3 and 1000 ms after the primes in blocks 2 and 4. Exposure to the target was terminated following 2000 ms or a response.

Participants were told to pay attention to the primes, but not respond to them. As primes were not an explicit component of the primary lexical decision task, they were regarded as contextual or secondary cues. Participants were told they could earn money for their performance and earned 3 cents for each correct response. Participants completed one practice block of ten trials. The inter-stimulus intervals (ISI) for the practice trials were of double normal length to allow participants to achieve mastery before starting the actual trials. All stimuli were equated for mean word length, imageability, and log word frequency. Non-words were created by substituting one letter from a real word and substituted letters varied across non-words. Each stimulus appeared only once. Stimuli for this experiment were based on those used in previous studies of semantic priming (Chiarello, Burgess, Richards, & Pollock, 1990; McNamara & Altarriba, 1988; Shelton & Martin, 1992).

2.2. Results

Preliminary analyses revealed that the groups were well matched for age and intelligence. The principal analysis involved a mixed-model analysis of variance (ANOVA) with psychopathy (high/low) and anxiety (high/low) as the between-subjects variables and with ISI (100 ms/1000 ms) and relation between the prime and target (related/unrelated) as the within-subjects variables.¹ The results revealed a significant main effect for Relation ($F(1, 54) = 105.18, p < .001$), with participants identifying target words more quickly when the prime preceding it was semantically and associatively related than when it was not (see Table 1). No other effects were significant.

We used two planned comparisons to examine group differences in response time between related and unrelated prime trials for low-anxious psychopaths and controls—one for each ISI. Neither comparison approached statistical significance, both t 's (108) < 1.2.

3. Experiment 2

Experiment 2 examines the degree to which color naming is affected by words differing in their level of semantic relationship to colors (Klein, 1964). Data suggest color-related words (sky, grass, lemon, fire) written in incongruent colors produce significant interference although color words (blue, green, yellow, red) written in incongruent colors produce significantly more interference

¹ Analyses of reaction time for both experiments included only data from trials where participants provided correct responses.

Table 1
Facilitation for related and unrelated priming trials

	<i>n</i>	Trial type							
		100ms ISI				1000ms ISI			
		Related		Unrelated		Related		Unrelated	
		<i>M</i>	SD	<i>M</i>	SD	<i>M</i>	SD	<i>M</i>	SD
<i>Participants</i>									
Low WAS controls	19	595.42	68.84	659.17	97.30	603.70	60.19	653.47	84.97
Low WAS psychopaths	12	596.73	85.85	647.08	83.91	590.02	73.40	642.56	109.63
High WAS controls	12	577.33	107.07	635.92	122.61	569.81	54.55	623.50	90.97
High WAS psychopaths	15	587.75	105.03	646.67	95.91	580.85	84.16	627.38	87.87

Notes. *M* = mean; SD = standard deviation; WAS = Welsh Anxiety Scale; ms = milliseconds; ISI = inter-stimulus interval; all means and standard deviations represent time in milliseconds.

(Dalrymple-Alford, 1968, 1972; Dalrymple-Alford & Azkoul, 1972; Harrison & Boese, 1976; Klein, 1964). We predicted that psychopaths would show normal interference on standard Stroop color word trials (which require little semantic processing) but would show little or no inhibition on color-related word trials (which require greater semantic processing).

3.1. Methods

3.1.1. Participants

Participants were 124 Caucasian male inmates from Wisconsin correctional institutions. We used the same exclusion criteria and recruitment procedures as in Experiment 1.

3.1.2. Assessment measures

We used the same diagnostic instruments and methods as in Experiment 1 and hypotheses were again tested using Caucasian inmates. Independent PCL-R ratings were available for 97 inmates in this sample. The intra-class correlation for the dual ratings was .89 indicating good reliability.

3.1.3. The semantic stroop task

We administered a modified version of Klein (1964) task using a PC and 14 in. monitor. Participants were tested individually by male experimenters blind to group membership. Participants were instructed to speak clearly into a headset-mounted microphone and respond as quickly and accurately as possible. Reaction times (RTs) for verbal responses were recorded automatically by a voice activated relay connected to the computer. Experimenters coded the accuracy of each response using the computer keyboard (1 = correct, 2 = incorrect, 3 = unclear).

There were 40 practice and 240 experimental trials. All instructions and experimental stimuli were presented centrally on the computer screen. Each stimulus appeared for 3000ms or until a response was given. A blank screen then appeared until the experimenter coded the accuracy of the response.

The first practice block consisted of 20 trials using color-related words (fire, sky, grass, and lemon). The second practice block consisted of 20 trials using colored (red, blue, green, and yellow)

rectangles measuring .8cm × 1.9cm. Participants were instructed to, on all experimental trials, name the color of the stimulus while ignoring all other information (e.g. incongruent words). All experimental trials were presented in red, blue, green, or yellow. These trials were grouped into two blocks of 120 trials each, with a total of 80 congruent, 80 incongruent, and 80 neutral trials. For the congruent and incongruent trials, half consisted of color-words, and half consisted of color-related words. All of the neutral trials consisted of strings of letter i's (iiii). The experimental blocks were separated by a 30s break.

The practice and experimental trials were presented in a fixed order so that the same words or colors did not appear on consecutive trials to reduce potential priming effects (see Neill, 1977). For example, if the color of the n th trial was blue, neither the color, the color-word, nor the color-related word of the n th + 1 trial would have any relation to blue.

3.2. Results

Preliminary analyses of estimated intelligence yielded a significant main effect for Psychopathy ($F(1, 65) = 4.61, p < .05, \eta^2 = .07$) with controls ($M = 102.4$) scoring significantly higher than psychopathic individuals ($M = 96.5$). However, subsequent analyses revealed that intelligence was unrelated to interference and including it as a covariate in the ANOVAs reported below did not alter the results.

The primary dependent variable for the Stroop task involves interference (in ms). Interference was calculated by subtracting the response time for neutral trials (strings of colored i's) from the response times for incongruent color word and color-related word trials. Before evaluating interference, we assessed group differences in accuracy using repeated measures ANOVA with Psychopathy (high/low) and Anxiety (high/low) as the between-subjects variables, Trial type as the repeated measure (color word/color-related word), and Accuracy as the dependent variable. This ANOVA yielded a significant main effect for Trial type ($F(1, 40) = 29.18, p < .001, \eta^2 = .31$) with participants making more errors on incongruent color word trials ($M = 4.30$) than on incongruent color-related trials ($M = 2.11$). No other main effects or interactions approached significance.

We then conducted a repeated-measures ANOVA with Psychopathy (high/low) and Anxiety (high/low) as the between-subjects variables, Trial type (color word/color-related word) as the repeated measure, and interference as the dependent variable. The main effect for Trial type was significant ($F(1, 65) = 68.34, p < .001, \eta^2 = .51$) with participants displaying greater interference on color word trials ($M = 127.97$) than on color-related word trials ($M = 76.81$). A significant Anxiety X Trial interaction ($F(1, 65) = 6.96, p < .01, \eta^2 = .10$) indicated that, whereas high-anxious participants ($M = 143.64$) displayed more interference than low-anxious participants ($M = 112.31$) on the color word trials, the groups did not differ on color-related word trials ($M = 76.15, M = 77.47$, respectively). No other main effects or interactions approached significance (Table 2).

Planned comparisons were used to test the hypothesis that low-anxious psychopaths would display significantly less interference than controls on the color-related trials but comparable interference on the color word trials. Contrary to expectation neither the comparison for color-related word trials ($t(33) < 1.0$, n.s.) nor the comparison for color word trials ($t(33) < 1.50$, n.s.) approached statistical significance. In fact, all four groups displayed significant interference (all t 's > 2.90 , all p 's $< .01$) regardless of trial type.

Table 2
Performance on color and color-related word interference trials

	<i>n</i>	Color word		Color-related word	
		<i>M</i>	SD	<i>M</i>	SD
<i>Participants</i>					
Low WAS controls	24	118.25	64.37	74.44	40.22
Low WAS psychopaths	11	106.37	60.95	80.50	50.46
High WAS controls	13	156.08	74.83	77.00	50.96
High WAS psychopaths	21	131.19	73.94	75.30	45.80

Notes. *M* = mean; SD = standard deviation; WAS = Welsh Anxiety Scale; all means and standard deviations represent time in milliseconds.

4. Discussion

We predicted that psychopaths would perform more poorly than controls on tasks assessing implicit use of semantic networks (i.e., semantic connotations). In contrast, the groups were not expected to differ on a traditional Stroop task that involves a direct conflict between the incongruent word and color name. Contrary to our predictions, both psychopaths and controls identified target words more quickly when they were preceded by semantically related primes than when they were not. This finding was unaffected by the duration of the prime-to-target interval, suggesting that psychopaths are able to utilize a prime's meaning despite limited processing time (i.e., 100ms) or the need to maintain the meaning during a lengthy inter-stimulus interval (i.e., 1000ms).

The semantic Stroop task results were also inconsistent with our predictions. Psychopaths displayed significant interference on both types of incongruent trials (traditional color word trials and semantic color-related trials). This suggests that word meaning impaired psychopaths' color naming regardless of the depth of semantic processing required. That psychopaths and controls displayed comparable interference in both conditions of the Stroop task, suggests that processing of word meanings is relatively automatic for both groups. In contrast to the priming task used in Experiment 1, it is unlikely that participants would deliberately process word meanings in a Stroop task since they hinder, rather than facilitate, performance.

The present data appear to have important implications for our understanding of semantic deficits in psychopaths. Experiment 1 suggests psychopaths can process and utilize implicit semantic information. Experiment 2 suggests psychopaths can efficiently access at least the first layers of associative semantic networks. Based on these results, it seems unlikely that a simple semantic deficit can explain deficits in psychopaths' task performance.

A more refined hypothesis, however, may be capable of accounting for the existing data. Hare et al. (1988b) suggested that psychopaths' semantic deficits only appear when complex processing is required. The present study made use of primes that were directly related to the target (both semantically and associatively) and always appeared in paired presentations with the targets. As such, it could be argued that the task required only simple semantic processing to complete. If the processing demands could be increased, psychopathic deficits might emerge.

One way to do this might be to use more complex priming stimuli. There is a considerable literature suggesting that priming effects are reduced in normal individuals when priming is

mediated (i.e., lion and stripes) rather than direct (i.e., lion and tiger) (Lund, Burgess, & Atchley, 1995; McNamara & Altarriba, 1988; Shelton & Martin, 1992). Use of the mediated priming technique might provide sufficient processing demands to achieve the deficits described by Hare et al. (1988b).

An alternate approach would be to consider the impact of the bio-psychological systems influencing semantic processing and how these systems might differ in psychopaths. Chiarello et al. (1990) have demonstrated that inter-hemispheric communication is important for processing semantic information, particularly when the information is related only via meaning and not association. There is a growing body of research suggesting that inter-hemispheric communication in psychopaths is impaired (Hare et al., 1988b; Hare, 1998; Kosson, 1998; Hiatt et al., 2002).

The present study used central presentations of stimuli and the primes were related to targets both semantically and associatively. It is possible that psychopaths would perform like controls on semantic tasks that can be performed unilaterally, but impaired on semantic tasks that require bilateral processing (see Newman, Brinkley, Lorenz, Hiatt, & MacCoon, *in press*). If lateralization is a key element of the semantic deficit described by Hare and Jutai (1988), psychopaths would not be expected to show differences on the present tasks. The only way to test this hypothesis would be to make use of divided field paradigms.

It is noteworthy that most of the existing data supporting a “semantic” deficit in psychopaths examines emotional processing (Lorenz & Newman, 2002; Louth et al., 1998; Williamson et al., 1991). Even the word-sorting paradigm used by Hare et al. (1988b) was not explicitly affect neutral. As such, it might be argued that the present data support the conclusion that psychopaths’ deficits are specific to processing affective information rather than semantic information more generally (Hare, 1998). Such an explanation, however, would still not account for the non-affective processing deficits discovered by Newman et al. (1997) using the picture-word paradigm. Future studies should make use of both affective and affect free stimuli to help clarify the nature of the deficit in question.

The present data also have implications for the Response Modulation Hypothesis (Newman, 1998). In its present form, the hypothesis suggests that psychopaths are deficient at using secondary cues to influence their behavior on a primary task. The present study, however, demonstrated that psychopaths were capable of using the secondary semantic information to facilitate performance on the primary lexical decision task. As such, the current data support the contention that psychopaths are capable of using some kinds of secondary information or that their deficits may be limited to specific situations. Provided that these results are replicable, this would suggest that the response modulation model may have some constraints that need to be considered and specified.

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